

Lewis and Clark: Rockhounding on the Way to the Pacific



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Meriwether Lewis and William Clark, *The Journals of the Lewis and Clark Expedition*, 13 volumes and an abridged edition. Edited by Gary E. Moulton. Lincoln, Nebraska: The University of Nebraska Press, 1983-2001. The first volume is the oversized atlas, the last an index. Each volume has a separate subtitle.

American Federation of Mineralogical Societies

Brenda J. Hankins, Editor

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The Rockhound Hobby

Have you ever seen a hound dog traveling through the woods with his nose close to the ground chasing the scent of something special? If so, you have a pretty good idea what a “rockhound” is! Rockhounds think rocks, minerals, and fossils are special. Whether putting their faces close to a creek gravel bed, the bottom of a quarry, or the top of a mountain, rockhounds want to see and study the treasures of the earth.

Maybe you are a rockhound but don’t even know it. Have you ever picked up a rock or a diamond and looked at it closely? Did you wonder why it sparkled or had bands of colors? Were you curious about where it came from or how it developed? Do fossils amaze you?

There are about 50,000 card-carrying rockhounds in America who are affiliated with the American Federation of Mineralogical Societies. These are people just like you from across the United States who are interested in studying and enjoying rocks, minerals, and fossils. Some rockhound hobbyists also enjoy taking the rocks, minerals, and fossils and turning them into beautiful pieces of jewelry or functional items, like bookends and clocks.

Lewis and Clark—Rockhounding on the Way to the Pacific was written by members and friends of the American Federation of Mineralogical Societies as a service project. All contributing individuals provided their assistance as volunteers. This document is a brief traveler’s guide to some of the rocks, minerals, and fossils along the Lewis and Clark Trail, and it will help you become better acquainted with the rockhound hobby. We hope you enjoy your experience along the Lewis and Clark Trail and that you discover you have a little rockhound within you.

About This Publication

Welcome to the world of Lewis and Clark and the Journey of the Corps of Discovery. This material focuses on the rocks, minerals, and fossils seen along the way West. It will help you discover areas to explore and sights to see along the Lewis and Clark Trail. Use this information along with the National Park Service historic markers identified in the National Park Service Guide *The Lewis and Clark Trail*. A copy of this document may be obtained free of charge by emailing your request to led_administration@nps.gov or by post at Lewis & Clark NHT, 601 Riverfront Drive,

Omaha, NE 68102. Teachers and students will find in-depth information at <http://www.cr.nps.gov/nr/twhp>. For additional information, visit the NPS Lewis and Clark National Historic Trail site at www.nps.gov/led.

Because there are rocks, minerals, and fossils on the ground and beneath the surface along the entire route from Wood River, Illinois, to the Pacific Ocean, only some of the more interesting, visible, or easily visited areas will be discussed. Once you return home, your computer, your public library, and your school library will have more information on rockhounding and on the Lewis and Clark Trail.

Activities throughout this publication identified by the mountain  will help you learn more about rocks, minerals, and fossils. Another way to get the most from your Lewis and Clark experience is to create your own personal Journal of Discovery as you travel the Trail. Make notes of where you go, what you see, and what you do. Your journal will be as important to you and your family as the Lewis and Clark journals are important to all of us today. The activities you complete in this guide will give you ideas for your journal notes and observations, and you will also get ideas for your  journal when you see the walking paper and pencil. Fun word puzzles that focus on Lewis and Clark are also included. These will help you learn more and apply what you have learned along your journey. Answers are provided at the end of the booklet.

As you travel on the Trail and study the rocks, minerals, and fossils along the way, you may want to know more about the rock clubs in your area. Your local library or chamber of commerce may have the information you are seeking. You may also e-mail the American Federation of Mineralogical Societies at central_office@amfed.org or visit the American Federation website at www.amfed.org. Questions by post should be sent to AFMS Lewis and Clark Project, POB I058, Pelahatchie, MS 39145.

All of the sites discussed in this guide can be viewed while driving along established roads, boating in public waters, or when visiting National Park areas along the Trail. We ask you to respect private property and the rights of landowners as you learn about the rocks, minerals, and fossils along the Lewis and Clark Trail. Remember there is no defacing or collecting of any objects on National Park lands.

Direct quotations in the document are from the Gary Moulton, University of Nebraska, editions of the Journals of Lewis and Clark and appear with their original spelling.

Sites & Dates Covered

Illinois	December 13, 1803-May 14, 1804 Camp River DuBois, Wood River
Missouri	Jefferson National Expansion Memorial, St. Louis
Missouri	June 7, 1804, Katy Trail State Park, Rocheport
Kansas	July 4, 1804, Independence Creek, Atchison
Iowa	August 20, 1804, Sergeant Floyd Monument, Sioux City
Nebraska	August 21, 1804, Ponca State Park, Ponca
South Dakota	August 24-25, 1804, Spirit Mound, Vermillion
North Dakota	October 27, 1804, Knife River Indian Villages National Historic Site, Stanton
Montana	July 25, 1806, Pompeys Pillar, Billings (return trip)
Montana	May 31, 1805, Upper Missouri River Breaks National Monument, Ft. Benton
Montana	June 13-July 15, 1805, Great Falls of the Missouri, Great Falls
Montana	July 19, 1805, Gates of the Mountains, Helena
Montana	July 25-30, 1805, Missouri Headwaters State Park, Three Forks
Montana	August 8, 1805, Beaverhead Rock State Monument, Dillon
Montana	August 12, 1805, Lemhi Pass, Montana-Idaho Border

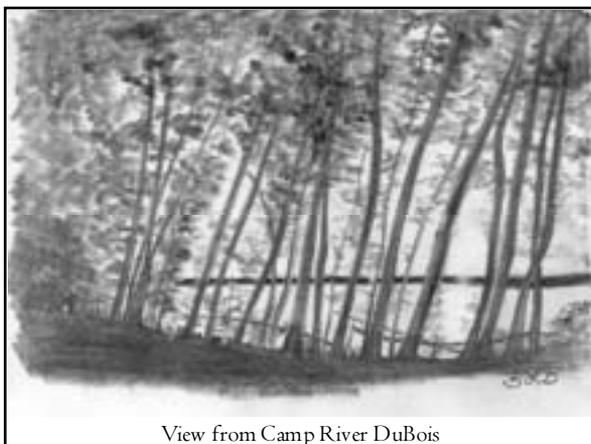
Montana	September 9-11, 1805 and June-July 1806, Traveler's Rest, Lolo and July 22-26, 1806, Camp Disappointment, Browning
Idaho	September 26-October 5, 1805, Canoe Camp, Orofino
Oregon	October 19, 1805, Hat Rock State Park, Hermiston
Oregon	October 25-28, 1805, Rock Fort, The Dalles
Washington	October 31, 1805, Beacon Rock State Park, North Bonneville
Oregon	December 1805-March 1806, Salt Works, Seaside
Oregon	January 7-8, 1806, Ecola State Park, Clarks Moun- tain

December 13, 1803–May 14, 1804 Camp River DuBois, Wood River, Illinois

Imagine that you and your family—or scout troop, or group of friends—are gathering together to embark upon the vacation of a lifetime. You are going to take the road/water/trail trip from St. Louis to the Pacific Ocean that you have been planning for nearly three years. Of course, you don't have all the details worked out yet, but you do have enough done to be ready to go. Your group has individuals with pretty keen travel skills, so you are anxious to just get started. Let's also suppose that none of you have been West nor have seen pictures of the West. As you sit here at Camp River Du-Bois, looking across the Mississippi River and up the Missouri River,  what would you be thinking about the West?

You might think about who you would meet and if they would be nice to you. You might worry about finding good places to sleep, and good food would be high on the list, too. The weather would be important to you—hopefully not too hot and certainly not too cold. You would think about the animals you might meet and whether they would be big or small, cute or dangerous.

Something else to think about is what kind of land you will have to cross. It is a long way to the Pacific Ocean. You are certain you and your family could get across—and get back home, but will the land be flat or hilly? Will  there be marshes, quicksand, or mountain passes to find and cross? What about the rivers—will they be deep, wide, or swift? Will the ground be covered with timber, soil, or rocks?



View from Camp River DuBois

As May 14, 1804 approached, the men of the Lewis and Clark Expedition were at Camp River DuBois thinking the same kinds of things about the trip they were about to begin.

They would be traveling West through land they had never seen. They were confident they would make it there and back, but they were also concerned about what they would encounter along the way.

Thank goodness they didn't know just how tough it would be! They were accustomed to living and working in the East—a land that, although hilly and rugged in places, was manageable. The Corps of Discovery was about to enter a land that would itself be as unbelievable as many of the experiences they would have along the way.

The Lewis and Clark Expedition took a journey through geological time as they traveled west. The Expedition would first encounter the Interior Plains, a vast area that forms the stable mid-continent region of the United States. It formed when several small continents collided over a billion years ago, resulting in the formation of Precambrian-age metamorphic and igneous rocks. During the Mesozoic era, most of this region was covered by a shallow interior sea, which left extensive horizontal and undeformed sedimentary rocks rich in fossils.

The Expedition would then cross into the Rocky Mountain region, which took shape during three mountain building episodes about 170 to 40 million years ago, the last of which uplifted unimaginable masses of rocks to form the Rocky Mountains.

Once over the Continental Divide, the Expedition would pass through two of the youngest geological regions of the United States, the Columbia Plateau and the Cascade Range. Volcanic activity on the Columbia Plateau, one of the most extensive accumulations of basaltic lava on earth, inundated a region of 500,000 square kilometers 17 to 6 million years ago with countless lava flows. The Cascade Range is a chain of very active volcanoes, which have only formed in the last 1.6 million years, some of which erupted just before the Expedition arrived.



As you stand at Camp River DuBois, look across the Mississippi River and imagine all the varieties of rocks, minerals, and fossils you may see as you travel from Wood River to the Pacific Ocean. Take the time to start

your personal journal of discovery by writing notes about what you already know about rocks, minerals, and fossils—rocks you know by name, fossils you have seen, or things you learned about rocks, minerals, and fossils in school. Make as many notes as you can. You will be amazed at how many wonders of the earth you will note in your journal as you travel with Lewis and Clark as they go rockhounding to the Pacific.

Websites: <http://www.cr.nps.gov/nr/travel/lewisandclark/journey.htm>
<http://www.campdubois.com/>



Lewis' Woodpecker

Lewis and Clark Word Find—Word Puzzle #1

Rockhound on the way to the Pacific with Lewis and Clark by thinking about distance, rivers, people, and rocks! Find the words in the puzzle that are named in the word list at the bottom. Answer on page 51.

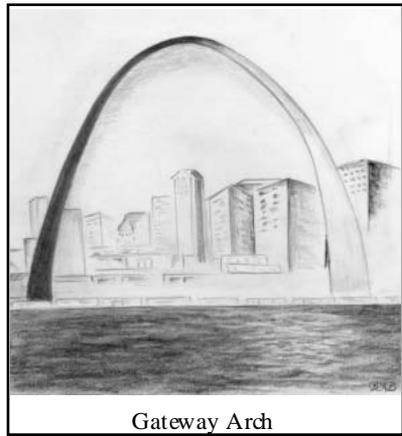
L	E	W	I	S	Z	Q	I	L	L	I	N	O	I	S	W	I	O	W	A	X	Y	Z	K
E	T	I	R	O	U	L	F	R	O	J	N	R	E	U	T	R	G	A	L	E	N	A	A
C	S	D	M	O	N	T	A	N	A	W	R	I	C	V	4	B	M	N	J	K	N	L	P
L	K	O	J	H	G	F	E	S	A	Q	W	D	E	R	I	T	Y	U	F	S	I	O	N
A	L	Z	U	S	X	C	M	V	B	N	M	A	Q	W	3	E	R	T	A	Y	U	I	E
R	N	E	W	T	D	S	O	N	R	E	W	H	T	D	3	C	E	S	I	O	R	O	B
K	B	R	D	A	H	E	S	T	N	R	X	O	C	C	M	D	D	E	R	I	O	P	R
G	A	E	E	R	G	D	S	D	E	O	D	A	D	G	I	E	R	E	B	E	S	E	A
M	A	C	E	G	E	E	A	E	N	N	R	B	B	D	L	B	A	B	U	D	E	D	S
I	E	Q	Q	A	Q	A	G	K	Q	W	O	T	D	K	E	J	I	L	R	E	Q	D	K
S	A	D	X	R	X	A	B	O	D	S	T	H	E	S	E	B	U	N	D	U	E	A	A
S	D	N	B	N	E	E	T	W	E	T	W	W	S	D	E	M	M	E	A	E	A	E	R
O	E	D	W	E	E	D	E	B	E	T	A	X	C	N	A	N	U	A	G	I	R	O	P
U	D	E	B	T	S	E	S	X	S	E	S	D	E	F	U	K	L	G	A	B	T	U	E
R	O	U	Y	Y	R	Y	W	R	R	W	F	U	N	Q	A	S	O	A	T	A	Z	D	K
I	E	V	P	E	T	R	I	F	I	E	D	W	O	O	D	M	C	T	E	C	W	D	A
G	G	E	R	E	D	N	U	H	T	V	T	O	P	R	C	R	T	E	A	E	D	X	N
W	A	S	H	I	N	G	T	O	N	C	V	P	O	C	R	E	R	I	H	P	P	A	S

Puzzle Word List

4133 Miles	Iowa	Sapphire
Blue Agate	Kansas	Snake
Clark	Lewis	South Dakota
Columbia	Missouri	Star Garnet
Fairburn Agate	Montana	Sunstone
Fluorite	Moss Agate	Thunder Egg
Galena	Nebraska	Washington
Geode	North Dakota	
Idaho	Petrified Wood	
Illinois	Rose Quartz	

Jefferson National Expansion Memorial, St. Louis, Missouri

There can be no mistaking the Jefferson National Expansion Memorial. The Arch that forms the bulls-eye for the West can be seen for miles. The arch is an earthquake proof stainless steel structure, 630 feet high with a 60-foot foundation. A 20-mile per hour wind makes the Arch sway one inch, and the Arch is designed to sway 18 inches! For those with the spirit, take the tram ride to the top. It seems that you can almost see to the Pacific Ocean.



Gateway Arch

Then visit the Museum of Westward Expansion to view some of the sites you may see first hand along the Lewis and Clark Trail.

Allow plenty of time for this experience as there are many interesting and fun things to do here. Watch the videos available as they are always helpful. Browse through books and other materials in the gift shop so you will taste the full flavor of your expedition.

 At the entrance to the Museum of Westward Expansion, you can even have your picture made with the person who was the mastermind for the early westward movement that established the United States of America as a large and important country. Though one person hardly ever deserves all the credit for a successful venture, some people are the right people in the right place at the right time with the right skills to make the difference. The same is true for what you will experience on your journey. Though each member of your group will have to contribute to make your trip successful, without someone having the idea for going and planning the trip, you would not even be starting the trip! Stand close to Mr. Jefferson (but please don't touch); you two make a good pair.

Check out the 15-foot-high Photo Murals that show what you can see traveling on the way to the Pacific along the Lewis and Clark Trail. You can also see the murals online at the website below.



All of the 33 photo murals give great views of the sites along the Lewis and Clark Trail. The photo murals with the following numbers are of special interest to *Lewis and Clark: Rockhounding on the Way to the Pacific*: 1, 3, 4, 8, 9, 15, 17, 20, 21, 29, and 32. We hope you can visit many of these sites as you learn about the rocks, minerals, and fossils along the route to the Pacific.

How far do you think it was from Camp River DuBois to the Pacific Ocean? William Clark used “dead reckoning” to determine that it was 4,162 miles; he was only 40 miles off! You have just walked 500 feet from Photo Mural 1 through Photo Mural 33. If you were going to walk Clark’s distance of 4,162 miles, how many times would you have to walk the 500 feet of this mural?



Keep reading—you will find the answer on another page.

Websites: <http://www.cr.nps.gov/nr/travel/lewisandclark/jef.htm>
<http://www.nps.gov/jeff/LewisClark2/TheJourney/PhotoAlbum/LCMurals/L&CMURALS1.htm>

June 7, 1804, Katy Trail State Park, Rocheport, Missouri

This is a great place for you and your companions—you can ride a bike, jog, or take a walk of any length you choose. The scenery along the way is enough to cause you to stop and look more than once—even if you do not get tired. The name of the town itself is especially inviting to rockhounds. “Rocheport” is the French word for “port of rocks”!



The journals of Lewis and Clark tell of rattlesnakes, caves, and petroglyphs (rock carvings), and all of them are in, on, or around the limestone bluffs. You can see these sites—hopefully minus the rattlesnakes!—by heading east on the Katy Trail as you leave the Rocheport Trail Head. As you move along the Trail, look up and to the left to see huge bluffs occasionally visible from under the foliage.

These limestone bluffs are made up of the shells of tiny sea animals that fell to the bottom of a deep ocean in this very spot during the Mississippian Period some 360 to 325 million years ago. How did those thin, brittle, tiny animal shells turn into a high bluff that is hard as rock? First, imagine how many tiny sea animals would live and die over mil-



lions of years. Lots of them! Then, think about how heavy water is. If you are carrying a water bottle or a sport drink along this Trail, how heavy do you think it is? Well, if you are carrying one pint, it weighs a little over a pound; if you are carrying a quart, how much would it weigh?



You are right, a quart weighs over 2 pounds. Imagine how heavy the deep ocean that covered these tiny animal shells would have been, and think about how long all that weight would have been on those shells. That helps you have a good idea of how these limestone bluffs were formed.

After about 3 miles, you will see the Lewis and Clark Cave on your left. Obey the signs asking you to stay on the Trail and do not enter the cave. The small cave is partially covered by vines and other growth during warm weather months. Snakes like to visit the cool cave, so watch for those, too.



The Katy Trail near Rocheport

Water running through the limestone and issuing forth at the cave opening served as a spring.

Travelers need good water sources along their routes. Without water, they would not survive. Water was certainly available in the Missouri River, but it did not taste like spring water. River water is not as clean and healthy as spring water. So travelers tried to let other travelers know where good water

could be found. Since the Native Americans did not have “billboards,” how could they let others know that there was good water near this spot?



Look up above the cave, and, though it is very hard to see, you can make out a rare, surviving petroglyph. In your journal, draw this bluff and its petroglyph. According to the journals of Lewis and Clark, petroglyphs in the bluffs in this area had been inlaid with red, white, and blue flint. What an All-American sight to have seen! This naturally-occurring multi-colored variety of flint, known as Mozarkite, was designated the Missouri State Rock in 1967.



Websites: <http://www.cr.nps.gov/nr/travel/lewisandclark/rhd.htm>
<http://www.mostateparks.com/katytrail.htm>
<http://www.dnr.state.mo.us/geology/adm/publications/Mozarkite.pdf>

July 4, 1804, Independence Creek, Atchison, Kansas

The Corps of Discovery had the honor of being the first group of American citizens to celebrate the Fourth of July west of the Mississippi River. Why do we celebrate the Fourth of July? What do you usually do to celebrate the date? 

July 4, 1804 was especially important to Lewis and Clark and the men of the expedition. The Declaration of Independence had been signed in 1776—only 28 years earlier. Lewis' father served in the army during the American Revolution, and Clark's brother, George Rogers Clark, was a national hero of the Revolution. Members of the expedition remembered very well the sacrifice and courage it took to secure this country's freedom from taxation without representation.



The day for the Corps included many of the festivities that you probably enjoy on Independence Day—water sports, picnics, hikes, and “fireworks.” Other events that day included one of the expedition members becoming the first victim of snakebite and the naming of a creek near present-day Atchison, KS as Independence Creek.

Captain Lewis celebrated Independence Day with a hike. He Walked along the shore of the Missouri and then up to the top of a mound where he enjoyed a grand view of the surrounding area, the result of major geologic forces that had begun in this area about 1.6 million years ago.

If you had visited this area with him on July 4, 1804, what would you have expected the temperature to be? What color would you expect the landscape to be? What would you expect to see growing and flowing? 

This area looked quite different from 1.6 million years to about 10,000 years ago! Then, you would have been very cold. There was only white on the landscape, and nothing green was growing. This section of Kansas is called the Glaciated Region because it experienced at least two of the eight or nine glaciers that worked their way across the United States. Sometimes 500 feet thick, these growing, moving bodies of ice pushed everything in their path out of the way—soil and rocks. The soil piled up at the sides and ends of glaciers. Rocks, even huge boulder sized ones, were caught up in the glacier and carried many miles. Where you see them now is where they were left when the ice melted; they are called glacial erratics.

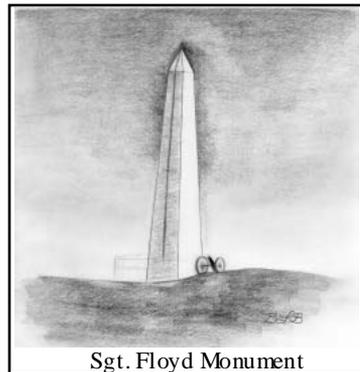
As you travel through this part of Kansas, look in the bluffs of the Missouri to see the yellowish-buff color of loess (pronounced LUSS) soils that were deposited during this period of time. Count how many rock boulders you can find sitting in unusual places—like  on tops of hills covered by grass. These may have come from Iowa or Minnesota. Give yourself two points for every reddish colored boulder you see; this material is called “Sioux Quartzite” and came all the way from South Dakota.

Website: <http://www.arthes.com/lewisandclark/archison>

August 20, 1804, Sergeant Floyd Monument, Sioux City, Iowa

The Sergeant Floyd Monument standing high above the Missouri River along the interstate highway is an impressive sight. It is a “one and only” for the Lewis and Clark Expedition, and it is also the site of a “first” for the National Park Service and the citizens of the United States.

 Take a few moments before reading any farther and guess what the “one and only” and the “first” might be.



Sgt. Floyd Monument

This site memorializes the death of the “one and only” member of the Expedition to die during the entire campaign from Camp Wood to the Pacific and the return home. It is believed that Sergeant Charles Floyd, Jr., died of

an appendix problem from which no doctor could have saved him in 1804. The Sergeant Floyd Monument was the “first” site chosen to be listed by the National Registry of Historic Places in 1966.

 Is there a major river where you live? What major rivers have you seen before—maybe the Delaware, the Ohio, the Mississippi, the Rio Grande, or the Colorado? If you have already visited the National Park Service marker for Katy Trail State Park, you have walked along one of the major rivers—the Missouri River. Do you remember what you saw along the Katy Trail? Maybe you remember seeing one of the things that most very old rivers have in common—their “bluffs.” But they are not “bluffing” in a teasing sort of way!

Bluffs are the present-day earth or rock sides of a waterway. They are created when water headed to another river, a lake, or an ocean erodes the land. Whatever is in the water’s path will be worn down—slowly if  it is solid rock, more quickly when it is soil or silt—and washed away. Do you remember what material formed the bluffs along the Katy Trail? What formed the yellowish-buff color bluffs in Kansas?

 Study the bluffs you see as you continue to travel along the Missouri River. Notice how the bluffs are similar to and different from one another and from those you have already seen. Just by thoughtful study, you can determine if the land was covered by water and sea animals or if wind blew in sediments that covered the land.

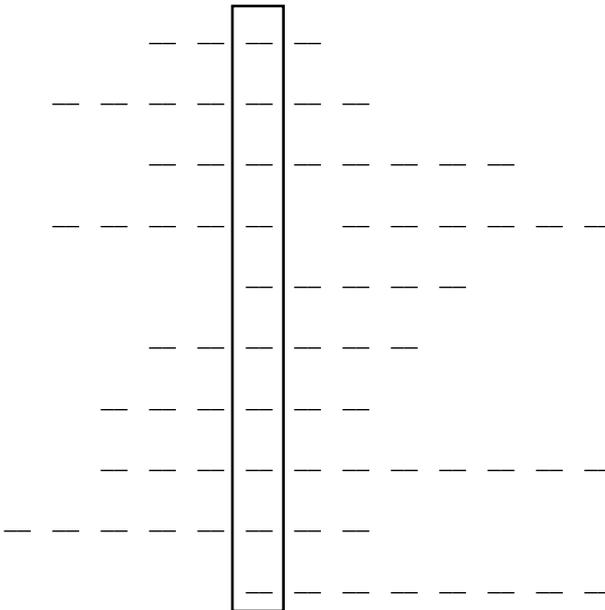
Websites: <http://www.cr.nps.gov/nr/travel/lewisandclark/ser.htm>
<http://lewisandclarktrail.com/section1/iowacities/SiouxCity/FloydMonument/>

Remember the question on page 10 about how many times you would have to walk the 500 feet of the Photo Mural at the Jefferson National Expansion Memorial to walk Clark’s “dead reckoning” distance of 4,162 miles? The correct answer is 43,784.24 times. (4,162 miles X 5,280 feet in a mile / 500 feet) = 43,950.72 times)

Lewis and Clark Word Search—Word Puzzle #2

After leaving St. Louis, the Lewis and Clark Expedition crossed through or along the borders of eleven states. All 11 states are used in this puzzle – ten are arranged horizontally spelled left to right. The eleventh is the answer to the puzzle and will be found spelled down, top to bottom, in the bold outlined square. Answer on page 51.

States: Idaho, Illinois, Iowa, Kansas, Missouri, Montana,
Nebraska, North Dakota,
Oregon, South Dakota, Washington



August 21, 1804, Ponca State Park, Ponca, Nebraska

America's longest river and Ponca State Park combine to make this area a scenic portion of the Lewis and Clark Trail. From here to Gavins Point Dam, the area is recognized as the Missouri National Recreational River and is one of the only two sections of the Missouri River where it looks somewhat like it did during Lewis and Clark's visit. The park itself is noteworthy because of its rocks, minerals, and fossils. Ponca State Park was named for a proud Nebraska Native American Tribe whose most important member was Chief Standing Bear. He won a court battle in 1879 to have Native Americans declared as "persons" under American law.

As Lewis and Clark were passing through this area, they continued to follow the instructions Thomas Jefferson had given them: to learn all they could about every mineral they found and to look for remains of animals that might no longer exist. Fossils were rare but several species were found. There are four instances where fossil evidence was discussed in the journals (visit Fossil website on the next page). The only surviving specimen from the Lewis and Clark Expedition is an upper-jaw fragment of a fish, *Saurocephalus lanciformis*. It was collected by Patrick Gass on August 6, 1804 from Cretaceous-age rocks along the Soldier River between Omaha, NE and Sioux City, IA.

Though Lewis and Clark missed them during their visit to this area, exciting discoveries of fossils have come from this area. In 2001, bones of a fossil Plesiosaur were found in Ponca State Park. Though only 35% complete at this time, it is one of only two representatives of this species ever found. Can you guess where the other was found?



Ponca State Park Shelter House

Would you believe the other specimen was found in the late 1800s in what is now Ponca State Park! And that is not all: numerous fossils can be seen in the rocks along the River Trail that is downstream from the boat landing. You can see dams, ripple marks which were caused by waves, and the burrows of an unknown creature. There are also many different types of rocks that are identified along the Trail.

Inquire at the Visitor Center for information about the Trail. The book store has materials you can purchase that give a full description of what can be found. Walk the River Trail with your traveling companions, and see how many different types of fossils and rocks you find. You cannot collect them, but you could draw pictures of them in your journal.



Continue your Ponca State Park adventure by checking out two other sites. Find the Shelter House and take a very close look at the rocks from which it was made. It was constructed of rocks over 600 million years old—boulders that do not look like any other rocks in the Park. How do you think these erratic rocks got here?



 Find the River Overlook where you may see three states from this one place. What states do you think you see? If you look east or across the river, you will see South Dakota. If you look down the river or south, you will see Iowa. And, if you look at the river right there at your feet, you are looking at Nebraska.

Websites: <http://www.ngpc.state.ne.us/parks/parks.asp> (click "northeast region")
<http://www.nps.gov/jeff/LewisClark2/TheJourney/Fossils.htm>
<http://www.trailsandgrasslands.org/ponca.html>

By the way, you were right if you said that those erratic rocks arrived at Ponca State Park after the Pleistocene-age glaciers that they were trapped in melted here.

August 24– 25, 1804, Spirit Mound, Vermillion, South Dakota

What a week this had been for the Lewis and Clark Expedition! On August 20 the Corps of Discovery had said a sad good-bye to Sergeant Charles Floyd, Jr. On August 22 Meriwether Lewis had found a substance along the bluffs of the Missouri that he believed to be arsenic or cobalt. According to Clark's journal, Lewis decided to taste and smell the specimen so that he could conclusively record what it was. Lewis was immediately overcome by the substance and nearly poisoned. To ease his condition, Lewis took some Rush's Pills, often called "Thunderbolts" because of their impact on the bowels! Without a doubt, the pills were not an appropriate treatment, and

they only added to Lewis' misery. Fortunately, however, Lewis survived this near-fatal experience.

On August 23, Joseph Fields had killed the Expedition's first buffalo, which surely caused the men to sleep well on full stomachs. Then, in the afternoon of August 24, they were passing Spirit Mound where they had been warned by the Oto Indians they would find devils!



Spirit Mound

The Otos were very specific. The devils had large heads and were about one-and-a-half feet tall. Keeping a very steady eye on Spirit Mound, these human-like devils had their penetrating arrows pointed and ready to fly if anyone should try to climb to the top of the mound. Clark reported that no Native American would attempt to go to the top because of the certainty of the devils' existence.

What should the expedition do? What would you do? Climb to the top and meet your fate or scurry around the area on the far side of the river and let the little devils keep it? We are not exactly sure what the Expedition said about the mound, but we are fairly certain that they did not leave the boats on August 24 until they reached their campsite near present-day Vermillion, South Dakota.

The next day was a Saturday. What do you usually do on Saturday? Well, of course, you do something adventurous and fun ...like climb to the top of Spirit Mound. And that is exactly what nine men of the expedition and Lewis' dog Seaman did. They all went to the top of the Mound, and they lived to tell it, even though Seaman had to be sent back because he got hot and tired. Lewis grew very tired because he had not completely recovered from his arsenic or cobalt experiment. Clark had the satisfaction of writing in his journal that from the top they had enjoyed a view of the beautiful countryside all around. As an added bonus, the men came upon several types of ripe and delicious fruits as they returned to the camp site.



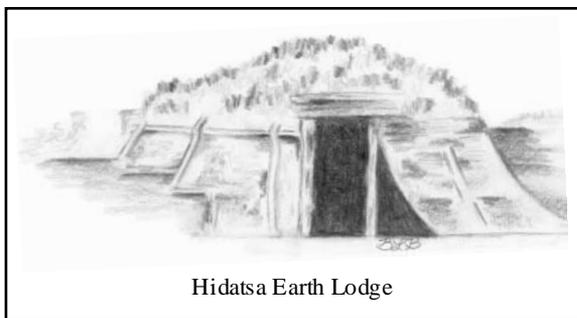
What was this single mound standing there alone on the prairie? Did it develop naturally, was it built by human hands, or was it built by the hands of devils? In truth, Spirit Mound is a remnant of a knob of Niobrara Chalk bedrock that was not eroded away by Ice Age glaciers.

Websites: <http://www.cr.nps.gov/nr/travel/lewisandclark/spi.htm>
http://www.sdhistory.org/Exhibit1/mus_Panel6.html

October 27, 1804 Knife River Indian Villages National Historic Site Stanton, North Dakota

As Lewis and Clark approached the North Dakota area of the Missouri River in October 1804, there were no grocery stores for food supplies and no hardware stores for buying implements and tools. The Arikara, Hidatsa, and Mandan tribes living in this area had to collect, harvest, slaughter, make, or trade for every item they needed.

Their location along the Missouri River set them up as an “all-purpose shopping-center mall” for the region. The Missouri River and the narrow foot paths leading to the Mandan villages annually brought in traders from across the central and western plains and Canada. Archeological evidence indicates Native Americans were in this area about 11,000 years ago: ancestors of the Hidatsa tribe had arrived around the year 1300.



Hidatsa Earth Lodge

Here at the Knife River Indian Villages was also the campsite of Toussaint Charbonneau, a French-Canadian fur trader and his Shoshone wife Sacagawea.

Though there has been some confusion about Sacagawea’s role in the Expedition, we know for certain that she provided some service as an interpreter, that she recognized landmarks as the Expedition neared her Shoshone

homeland in Idaho, that her brother was the chief of the tribe that provided the horses for the Expedition to cross the Bitterroot Mountains, and that her very presence with her baby son, born in February 1805, sent a message of peace to all whom they encountered. Add to that her favorable appraisal by Captain Lewis, "... to whom I ascribe equal fortitude and resolution, with any person onboard at the time of the accident. ...," and we know more than enough to honor her for her contributions.



In the Visitor Center, ask to see a piece of the natural object that makes this site of special interest to rockhounds. This local raw material is Knife River Flint, and it has been highly valued for making important tools for native peoples. With no grocery stores or hardware stores around, this flint was chipped or knapped into sharp objects that could be used for tools and implements to make it possible to put supper on the table. The flint also served as the material to start the fire to cook the supper!

Flint is the name for a very hard variety of quartz. Knife River Flint is dark brown in color and has been used for thousands of years by Plains Indians. Rockhound hobbyists who make their own arrowheads are called "flint knappers."

As you continue along on the Lewis and Clark Trail through the lands of the Native Americans, see how many items you can find that have been made out of flint. Make a note of the purpose of each item and of the many different colors of flint you see. What is the name of each variety you find? If you had goods or money to trade, what flint items would you like to own?



Websites: <http://www.cr.nps.gov/nr/travel/lewisandclark/kni.htm>
<http://www.nps.gov/knri/snaps2001/THUMBS/index.htm>
<http://www.l3-lewisandclark.com/ShowOneObject.asp?SiteID=31&ObjectID=626>



Clark's Nutcracker

Lewis and Clark 3's, 8's, and 13's— Word Puzzle #3

Listed in the 13 by 13 square on the next page are 13 of the many American Indian Tribes encountered by the Lewis and Clark Expedition.

All of the Indian Tribe names in this puzzle are 8 letters long. The 8 letters are printed clockwise or counter-clockwise around the perimeter of individual 3 by 3 boxes. The first letter of the tribe's name can start in any position. All of the tribe names are interlocked in some fashion, sharing between 1 and 3 letters with another tribe's name. When you find a Tribe Name, draw a heavy outline around the name, then circle the remaining letter in the center of the box.

When you are through, the 13 circled letters, read left to right, top to bottom will spell out a familiar name or saying that is three words long. The Indian Tribe "SHOSHONE" has been outlined for you as a start, and the center letter of the box, the "E," has been circled. Note that "SHOSHONE" reads clockwise around the box, starting at the "nine-o'clock" position. Puzzle answer on page 52.



Sacagawea and "Pompey"

Lewis and Clark 3's, 8's, and 13's—A Bunch
 Word Puzzle #3, *continued*

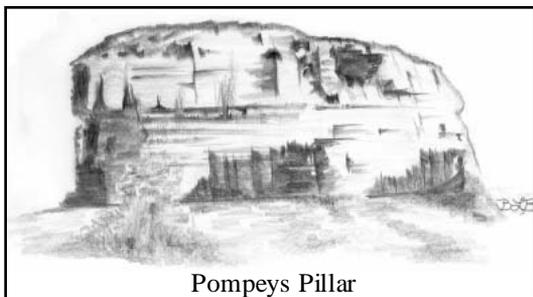
N	D	G	U	P	K	A	I	T	W	T	E	Z
E	U	Q	W	B	U	L	K	B	M	K	T	D
Z	R	G	N	M	W	A	H	O	S	S	A	S
T	I	H	T	S	L	J	S	P	H	R	T	B
K	R	R	A	T	N	N	E	N	O	A	O	A
L	G	I	W	I	E	I	Y	O	U	N	I	U
S	I	M	I	N	C	H	E	L	L	A	S	Q
G	R	A	S	V	S	N	H	I	D	U	L	T
C	U	O	S	K	I	L	A	T	A	M	W	X
P	O	O	T	C	L	F	L	H	F	L	C	S
A	A	K	O	O	L	D	A	E	Z	P	Q	Y
K	C	I	R	T	D	C	S	N	K	E	U	G
K	C	A	N	E	J	X	J	E	C	R	Z	K

<u>Tribe Names</u>	
CHEHALIS	NEZPERCE
CHEYENNE	QUINAULT
FLATHEAD	SHOSHONE
KICKAPOO	SKILLOOT
KOOTENAI	UMATILLA
MINITARI	WAHKIAKU
MISSOURI	

Your answer with the circled letters:

— — — — — — — — — —
 — — — — — — — — — —

July 25, 1806, Pompeys Pillar, Billings, Montana



Pompeys Pillar

Pompeys Pillar is a very important site; in fact, it wins the prize of being “the only.” Do you know what makes this site “the only”?



If you said because it is the only place to be named “Pompeys Pillar,”

you are right. If you said it was the only place that was named for Pompey, you are right. But there is something even more important about this site to make it “the only.” Pompeys Pillar is the only place where you can see evidence left on the land by a member of the Expedition just as it was when it was left there. During the entire trip, buildings were built, camp sites were established, and names were carved into trees, but not one of those can be found today as it was when the Expedition left it. By carving his signature and the date “July 25, 1806” in this rock, Clark informed all who would come after him, as well as all who might have to come looking for him, that he had arrived at this particular spot on this specific day.

How did Pompeys Pillar get its name? Sacagawea’s son Jean Baptiste had been born on February 1, 1805, and in April he was part of the team that left Fort Mandan to continue the journey west. William Clark was very fond of the infant, giving him the nickname “Pomp” or “Pompey” and probably treating him like a special nephew. Pomp was about eighteen months old when the expedition came to this site on their return trip from the Pacific Ocean. Clark named the stone outcrop “Pompy’s Tower” in the child’s honor. The name was later changed to Pompeys Pillar.

Pompeys Pillar is a huge outcrop of Cretaceous-age sandstone that stands about 200 feet high, isolated from the main line of bluffs on the Yellowstone River. Sandstone is a sedimentary rock composed of grains of sand, mainly quartz, cemented in a matrix of clay or silt. Depending on the character of the natural cement, sandstone may be yellowish, red, gray, or white. Carefully study the colors and shapes of the grains you see in Pompeys Pillar.



Though William Clark left his name and date on this rock in 1806, you know that this site and all other public places must be protected for generations to come. Defacing or collecting anything on National Park Service land is prohibited. Today, as a responsible citizen, you always “take only pictures, leave only footprints.”

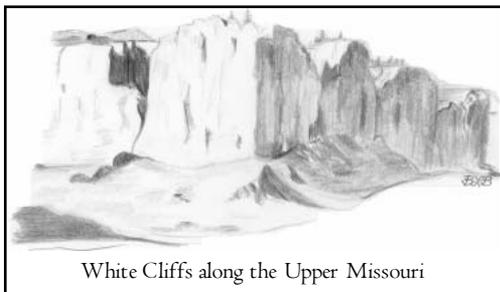
Though you now know how Pompeys Pillar was “the only,” you also need to know that it was “one of only four” fossil sites found by the Lewis and Clark Expedition. Several miles below Pompeys Pillar, Clark reported the fourth and final fossil find of the expedition related to prehistoric creatures.

He found bones in rock layers from the Cretaceous Period, 144-65 million years ago. The area around Pompeys Pillar was at that time an area of land, not water, thus ruling out Captain Clark’s guess that he had discovered “the rib of a fish.” Clark knew nothing of dinosaurs and was not looking for one. In fact, the term “dinosaur” was not even coined until 1942. Clark’s dinosaur find, even though we don’t know exactly what was found, is often discussed as one of the world’s earliest dinosaur finds!

Websites: <http://www.cr.nps.gov/nr/travel/lewisandclark/pom.htm>
<http://www.pompeyspillar.org/>
<http://www.nps.gov/jeff/LewisClark2/TheJourney/Fossils.htm>

May 31, 1805, Upper Missouri River Breaks National Monument, Ft. Benton, MT

If you have been thinking about traveling literally “on the Missouri River,” this is one of the best spots! Along the upper area of the Missouri National Wild and Scenic River, you can take a boat ride and have an experience similar to that of the Expedition. Lewis saw natural stone walls that were as



White Cliffs along the Upper Missouri

high as 100 feet, and only 1 to 10 feet thick with some running parallel and others perpendicular to those around it. He also described beautiful white rock cliffs that had a variety of columns that looked like statues.

The white cliffs are composed of rocks of Cretaceous age; their distinctive color is now believed to be a result of a unique sequence of events that took place during the deposition of this rock millions of years ago. Blankets of volcanic ash fell on ancient barrier islands and off-shore sandbars, supplying an unusual white-clay cement that bound this sandstone together. This is a weak cement and quite vulnerable to percolating water, the principal agent of erosion that is responsible for the columns, pillars, pedestals, toadstools, and other unique features of the white cliffs. Compare this “eroded rock”



with other rocks you have seen along the Lewis and Clark Trail. What similar events and what unique events do you think occurred to shape the rocks? Why do some of the rocks look more alike, and why do some look different?

The dramatic views inspired Lewis to write one of the most often quoted passages in the journals: “As we passed on it seemed as if those scenes of visionary enchantment would never have an end; for here it is too that nature presents to the traveler vast ranges of walls of tolerable workmanship, so perfect indeed are those walls that I should have thought that nature had attempted here to rival the human art of masonry had I not recollected that she had first began her work.”

Some of these white cliffs and other formations may remind you of grand buildings, monuments, statues, or other things you have seen. Do you see a formation that resembles the Arch in St. Louis or Sergeant Floyd’s Monument? Just for fun, write a brief passage about something you “see” in the white cliffs using the Lewis and Clark style of writing—spell the words the way they sound.

Today, modern dams and reservoirs have caused changes to most of the rivers that Lewis and Clark traveled. This section of the Missouri is one of only two sections of the entire river from Montana to St. Louis that runs free as it did when Lewis and Clark saw it. Where is the other section?



Website: <http://www.mt.blm.gov/ldo/fbgeo.html>



Bison

Lewis and Clark Wonderword—Word Puzzle #4

Hidden in the Wonderword on the next page are a few of the official state fossils, gemstones, and rocks of the various 11 states through which Lewis and Clark traveled.

Instructions: Look for the words **bolded and underlined** and circle the letters of these words. When you have found all the words, the remaining letters not circled form a hidden message. Use the spaces below to form those letters into a word. Answer on page 52.

— — — — —



York

Lewis and Clark Wonderword—Word Puzzle #4, *continued*

S D I O N I R C
 A U E T A G A A
 P T N G O L D N
 P E Y S K E O E
 H N L E T D O L
 I R L U A O W A
 R A U L N E N G
 E G T B S G A E
 S R E T S N O M
 H A G E R M A N
 E T I R O U L F
 S S Z T R A U Q

MONTANA

Fossil: Dinosaur *Maisaura peeblesorum*
 Gemstone: Sapphires, Moss Agate

OREGON

Gemstone: Sunstone
 Rock: Thunder Eggs

WASHINGTON

Gem: Petrified Wood
 Fossil: Columbian Mammoth

IDAHO

Fossil: Hagerman horse
 Gemstone: Star Garnet

MISSOURI

Mineral: Galena
 Rock: Mozarkite
 Fossil: Crinoid *Delocrinus missouriensis*

IOWA

Fossil: Crinoid (proposed)

Rock: Geode

KANSAS

None

ILLINOIS

Fossil: Tully Monster

(found as separate words)

Mineral: Fluorite

NEBRASKA

Fossil: Mammoth
 Rock: Blue Chalcedony, Prairie Agate

NORTH DAKOTA

Fossil: Tereido Petrified Wood

SOUTH DAKOTA

Fossil: Triceratops
 Mineral: Rose Quartz
 Gemstone: Fairburn Agate
 Jewelry: Black Hills Gold

June 13–July 15, 1805

Great Falls of the Missouri, Great Falls, Montana

Hopefully, you and your traveling companions are enjoying your adventure along the Lewis and Clark Trail. As you are traveling along, how do you know if you are on the right road or if you are nearing the area of your next stop? You are right—signs are everywhere! How do you think Lewis and Clark knew if they were traveling in the right direction or if they were nearing their next destination?



There were no road signs along the Missouri River to tell them where they were or where they were headed. The Expedition did not have a map. In fact, one of their assignments from Thomas Jefferson was to develop a map of the area. Captains Lewis and Clark had collected information from the Mandans the previous winter, including some major landmarks they could use to verify that they were on the right trail as they headed toward the Pacific Ocean. One landmark they were told about was the Great Falls of the Missouri.



The Great Falls

As June approached, Lewis and Clark thought they were on the right river and that the Great Falls should be somewhere close. They were beginning to be pressed for time, because they knew the Great Falls would have to be portaged hastily if the Expedition was to find the Shoshones and get horses to travel over the Rocky Mountains before winter came. But, where was the landmark of the great falls the Mandans had told them they should find along the Missouri River? Was the Expedition traveling along the wrong river?

On June 10, Lewis set off across the land with four other men to look for the Great Falls. Three days later, he saw a column of water vapor rising high into the sky, and then heard the sound of a great water fall. He quickened his pace and saw what he called “... *this sublimely grand spectacle.*” What a relief!

Awestruck by what he saw, heard, and felt, Lewis moved onto some rocks about 20 feet high at the side of the falls and began to write. He wrote about the size, strength, and falling pattern of the water, the energy and beauty of it all, and the impressive rainbow that crowned his view. Though disappointed with his ability to express the majesty of it all, Lewis wrote in his journal that he hoped his information would help "...give to the enlightened world some just idea of this truly magnificent and sublimely grand object..." and "...which of it's kind I will venture to ascertain is second to but one in the known world."

The Great Falls was actually a series of five waterfalls. Today, hydroelectric dams capture the power of the falls, and one is covered over. Compare the cliffs you see here with the bluffs you saw along the River further south. How are they alike and how are they different? The cliffs around the Great Falls are a fine-grained brown and white sandstone of Cretaceous age and rise about 170 feet.



Look at the Missouri River running over the rock falls and think about what you see as if you were a geologist. Describe the route the water takes through the falls, and tell the sizes, shapes, and characteristics of the rocks that make up the falls. Explain what you think created the water's route through the falls, and tell what you think caused the sizes, shapes, and characteristics of the rocks.

Websites: <http://www.cr.nps.gov/nr/travel/lewisandclark/gre.htm>
<http://www.fs.fed.us/r1/lewisclark/lcic.shtml>

July 19, 1805, Gates of the Mountains, Helena, Montana

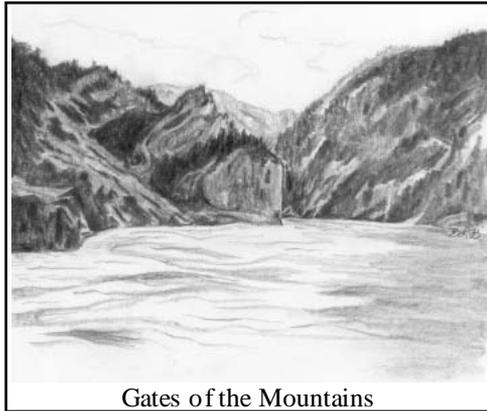


How do you think it would look if water dripped over a rock ledge until it carved a path through the rock that was about 450 feet wide, 1200 feet high, and nearly six miles long? How much water would have to drip over the edge? How long would it take? As it was cutting through the rock, would water flow slowly or quickly? What happens to the material that gets eroded out as the water runs through it?

One of the best places to see just how this works is at the Gates of the Mountains. Lewis described it this way: "every object here wears a dark and gloomy aspect. the tow[er]ing and projecting rocks in many places seem

ready to tumble on us. the river appears to have forced it's way through this immense body of solid rock...and where it makes it's exit below has thown on either side vast collumns of rocks mountains high. ... from the singular appearance of this place I called it the *gates of the rocky mountains.*" The expedition was approaching this area toward dusk, and, though already tired and ready to make camp, they had to travel through the nearly six miles of the gorge before they found an area with enough flat space to camp for the night.

Boat trips can be taken through this area today. You will realize there is something special about this place as the boat takes you along the sides where you can see pictographs, big horn sheep, mountain



Gates of the Mountains

goats, eagles, osprey, and more. And if that is not enough, wait until you see how the "gates" appear to open and close as you move slightly from one side of the river to the other. The boat also stops at what is thought to be the site of the Lewis and Clark camp.



Study how the Missouri River laps at the rock walls of the canyon and consider how it all came about. Lewis called the rocks a black granite, but today we know them to be a Mississippian-age gray limestone. These rocks are complexly folded and faulted, which gave the Missouri River an opening to carve a channel during the late Tertiary and Quaternary time, from about 24 million to 2 million years ago. Not only is this area rich in natural beauty, it is also rich in minerals—gold and silver were later mined in this area.

Imagine what it would be like setting up a campsite here for 33 people, including one baby. Have you gone camping? Did you use matches to start a campfire or grill? The expedition used flint to start their cooking fires. What else would a camper have today that Lewis and Clark's party did not? For example, did Lewis and Clark have flashlights?



Website: <http://lewisandclark.state.mt.us/sites.asp?IDNumber=10>

July 25-30, 1805

Missouri Headwaters State Park, Three Forks, Montana

This was a very significant place for the Lewis and Clark Expedition. Lewis declared this to be the “*headwaters of the Missouri*” because all three streams flowing into the Missouri River were “*noble*” without any one having major advantages over the other two. Thus, Lewis and Clark had achieved one of the objectives of their orders from Thomas Jefferson—to reach the headwaters of the Missouri River. The southeast fork was named “Gallatin” for Secretary of the Treasury Albert Gallatin, and the middle fork was named “Madison” for Secretary of State James Madison. The southwest fork that the Expedition planned to travel was named “Jefferson” for the president of the United States. The Ruby and Beaverhead Rivers come together south of here to form the Jefferson River. How do you think the Ruby River got its name?



This was a special place for some less positive reasons, too. It was the same spot where five years earlier Sacagawea had been kidnapped and taken from her home to live with the Hidatsa Indians. Another bad omen was that Captain Clark was ill and had terribly blistered and sore feet. Also, the Ex-

pedition knew that it was the end of July, and they had still not found the Shoshones. They had to find the Shoshones, and they had to be successful in bargaining with them to get the horses the Expedition needed to carry them over the Bitterroot Mountains. And, all of this had to be done before the early winter snows blocked their passage through the mountains.

 At this spot you can walk up to what may have been the very same lookout Lewis used to take in the sights and to make his decisions concerning the three forks. If you walk up, occasionally stop and look at the sites you can see. When you get to the top, look where your feet are placed: maybe you are standing exactly in the footsteps of Meriwether Lewis.

After that, you may want to look more closely at what is holding you up for this great view! Interestingly, each of the three forks flows through different types of rock before they join at the Missouri River. The Gallatin cuts through Devonian shale. The Madison cuts through Mississippian-age limestone. And the Jefferson flows through volcanic rocks and limestone.

By the way, even if you are standing in Lewis' footsteps to take in the views, some of the sites you see will be much different from those Lewis saw. For example, you and Lewis may both have seen prickly pear cactus, bluebunch wheatgrass, antelopes, and beaver, but only you will get to see people floating down the three rivers in rubber boats and driving motorcycles, motor homes, and other vehicles through the park! Do you think the land forms may have changed over time? How and why?



Website: <http://www.cr.nps.gov/nr/travel/lewisandclark/thr.htm>

By the way, the Ruby River was so named not because of any rubies there but because of the red garnets that were found in the river.

August 8, 1805

Beaverhead Rock State Monument, Dillon, Montana

 What are some of the geographic landmarks near your home? Maybe there is a sharp curve turning to the east as you head south out of town; maybe there is a noticeable elevation of the land as you look to the west. What is the earliest age at which you think you were able to point out specific landmarks near your home?

Beaverhead Rock is the formation along the Beaverhead River that Sacagawea recognized as being near her home. Identification of this landmark

was important to the members of the Expedition because they knew they were still headed in the right direction. It gave them encouragement and hope as they hurried to find the Shoshones and get the horses they needed to get across the Bitterroot Mountains. Keep in mind that Sacagawea was only about twelve years old the last time she had seen Beaverhead Rock.

Beaverhead Rock is about 370 feet high. When seen from the north, which is how Lewis and Clark saw it, the reddish-brown formation's outline does look like a beaver heading west. The material is now described as andesite. Andesite is igneous and fine-grained, and it erupted onto the surface of the earth where it cooled and crystallized. This tells us there were active volcanoes here long ago.



Work as a geologist at this site by making a detailed sketch of this rock. Tell its size, shape, and characteristics, and give its exact location. Also, make notes describing any other information you see that may be related to the geology of the area.

Website: <http://www.cr.nps.gov/nr/travel/lewisandclark/bea.htm>



Beaverhead Rock

Lewis and Clark Word Search—Word Puzzle #5

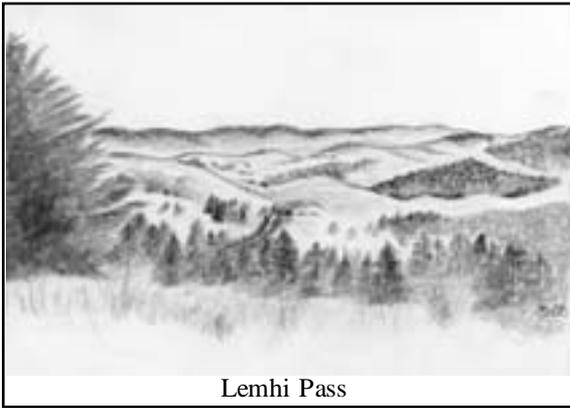
Listed below are clues that will help you determine the rock or Native American group commonly associated with several of the states Lewis and Clark passed through on their journey. The diagram below may be useful in solving the puzzle. For each statement, fill in the diagram with an “X” to mark true statements or an “O” to mark statements that are not true. As a hint, when you mark an “X” for known positive information, you should mark the remaining items associated with that row and/or column as “O.” Answer on page 52.

1. These Indians, who were not of South Dakota or Washington, used boards to deform their heads.
2. The Nez Perce Indians, who had piercings in odd places, could have used star garnets for decoration.
3. This blue semi-precious stone is not the same blue stone of Washington.
4. Although its name suggests otherwise, Oregon’s state rock has nothing to do with storms. Its Native American tribe doesn’t have anything to do with a farming technique.
5. The Teton Sioux are not of Montana or Idaho, and neither the Fairburn agate nor star garnet is associated with Montana.
6. The Chinook Indians could be associated with blue agate while the Flathead Indians could be associated with the other blue stone.

	Flathead Indians	Chinook Indians	Teton Sioux	Nez Perce	Tillamook	Sapphire	Star Garnet	Thunder egg	Blue Agate	Fairburn Agate
South Dakota										
Idaho										
Montana										
Washington										
Oregon										

August 12, 1805, Lemhi Pass National Historic Landmark, Continental Divide, Montana-Idaho Border

Let's design the ideal picnic area. Would you agree that it needs to have a meadow, preferably with many beautiful wildflowers? Should it be on the side of a mountain, with plenty of evergreens so that you can hear the gentle breeze moving through the tree branches? Would we also want a fresh spring with maybe just a little water coming forth, moving down the mountain in a trickle? We would also probably hope to find peace and quiet at this special place. Then, just to make it extra special, it should be named in honor of a very important person. 



Lemhi Pass

If this is your ideal picnic site, you will enjoy a picnic at Lemhi Pass in the Sacagawea Historical Area—a day-use-only site. Here, also, according to Lewis, is “...the most distant fountain of the waters of the mighty Missouri in surch of

which we have spent so many toilsome days and wristless nights.” This spring provides the water for a small water source that leads eventually to the Jefferson fork which eventually comes together at the three forks to make the Missouri River. Getting to Lemhi Pass will not be easy, but it will certainly be worth it. Be sure to check information on road conditions, vehicle sizes, and hazards with the USDA Forest Service, Beaverhead-Deerlodge National Forest, 404.683.3900, or 420 Barrett St., Dillon, MT 59725.

As you enjoy your picnic, you will feel like you are on top of the world. In a way, you are. This is the highest point of land over which the Expedition passed, 7,373 feet! It is also the Continental Divide.  What is a “continental divide?”

A “divide” is a tract of high ground that separates two adjacent drainage basins, dividing the surface waters that flow in one direction from those that flow in the opposite direction. The Continental Divide is exactly what it

says it is—it divides the continent. From this spot, water that flows down the west flank of the mountain ends up in the Pacific Ocean, and water that flows down the east flank of the mountains drains to the Gulf of Mexico. The Continental Divide goes through the entire length of the North American Continent—from Canada through the United States and on to Mexico. It also marked the western boundary of the Louisiana Purchase.



Using a road map, trace the location and length of the Continental Divide. Why do you think there are so few roads crossing the Continental Divide from Mexico to Canada?

Though Lewis and Clark knew this area was home to the source of the mighty Missouri, they did not know what rocks and minerals were near. Thorium, a radioactive mineral, can be found in this area. Agate is also in the area. Mining claims have been established near here for copper, zinc, lead, silver, and gold. Visit your library, the internet, or a rock club to learn more about these rocks and minerals.



Website: <http://www.cr.nps.gov/nr/travel/lewisandclark/lem.htm>
<http://www.fs.fed.us/r1/b-d/virtualtours/lemhi-pass/virtual-lemhi-pass.html>

September 9–11, 1805 and June to July 1806 Traveler's Rest, Lolo, Montana and July 22–26, 1806, Camp Disappointment, Browning, MT

The Lewis and Clark party stopped at Traveler's Rest twice—in September 1805 as they headed west and again in June to July 1806 on their return journey back home.

Near here is a hot springs where they camped and bathed. Hot springs develop where underground water is heated by hot magma and boils out of the ground. Here at Lolo Hot Springs, the hot water flows through fractures in the granite and is about 100 degrees Fahrenheit! How can you enjoy a type of hot springs with boiling water even if you do not live close to hot magma?



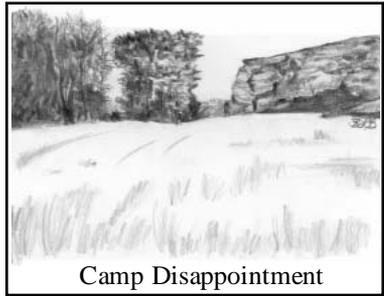
As they continued their return journey in this area, Lewis decided to explore farther up the Marias River. He hoped to find that the source of the Marias River was near the forty-ninth parallel so that the area might become part of

the Louisiana Purchase. The Captains and their followers divided into groups here with plans to reunite where the Yellowstone River meets the Missouri River.

Lewis' party would travel northwest and Clark's party would continue north and east.

Lewis made many journal entries on this part of the trip because he felt certain this area would be important in the nation's future.

Though there were many streams and it seemed a fertile area, the fine sandy soil became a slippery clay when it was wet. On July 26, 1806 Lewis and his group were forced to give up as the navigable Marias River ended within sight of the mountains of today's Glacier National Park. This is also the location where Lewis' party met the Blackfoot Indians. Lewis was so disappointed that the source of the Marias did not extend the proposed Louisiana Purchase boundary that he named this, the Expedition's northernmost stop, Camp Disappointment. On the way back he observed some "*birnt hills*" but did not have time to investigate. This "birnt" material was layers of seams of coal.



Meanwhile Clark's party journeyed through the Bitterroot Mountains and down the Yellowstone River. The rocky river bed contained cobbles and pebbles that today's rockhounds find interesting, such as colorful Montana agates, jasper, and petrified wood. Look for these rocks and sketch what you find in your journal.



Website: <http://www.cr.nps.gov/nr/travel/lewisandclark/tra.htm>
<http://www.cr.nps.gov/nr/travel/lewisandclark/dis.htm>
<http://www.travelersrest.org/VISITOR/Photo.htm>

September 26–October 7, 1805, Canoe Camp, Orofino, Idaho

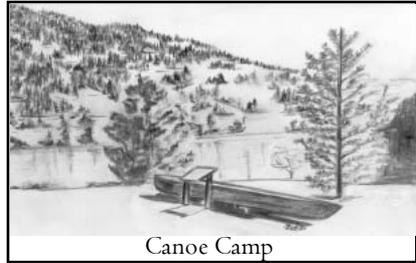


When was the last time your stomach made noises because you were truly "hungry"? Have you ever been hungry and sick at the same time? How did it feel? What did you think about while you were suffering?

The Corps of Discovery found itself in very difficult circumstances at the Canoe Camp. They had made the terrible trek over the mountains but ended up half starved to death. They came out onto the Weippe Prairie where the

food available was mainly roots. Only rarely did one of the hunters find any game, and occasionally a horse had to be sacrificed for food. All the men were accustomed to eating meat. A diet of mainly roots caused digestion problems for them; generally, all of the men were sick. Captain Lewis was very sick, and Clark noted in his journal "I am taken verry unwell with a paine in the bowels & Stomach, which is certainly the effects of my diet. . ." It was October, and the men knew that winter was coming soon. They desperately needed to get to the Pacific Ocean before winter arrived, but they were too weak and sick to start building their canoes.

It would have been easy for the Nez Perce to decide to kill these sick and weak strangers who were trespassing on their land. But they did not. They were friendly and shared the meager supply of food they had with the members of the Expedition. Eventually, the men gained strength and were



Canoe Camp

able to build their dugout canoes using methods taught to them by the Nez Perce. As the Expedition members pushed their canoes into the Clearwater River from Canoe Camp and headed for the Pacific, there was some good news; for the first time on the entire trip, they were traveling with the current! What caused the water to flow toward the west when before the water had flowed toward the east?



Though now the Canoe Camp area is a pretty spot with the gentle Clearwater River rolling along, it was not that way during the Mesozoic time between 245 million and 66 million years ago. At that time, it was the westernmost extension of land.

It resembled how California, Oregon, and Washington are today, a region of active volcanoes and tectonic subduction zones. New land would eventually form west of the area as water laden with sediments later rushed toward the sea. Also, later volcanic activity would add large igneous intrusions called batholiths.

Look around to see what signs you find that suggest this area was once active with volcanoes and other earth-changing events.



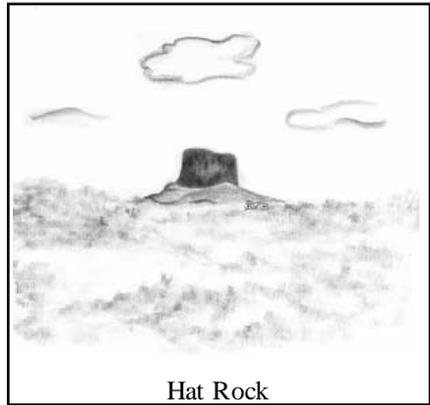
Website: http://vulcan.wr.usgs.gov/LivingWith/Historical/LewisClark/volcanoes_lewis_clark_october_1805.html
<http://www.nps.gov/nepe/site18.htm>

October 19, 1805, Hat Rock State Park, Hermiston, Oregon

Traveling down the Snake River, the Corps of Discovery reached the Columbia River on October 16, 1805. From here it would take them another 39 days to reach the Pacific Ocean.

Just imagine how the Columbia River may have looked in 1805 without any dams. There were rapids, cascades, short narrows, long narrows, and rocks everywhere. Traveling with the current, the Corps of Discovery was dashing through rapids and taking all kinds of chances with life and property. Salmon were making their annual spawning run up the river as the Corps went down the river, and the party passed a number of lodges where Native Americans were drying salmon.

According to Clark's dead reckoning, they had traveled 14 miles that day when they passed a rock on the larboard side (left, Oregon side) that looked like a hat. In fact, Clark is credited with giving the rock its name, one of the few places named by the Expedition that still goes by the name they gave it.



As you stand in the distance and look at Hat Rock, its resemblance to a hat is obvious. As you continue to study Hat Rock, however, the rock itself looks like it does not belong here. It appears to be a solid rock, sitting out there all alone. At one point in time, this entire land area was covered with rocks and soil higher than Hat Rock. Composed of basalt, Hat Rock is the plug of an ancient volcano. Hat Rock was more resistant to erosion than the rocks and soils that used to surround it. All the other material eroded and washed away, and now Hat Rock stands alone.



As you continue to travel in this area, look for other lone rocks. Do any of them remind you of a familiar object? Describe what you see.

Website: http://vulcan.wr.usgs.gov/LivingWith/Historical/LewisClark/volcanoes_lewis_clark_october_19_1805.html

Lewis and Clark Cryptograms—Word Puzzle #6

Directions: These are simple letter replacement puzzles. Each numbered puzzle is independent of the others and the code will not be the same. Answers on page 53.

A few hints that may help:

- A single letter word is generally A or I.
- Three letter words are often THE or AND. A three letter word following a series of commas is almost always AND.
- A four letter word of the form XYZX is often THAT, sometimes ELSE, and rarely something else.
- The word EXPEDITION appears in each puzzle.

1. ZBA TOLRY YMEAYJ ZYOEAYJAF UP ZBA
ACGAFMZMRQ KAYA ZBA TMJJRNYM, JQOWA, OQF
HRDNTUMO.
2. NOT BPWJ MBAEP NOEN MEL E ATAXTY BG
NOT WTMVL EPH SWEYZ TKRTHVNVBP MEL LE-
SECEMTE, E ATAXTY BG NOT LOBLOBPT NYVXT.
LOT MEL YTSTPEWJ OBPBYTH MVNO NOT
VLLFT BG NOT LESECEMTE CBWHTP HBWWEY.
3. ABC DAEACD FGHDDCI HG CJACGCI KL ABC
CMNCIOAOHJ PCGC QODDHRGO, SEJDED, JCKGEDSE,
OHPE, DHRAB IESHAЕ, JHGAB IESHAЕ, QHJAEJE,
OIEBH, HGCTHJ, EJI PEDBOJTAHJ.

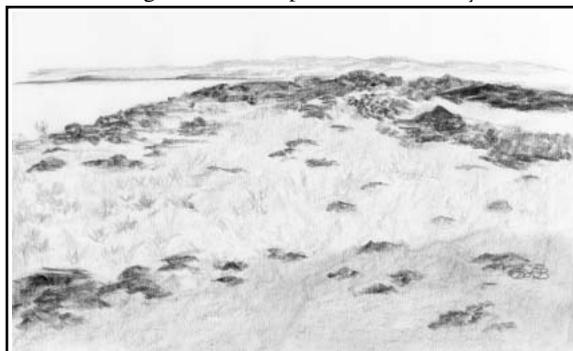
October 25–28, 1805 Rock Fort Camp, The Dalles, Oregon

The area along the Columbia Gorge and through The Dalles is so exceptional that it was the first National Scenic Area designated by the National Park System in 1986. The Columbia River continues along calmly now, thanks to man's intervention and what is often called "modern-day progress." It was quite different 200 years ago.

The Columbia River narrows here, and there was a great series of rapids that had to be negotiated by the canoes of the Expedition. Because the members of the Expedition had not had any experience with this type of whitewater, their success in navigating through without incident can only be considered luck and providence. Clark wrote in the journal, "...great number of Indians viewing us from the high rocks..." no doubt waiting their chance to salvage whatever could be found when the canoes turned over.

Without giving the Native Americans a chance to salvage anything, the Corps of Discovery made camp at what is known today as "Rock Fort Camp." Clark selected it because it could be more easily defended than other available spots along the River.

As you are driving from East to West along the Gorge, just prior to reaching The Dalles, notice the starkness and dryness of the semiarid shortgrass hills of the area. As you travel around a curve or two between The Dalles and present-day Stevenson, you will begin to see more green and greater lushness. In fact, you have just entered an area where the climate and the vegetation change dramatically. This is caused by the rain shadow of the Cascade Range, which keeps the moist rainy climate of the Pacific Coast



Camp Site on top of Rock Fort

confined to the western side of the mountains. The mountains and rock walls of the gorge set the climate pattern for this area.

A mountain Clark called "Timm or falls Mountain" was noted several times

in this area. Today this mountain is called Mt. Hood and is clearly visible from many areas as it stands 11,245 feet tall. Its cone-shaped rocky peak and its smooth, snow covered slopes lure climbers, hikers, snowboarders, and sightseers.

The Cascade Mountain Range is the most geologically young and active volcanic region in the United States. The volcanoes, principally forming in the last 1.6 million years and still growing, are a result of the collision of the North American Plate with a dense oceanic plate, called the San Juan (Farralon) Plate. Magma from this collision continues to rise to feed this chain of volcanoes.

Website: <http://www.cr.nps.gov/nr/travel/lewisandclark/roc.htm>

October 31 to November 2, 1805

Beacon Rock State Park, North Bonneville, Washington

There were days full of whitewater activity for the Corps, but here they portaged all of their goods around the cascades and lowered the canoes through on ropes. Again, the canoes came through without damage, to the amazement and relief of all.

As the group continued downstream on November 2, Clark made note of a particularly high rock, estimating that it was about 800 feet high and about 400 yards round. Now that is a big rock—even taller than the Seattle Space Needle! And, what better name for it than “Beacon Rock.” It is considered to be one of the world’s largest free-standing rock monoliths. Today you can see Beacon Rock dose up by hiking the 4,500 feet long trail of stairs with a 15% percent grade to the top.



Beacon Rock

From their camp here, the group could actually see the effects of Pacific Ocean tides as they watched the level of the Columbia River rise and fall. Sea otters, important to the northwest for trade, could be seen below the falls.



How do you suppose this rock got here? It is another core of an ancient volcano. The massive floods during the Ice Age eroded the softer, outer layer of the volcano, leaving only the dense “throat” of this once-active volcano. The view from the top is exceptional, especially looking upstream where today Aldrich Butte, Bonneville Dam, Hamilton, Ives, and Pierce Islands, Munra Point, and Wauneka Point are all visible.

If you ride by Beacon Rock or take a hike around or up it, use your geologist’s eye to observe the rocks and other land forms. Describe these in your journal.



Website: http://vulcan.wr.usgs.gov/LivingWith/Historical/LewisClark/volcanoes_lewis_clark_november_02_1805.html

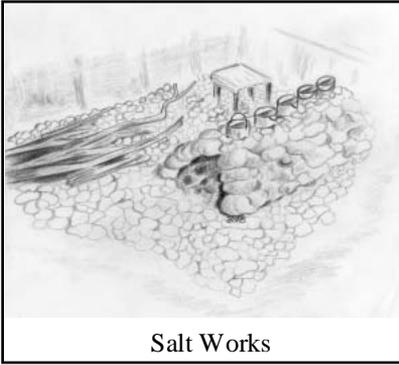
December 1805–March 1806, Salt Works, Seaside, Oregon

Have you ever heard the saying “a man should be worth his salt”? Do you know what it means? Why would Captains Lewis and Clark be interested in getting salt? What do you think salt actually is— is it a vegetable, fruit, rock, vitamin, or mineral? 

Some ancient Egyptians were paid for their labor with salt. Therefore, to be “worth your salt” meant you gave an honest day’s work for the pay you received. Our word SALARY comes from the word salt. Salt has been highly prized through the ages as a preservative and as a seasoning. Though Captain Lewis and most of the men considered salt a treat, Clark commented that he did not particularly like the taste of salt and would be satisfied without it. Actually, without it he would die, because salt is essential to life. The human body needs salt to maintain its blood, muscles, and cells.

The Expedition built their main winter headquarters at Fort Clatsop. Some of the men set up a smaller camp at Seaside to make the salt needed for their return journey. The minerals that make up salt are dissolved in the seawater. By boiling seawater to evaporate it, they would have crystals of salt. The salt obtained this way was “sea salt,” pure salt from sea water.

The table salt you use is a mixture of pure salt and calcium silicate (for added nutrients) and sometimes supplemented with iodine, a vital trace



Salt Works

mineral. Just think, you are eating “the salt of the earth” which is made up of minerals!

As a preservative because it draws moisture from food, salt kept meat and fish safe to eat. Overloading meat with salt, or “curing” it, prevented bacteria and mold from growing in the meat. Make a note in your journal of some ways that salt is used today.



Websites: <http://www.nps.gov/focl/salt.htm>
<http://www.cr.nps.gov/nr/twhp/wwwlps/lessons/108lewisclark/108lewisclark.htm>

January 7–8, 1806, Ecola State Park, Clarks Mountain and Point of View, Tillamook Head, Oregon

On January 6, 1806, Clark set out with a small party to visit the salt works and to see a whale that had beached along the coast. Sacagawea and her son, Jean Baptiste, or “Pompey,” were with the party. Jean Baptiste was born in February 1805: how old was he now?

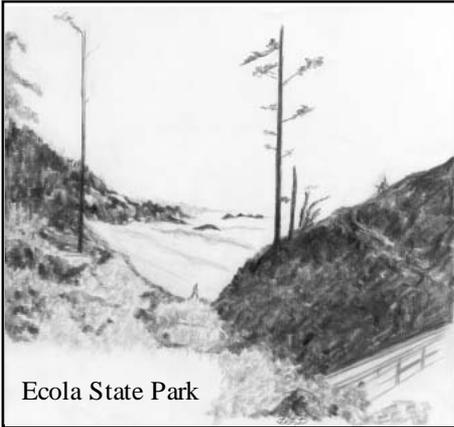


They arrived at the salt works camp on January 6 and began their travel to the whale site the next day. January 7 turned out to be a very special day for all the members of the expedition. It was the first day since moving into Ft. Clatsop that it had not rained!

Getting to the whale site was a long and difficult trip. For example, members of the party took two hours to climb up a perpendicular ledge, for 100 feet using bushes to pull themselves up, reaching the top only after scaling 1000 to 1200 feet. Clark noted in his journal that “... I looked down with astonishment to behold the height which we had ascended ...” How do you suppose Sacagawea and Jean Baptiste got up to the top of this ledge? Could



you have made it to the top?



When the party arrived at the top of “Clarks Mountain and Point of View,” today part of Ecola State Park, they had a panoramic view of the Pacific Ocean crashing onto the shore.

Clark noted how unstable the rocks were in this area, saying “their Slipping off or Splitting assunder at this time is no doubt Caused by the incessant rains.”

He is referring to the Cenozoic-

age (66 to 2 million years ago) sandstone and mudstone sedimentary rocks that make up the Astoria Formation in this region.

Websites: http://www.oregonstateparks.org/images/pdf/ecola_full.pdf
http://www.lewis-clark.org/FTCCOLUMBI A/fc_tilla.htm

End Note

On March 23, 1806, the Corps of Discovery started their long journey home. They arrived in St. Louis six months later on September 23, 1806.

The journey of discovery had taken two years, four months, and nine days and covered over 8,000 miles. The Expedition had identified 181 plants and 134 animals that were new to science, as well as noting “mineral productions of every kind.” But, more importantly, they had experienced the adventure of a lifetime and had written it all down in journals. Through their written words we continue to live the adventure and keep the spirit of the Lewis and Clark Expedition.

Did you catch that spirit as you rockhounded on the way to the Pacific? What adventures did you record in your journal? How many rocks and minerals and geologic features did you see and identify?

Contributors

Distinguished Recognition

The American Federation of Mineralogical Societies initiated this project in June 2001, under the leadership of President Isabella Burns. Izzie continued with the project while serving as Chair of the AFMS Long Range Planning Committee and then later as AFMS Lewis and Clark Volunteer. Her vision and willingness to promote the project ensured its success. Diane Dare of the Southeast Federation of Mineralogical Societies also earned distinguished recognition because of her tireless and thorough reviews of the manuscript.

AFMS wishes to express special thanks to John W. Jengo, P.G., CPG, for serving as the content reviewer for the document and for providing helpful ideas. His contribution was very important to the accuracy of this project, and the American Federation is grateful for his service. Special thanks also go to Brenda Scafidi whose pencil sketches add visual appeal to the text.

We are also indebted to the National Park Service, Lewis and Clark National Historic Trail, for permission to use their map of the Lewis and Clark Trail and to anchor our information to established sites along the Trail. We personally want to thank Midori Raymore from NPS for her assistance. Special thanks also go to the following individuals who contributed their support: B. Arlene Compher, Visual Information Specialist, Office of Communications, U.S. Geological Survey; Richard Fichtler, Lewis & Clark Bicentennial Coordinator, Bureau of Land Management, Montana/Dakotas; and Maria Thi Mai, State Interpretive Coordinator, Oregon Department of Parks and Recreation, Emigrant Springs Management Unit.



Jefferson Peace Medal

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Bull Elk

Lewis and Clark Word Puzzles Answers

Puzzle #1, page 8

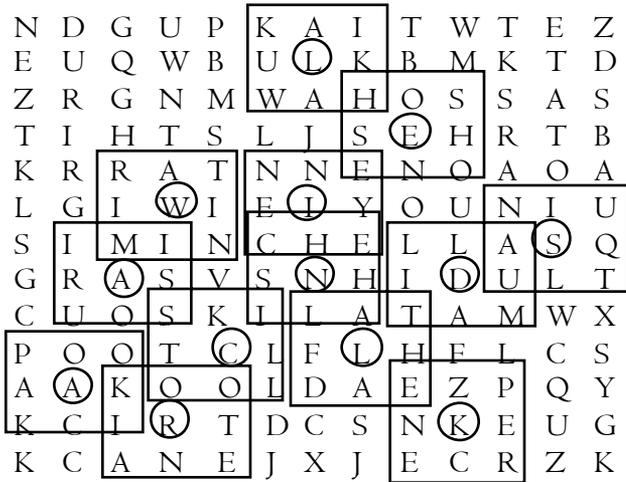
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E	T	I	R	O	U	L	F											G	A	L	E	N	A			
C	S		M	O	N	T	A	N	A		I		4										N			
L		O													D	1			F	S			N			
A			U	S		M									A	3			A				E			
R				T		O									H	3			S	I	R		B			
K				A	H	S		N		O					M				R	O			R			
				R	D	S		E	O						I				B	S			A			
M				G		A			N	R					L			A	B	U	E		S			
I				A		G	K		O	T					E			I	L	R		Q	K			
S				R		A		O		T	H				S			B	U	N		U	A			
S				N		T		T		S	D				M	E	A		A							
O	E			E					A		N	A			U	A	G		R							
U	D			T											U	K	L	G	A		T		E			
R	O																	S	O	A	T		Z	K		
I	E			P	E	T	R	I	F	I	E	D	W	O	O	D			C	T	E		A			
G	G	E	R	E	D	N	U	H	T										E	A			N			
W	A	S	H	I	N	G	T	O	N										E	R	I	H	P	P	A	S

Puzzle #2, page 15

				I	O	W	A							
				M	O	A	N	A						
				M	I	S	S	O	U	R	I			
				S	O	U	T	H	D	A	K	O	T	A
						I	D	A	H	O				
				K	A	N	S	A	S					
				O	R	E	G	O	N					
				N	O	R	T	H	D	A	K	O	T	A
				I	L	L	I	N	O	I	S			
						N	E	B	R	A	S	K	A	

Note: South or North Dakota are correct on either line

Puzzle #3, pages 21-22



Puzzle #4, pages 26-27

S D I O N I R C
 A U E T A G A A
 P T N G O L D N
 P E Y S K E O E
 H N L E T D O L
 I R L U A O W A
 R A U L N E N G K A N S A S
 E G T B S G A E
 S R E T S N O M
 H A G E R M A N
 E T I R O U L F
S S Z T R A U Q

Puzzle #5, page 34

South Dakota- Teton Sioux, Fairbum Agate
 Idaho- Nez Perce, Star Gamet
 Montana- Flathead Indians, Sapphire
 Washington- Chinook Indians, Blue Agate
 Oregon- Tillamook, Thunder Egg

Puzzle #6, page 40

1. THE MAJOR RIVERS TRAVERSED BY THE EXPEDITION WERE THE MISSOURI, SNAKE, AND COLUMBIA.
2. THE ONLY WOMAN THAT WAS A MEMBER OF THE LEWIS AND CLARK EXPEDITION WAS SACAGAWEA, A MEMBER OF THE SHOSHONE TRIBE. SHE WAS RECENTLY HONORED WITH THE ISSUE OF THE SACAGAWEA GOLDEN DOLLAR.
3. THE STATES CROSSED OR ENTERED BY THE EXPEDITION WERE MISSOURI, KANSAS, NEBRASKA, IOWA, SOUTH DAKOTA, NORTH DAKOTA, MONTANA, IDAHO, OREGON, AND WASHINGTON.

Puzzle #7, page 46

	I	L	L	I	N	O	I	S	
	O	R	E	G	O	N			
	W	A	S	H	I	N	G	T	O
K	A	N	S	A	S				
	M	I	S	S	O	U	R	I	
N	O	R	T	H	D	A	K	O	T
	N	E	B	R	A	S	K	A	
	S	O	U	T	H	D	A	K	O
	M	O	N	T	O	N	T	A	N

Note: South or North Dakota are correct on either line

List of Sources for Sketches

- cover—Lewis & Clark with AFMS logo, from 1997 Lewis and Clark Trail National Park Service brochure and American Federation of Mineralogical Societies
- page 5—Camp River DuBois, Wood River, IL, from <http://www.cr.nps.gov/nr/travel/lewisandclark/journey.htm>
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