

*Upper Missouri River Breaks National Monument
Interpretive Center*

Teacher's Guide

Junior High Activities

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Animal Olympics

Objectives:

The students will:

1. Compare and contrast differences between animals and themselves;
2. Define the concept of variation, a level or biological diversity;
3. Develop a classification system to group the animals (i.e. runners, swimmers, fliers, etc.).

Background:

Animals have certain characteristics that make them unique. By comparing ourselves to other species, we see how truly remarkable those species are. Even individuals within the same species have different physical abilities. For example, one frog may be able to jump higher than another one. One eagle may see further than another. These differences within a species are referred to as variation.

Materials Needed:

- Measuring tape
- Several stop watches (or second hands on a watch)
- Blindfolds for students to use with one of the activities
- Animal Olympics Activity page

Instructions:

1. In a large open area, divide the students in groups of four or as many groups as you have chaperones. Have an adult serve as leader at each station.
2. Inform the students that they will be competing in the Animal Olympics and distribute one activity sheet to each student. Have them make measurements for each student and each activity.
3. Following the Olympics, reassemble as a large group and discuss various differences between humans and animals and among animals of the same species.
4. Pick two animals from the Activity Page and have the students describe one likeness and one difference between the two animals. Similarities and differences should be based on food gathering, movement, birth of young, coloration and camouflage, or bright colors.

Animal Olympics Activity Page

Name _____

Date _____

1. A beaver can hold its breath for up to 15 minutes (900 seconds). I can hold my breath for _____ seconds.
2. A bald eagle may have a wingspan of 7 to 8 feet. I have a wingspan of _____ feet and _____ inches (how far can you stretch your arms?)
3. A mountain lion can jump 20 feet in one leap. I can jump _____ feet in one leap.
4. A sleeping heron can stand on one leg for more than an hour. Blindfolded, I can stand on one leg for _____ seconds or _____ minutes.
5. A snake can crawl along a branch without falling off. I can walk a straight line for _____ feet.
6. A pronghorn antelope can run 70 miles per hour for a short distance (or about 6,160 feet in 60 seconds). I can run _____ feet (or _____ inches) in 60 seconds.
7. Frogs can leap 120 times consecutively without stopping. I can leap _____ times without stopping.
8. Owls have the ability to stare without blinking for hours. I can stare down my partner without blinking for _____ seconds.

Birds of the Breaks

A variety of bird species consider the Missouri River Breaks area home. Songbirds, such as robins, woodpeckers, and yellow warblers, and shorebirds and waterfowl, including great blue herons, American white pelicans, and mallard ducks, can be seen. Different birds require different types of habitats, and you will encounter different habitats on your journey.

Materials Needed:

- Bird Identification Book
- Bird Call Device
- Binoculars
- Notebook/Journal
- Pens/Pencils
- Audubon Bird List of Montana
- Digital Camera (optional)

Instructions:

Divide into teams of 4 to 5, depending upon the number in your group. Each person will have a task. One person is the keeper of the Bird Identification Book; another will be in charge of the Bird Call device; someone else will be the Bird Spotter with the binoculars, and another person needs to be the Reporter/Writer. If you have a fifth person who likes to draw, have that person be the Illustrator.

While lunching, hiking, and camping, keep a log of the type and number of different birds you encounter. Use the various tools provided, such as the Bird Identification Book and Bird Call Device, to help identify the birdlife observed and heard. Listen and look for birds during all times of the day, even at night. Owls and nighthawks, for example, are more active during the evening and night. In camp, gather as a small group and go through the Audubon List and write down the birds you and your group identified. Then, before going to bed each night during your trip, compare your list of birds seen and heard with lists of the other small groups.

Which group has seen and heard the most number of birds that particular day? Did any one group discover a type of bird that the other groups did not see or hear? Were there any that someone could not identify? If so, have the different smaller groups see if they can identify that particular species.

At the end of your river journey, choose someone to log the total number of birds encountered and heard during your river trip as well as the number of different species.

Chart Your Course on the River!

As you travel the Upper Missouri River in your canoe during the next few days, keep track of times that different events occur. Keep a log as to how long it takes you to travel on Day One and on Day Two and how many miles you traveled on those days. Then, create a graph of the distance and time you travel on each day as outlined below.

X-Axis:
Distance
Traveled
(in Miles)



Y-Axis: Time It Took to Travel (use 30-minute increments)

What events occurred that may have helped your canoe gain speed? What events occurred that made you lose speed? What other factors might take place that cause a canoe to either gain or lose speeds, and therefore, gain or lose distance? Compare and contrast your days of travel – what took place each day to either increase or decrease the distance you covered that particular day? Graph your progress as a line graph ($x = \text{miles}$, $y = \text{time}$) and as a bar graph.

EXTENSION:

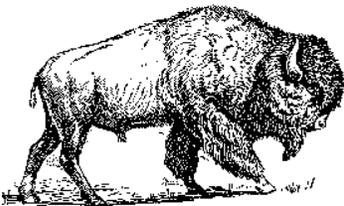
Lewis and Clark journeyed this same river more than 200 years ago. Do you think they encountered similar circumstances navigating the Missouri? Why or why not? What might have been different in 1805 traveling the Upper Missouri River compared with today?

Activity based on "Mississippi Math: Chart Your Course", Iowa Public Television, 2000.

Fill in the Blank: Animals of the Missouri River Breaks

Many wonderful wildlife species live on the Missouri River Breaks landscape. From river bottoms to grasslands, from canyons to streams, you can find many different special creatures. Discover some of the great animals that call this area home by filling in the blanks in the statements below. Choose from the list of words at the bottom of this page. HINT: You won't use all the words at the bottom of the page.

1. Grasslands are important places for burrowing _____ which often make their nests in prairie dog burrows.
2. There were once about 50 million _____ roaming the Great Plains of America; they were an important food source for Native Americans.
3. An animal of great speed, the _____ can reach speeds of 60 mph, making it the fastest land mammal in North America.
4. The black-footed _____ feeds primarily on prairie _____. Conservation partners are working together to help these animals survive.
5. The _____ snake can often be found soaking up the sun's rays on rocks – be mindful while walking: listen and look and they will sometimes tell you that you are too close!
6. Winging their way from flower to flower, _____ have an important job on the prairie - - pollinating blooms while splashing the landscape with color!
7. The secretive _____ sheep can sometimes be seen along the Missouri River in the Breaks area.
8. White _____ use their large pouch on their bill to scoop up fish from the river; they can often be seen either soaring above or swimming in the Missouri River.
9. Both mule and white-tail _____ call the Missouri Breaks area their home.
10. Male sage _____ fan their tails and thrust out their chests as they strut near females during mating season.



Possible answers:

coyote, owls, garter, mouse, moose, bison, eagle, butterflies, chicken, rattle, pelicans, eagles, bighorn, deer, dragonfly, trout, grouse, ferret, elk, beaver, pronghorn, hawks, dogs.

Habitat Diversity in the Breaks

Objective:

Students will identify the four primary ecosystems found in the Missouri River Breaks region and learn about the diverse plants and animals found in those habitats. Students will also understand that many animals use different ecosystems at different times.

Materials Needed:

- “Exploring Habitats” Student Activity Sheet
- Writing Materials, including a notebook or journal and pens or pencils
- Binoculars
- Camera

Procedure:

1. Define and discuss the term “ecosystem”.
2. Explain to students that the Missouri River Breaks area is composed of 4 diverse ecosystems: river/riparian areas; plains desert areas; rocky outcroppings areas; and forested areas.
3. Discuss what plants might likely grow in each of these areas and why.
4. Discuss what animals might be found and why.
5. Divide group into pairs and assign a habitat area to each pair.
6. Ask students to go to their respective habitat area and observe the plants, animals, soil, and climate.
7. Have students record their observations in their notebook/journal and fill out their “Exploring Habitats” Student Worksheet.
8. Students may also want to use binoculars to scan their area, particularly for wildlife, such as raptors, songbirds, and big game, as these animals may be secretive and not able to be seen with the naked eye.
9. Students may also want to take photos of their respective habitat and any plants and animals they observe.
10. Students can also sketch what they observe.
11. Remind students that observation is not only done with the eye, but also by listening, smelling and touching.
12. After 30 minutes of observation, have the students reconvene and discuss what they observed and learned from their experience.

Activity based on “Exploring Ecosystems”, Boundary Waters Canoe Area, National Park Service.

Exploring Habitats in the Missouri River Breaks

Student Activity Sheet

1. Your habitat is called what? _____
2. What does your habitat area look like? What does it sound like? What does it feel like? List words that you think best describe your habitat area.

3. There is a lot of life found in your habitat area. List plants and animals that you see and hear in your assigned habitat.

Plants:

Animals:

4. What other habitats in the Missouri Breaks do you think the animals in your habitat might use and why? For example, a mule deer will use both forested areas and open plains to seek shelter and find food and also go to the river for a drink of water.

5. What did you learn today about habitats in the Missouri River Breaks?



Nature Journal

Being outdoors and watching wildlife and other things in nature can be enjoyable. Many people, past and present, have spent time in nature and found this time to be relaxing and inspirational. Writers such as Henry David Thoreau and Aldo Leopold observed the plants, animals, and seasons of the year to learn more about the natural wonders around us each day.

Aldo Leopold is considered by many to be one of the greatest conservationists of all time. What is a conservationist? _____

Mr. Leopold was born in Iowa in 1887. He was interested in the natural world as a child, and he spent many hours observing, journaling and sketching the area where he lived. He was one of the first employees of the U.S. Forest Service, which began in 1905. After many years of living in other states, Mr. Leopold moved back to the Midwestern United States, buying an old farm in Wisconsin and restoring the prairies and planting thousands of pine trees on the farm. He is most known for a book titled *A Sand County Almanac*, one of the most respected books about the environment that's ever been written. Mr. Leopold died in 1948, but his work is still remembered and his importance to conservation still carried on through the Aldo Leopold Foundation (see <http://www.aldoleopold.org>).

Another early American conservationist was **Henry David Thoreau**. He was born in 1817 and lived through the early years of the Civil War when black people were slaves on large farms in southern America. Mr. Thoreau is best known for his book *Walden* (or "Walden's Pond"), a place where he enjoyed living close to nature. To learn more about Thoreau, visit <http://plato.stanford.edu/entries/thoreau/>

Like Leopold and Thoreau, you, too, may find nature to be a wonderful place and simply enjoy spending time observing areas around you. These next few pages can help guide you into learning more about the natural wonders in your area. Like Thoreau and Leopold, you, too, may find inspiration in the natural world!

Using all of your senses (hearing, sight, smell and touch) spend time in nature – at a park, in a forest, near a stream or river. Use the following pages to write down ("record") what you see, smell, hear and touch (these are your observations). Do these observations at different times of the day and different weather conditions. What animals do you see? What types of animals might have been at this location before you arrived? (do you see scat, feathers, tracks of any kind?) Are birds singing or bees buzzing around? Can you smell flowers in bloom or the fragrance of freshly-fallen rain? Use these questions to guide you as you record your nature observations using the Nature Journal on the next few pages (you can make more copies of these pages if you like). Perhaps you'll want to write a story or draw a picture about what is happening or might have happened. These are your pages – express yourself! And enjoy yourself!

Conservation is a state of harmony between men and land. Aldo Leopold

There can be no greater issue than that of conservation in this country. Teddy Roosevelt

The old Lakota was wise. He knew that man's heart away from nature becomes hard; he knew that lack of respect for growing, living things soon led to lack of respect for humans too. So he kept his children close to nature's softening influence. Chief Luther Standing Bear



My Nature Journal

I love to be alone. I never found the companion that was so companionable as solitude. Henry David Thoreau

Today's date is: _____ The time is _____

What's the weather like? _____

Where are you? Describe the location. _____

What do you see? _____

What do you smell? _____

What do you hear? _____

What can you touch? How does it feel? _____

What else is special about what and where you're observing? (for example, if there are people with you or near you, what are they doing? Describe other things you can see, smell, hear and touch).

Draw some of the things you've observed (leaves, trees, animals, people).

Now, using the template on page 16 or your own notebook, take a few minutes to write a short story about your nature observations. Your story can be fiction or non-fiction.



My Nature Journal

In every walk with nature one receives far more than he seeks.
John Muir

Today's date is: _____ The time is _____

What's the weather like? _____

Where are you? Describe the location. _____

What do you see? _____

What do you smell? _____

What do you hear? _____

What can you touch? How does it feel? _____

What else is special about what and where you're observing? (for example, if there are people with you or near you, what are they doing? Describe other things you can see, smell, hear and touch).

Draw some of the things you've observed (leaves, trees, animals, people).

Now, using the template on page 16 or your own notebook, take a few minutes to write a short story about your nature observations. Your story can be fiction or non-fiction.



My Nature Journal Stories and Drawings

Adopt the pace of nature: her secret is patience. Ralph Waldo Emerson

Let's Go on an Owl Prowl!

Background:

Various owl species call this area home, from the small burrowing owl to the large great-horned owl. Some live here year-round while others for only a short time during certain seasons. Each owl is uniquely equipped to live and survive in its habitat.

Below is a listing of owls that can be found in our area. As you traverse the area in your canoe, watch and listen for these important birds (not all owls are night owls!).

Burrowing Owls summer in open grasslands and lives in abandoned burrows of small mammals, such as ground squirrels and prairie dogs. These small owls (often no more than 10 inches long with a weight of about 5 ounces) are known for their long legs, oval face and bright yellow eyes. These owls feed on insects, reptiles and small birds. Burrowing owls are considered a species of concern, which means they are at-risk due to declining populations and/or habitat loss.

Eastern Screech Owls may occasionally be found in our area. They primarily use cottonwood trees near river bottoms. They are year-round residents of eastern Montana and feature a white-gray face, ear tufts, and yellow eyes. These owls feed primarily on small mammals and sometimes small birds.

Northern Pygmy Owls may also be seen occasionally in our area. These tiny owls weigh only 2 or 3 ounces and stand 6 to 7 inches tall. With round heads and yellow eyes, these owls also have white eyebrows with feathers that can be raised like tufts when they are startled or alarmed. Their heads also look like they have small white dots on them. Northern Pygmy Owls live in both wooded and river bottom habitats. Small birds, small mammals, insects and even the occasional reptile or amphibian make up this owl's diet.

The Northern Saw-whet Owl is another small owl at times observed in the area. This round, reddish-brown faced owl is most often found in forested areas, however, they also use cottonwood river and creek bottoms. These owls weigh only 3 to 4 ounces and stand 7 to 8 inches tall. This is a migratory species in the eastern part of Montana but can be found year-round in the western part of the state. They feed mostly on mice but will also eat small birds and insects.

The **Great-horned Owl** is the most well-known owl species in the state; it lives in Montana year-round. A large owl, it can weigh 3 to 4 pounds and be nearly 2 feet long. This owl features large, tufted ears, yellow eyes and a black bill with dark-brown, horizontal bars on its chest feathers. Great-horned owls live in a variety of habitats, from river bottoms to timberline areas. These owls feed on small to medium-sized mammals and birds, including rabbits and the occasional goose.

Similar in appearance to the Great-horned Owl, the **Long-eared Owl** is also a year-round resident of Montana. This owl features a rounder head than the Great-horned, similar to that of a Barn Owl. It is also smaller than the Great-horned, weighing not even one pound and standing 1 to 1.5 feet tall. These owls enjoy living in juniper thickets, hedgerows, and woody draws; they often hunt in open areas feeding on small rodents but hunt at night so are not often seen.

Short-eared Owls are found throughout Montana. These owls differ from their long-eared cousins not only in the size of the ears, but in the fact they hunt during the daytime hours as well as at night. They feature long wings and round faces, feathered legs and feet, yellow eyes, and a black bill. They average 15 to 16 inches long and weigh ½ to 1 pound (females are generally larger in weight than males). These

are the most silent of the owls found in our area, often only vocalizing during courtship. These owls live in open grasslands, plains and agricultural areas, feeding mostly on voles and mice.

The **Northern Hawk Owl** more closely resembles a hawk than an owl. Like a hawk, this owl glides low over the ground and can attain high flight speeds and features short, pointed wings and a long tail. Unlike most owls, this species hunts during the day. These creatures travel through most parts of Montana during the winter months, and may stay for weeks or months depending upon weather conditions. These owls are generally found in forested areas which once saw fires; they use tall trees and dead snags for hunting and perch sites. Small mammals and small birds make up this owl's diet.

Instructions:

1. As you take your hikes in the area, look for owl pellets (droppings). Using small dissecting tools, pick the pellets apart – can you tell what the owl has been eating? Look for small bones in the droppings. Based on the information provided about the different owl species in our area, what type of owl do you think might have left these pellets?
2. Watch and listen for owls during the day as well as at night. Each species has a different type of hoot. Can you return the owl's hoot that you hear? Does it answer back?
3. As a group, discuss the importance of the different species of owls in the habitats in which they are found. How do the different species help their habitat? How do owls help humankind?
4. As the students gather around the campfire one evening, ask how many have seen the movie "Legend of the Guardians"? How many have read books that feature an owl in the story? Create an owl tale around the campfire one evening. Someone chooses the species of owl then going in a circle, each person adds to the story.
5. If you could be an owl, which species would you like to be and why?

Activities adapted from an educator, kids' and parents' guide from the National Wildlife Federation:
[http://www.nwf.org/About/NWF-at-the-Movies/~media/PDFs/About/NWF-Movies/LOTG_KidsGuide.ashx](http://www.nwf.org/About/NWF-at-the-Movies/~/media/PDFs/About/NWF-Movies/LOTG_KidsGuide.ashx)

Owl information provided by an online Montana Field Guide:
<http://fieldguide.mt.gov/displaySpecies.aspx?family=Strigidae>

Create a Rock Legend

Background:

The geology of the area is filled with stories, from geological time and fossils to Native American legends and lifeways. The Blackfeet and other tribes traveled through this area following the large bison herds through the mid-1800s. In fact, a Blackfeet legend surrounds what is known as *Iniskim*, or the sacred buffalo stone. It is usually a fossilized shell that was found on the prairie. Some of the stones look a lot like animals. In the old days, these stones were used in a ritual for calling buffalo. The stones were said to have called attention to themselves by making a faint chirp much like a bird would make, thereby creating its own “song”.

Some Native American tribes communicated by painting pictures on rocks (these are called pictographs) or by carving designs on rocks (these are called petroglyphs); some of these drawings and carvings can still be seen today. For example, in New Mexico, there is a national monument called Petroglyph National Monument, where a person can view the many works of rock art created by Native Americans thousands of years ago (to learn more visit



<http://www.nps.gov/petr/historyculture/what.htm>) An ancient tribe called the Anasazi used petroglyphs and pictographs; learn more by visiting this website: <http://www.blm.gov/co/st/en/fo/ahc.html>

Materials Needed:

Time to hike (sturdy shoes and lots of water needed!)

Rocks discovered on the hike

The First Buffalo Stone” legend (found on the following pages)

Notebook

Pens/Pencils

Colored Markers

Objective:

Students will understand more about Native American lifeways and legends and will write their own legend based upon the geology and wildlife of the area.

Instructions:

Take a geology hike in the area and note the various types of rocks. Look for Igneous, sedimentary and metamorphic rocks. Have students identify all three types. Ask students to collect a special rock and tell them they will be using this rock in an activity when they return to camp.

Upon returning to camp, read the legend found on the following pages. Have students write their own rock legend and have them include an animal native to the area in their story. Then, ask them to a pictoglyph depicting the legend using the markers and the rock they collected. Have students share their story with campmates.

NOTE: Rock-Hard Facts about Rocks: Three types of rocks are found on Earth: igneous, sedimentary, and metamorphic. Igneous rocks are the most common and oldest; sedimentary are layered pieces of the earth, pressed together to form solid rock – sedimentary rocks often contain fossils; and metamorphic rocks form deep in the Earth and are created when one type of rock changes into another.

Activity based on “Creating Your Own Rock Legend” from Great Basin National Park, National Park Service.

“The First Buffalo Stone”– Blackfeet Legend

Long ago, in the wintertime, the buffalo suddenly disappeared. The snow was so deep that the people could not move in search of them, for in those days they had no horses. So the hunters killed deer, elk, and other small game along the river bottoms, and when these were all killed off or driven away, the people began to starve.

One day, a young married man killed a jackrabbit. He was so hungry that he ran home as fast as he could, and told one of his wives to hurry and get some water to cook it. While the young woman was going along the path to the river, she heard a beautiful song. It sounded close by, but she looked all around and could see no one. The song seemed to come from a cottonwood tree near the path. Looking closely at this tree she saw a queer rock jammed in a fork, where the tree was split, and with it a few hairs from a buffalo, which had rubbed there. The woman was frightened and dared not pass the tree. Pretty soon the singing stopped, and the I-nis'-kim [buffalo rock] spoke to the woman and said: "Take me to your lodge, and when it is dark, call in the people and teach them the song you have just heard. Pray, too, that you may not starve, and that the buffalo may come back. Do this, and when day comes, your hearts will be glad."

The woman went on and got some water, and when she came back, took the rock and gave it to her husband, telling him about the song and what the rock had said. As soon as it was dark, the man called the chiefs and old men to his lodge, and his wife taught them this song. They prayed, too, as the rock had said should be done. Before long, they heard a noise far off. It was the tramp of a great herd of buffalo coming. Then they knew that the rock was very powerful, and, ever since that, the people have taken care of it and prayed to it.

From the First Peoples website:

<http://www.firstpeople.us/FP-HTML-Legends/TheBuffaloRock-Blackfoot.html>

Settler Sense (Cents)!

Background:

During the early 1900s, settlers came to the Missouri Breaks region. The Homestead Act of 1862 gave Americans title to 160 acres of undeveloped land west of the Mississippi River. The law required homesteaders to file an application, improve the land, and file for deed of title. Much of the prime land near or along waterways became settled. Congress enacted another homesteading law in 1909 called the Enlarged Homestead Act. This law targeted land suitable for **dryland farming** and increased the number of acres to 320. In 1916, the **Stock-Raising Homestead Act** targeted settlers seeking 640 acres of **public land** for **ranching** purposes.

The farmer was dependent on nature. The unpredictable weather of the Great Plains, and specifically of the Missouri River Breaks area, tested the tenacity of many people trying to earn a living on the landscape. Climate, lack of water, and poor soil plagued homesteaders, and within a few years, the majority of the landscape belonged to large ranchers who didn't depend upon crops to make a living. Several historic structures still stand within the Missouri Breaks National Monument, testifying to the homesteading history of the region.

Objectives:

To help students better understand the challenges of homesteading the region during the early 1900s.
To increase student's math and critical thinking skills.

Note: Students may use the resource listings on the pages that follow to help answer the questions and participate in group discussions.

Activity 1: Decision-Making

With a partner, imagine that you are a homesteader in the early 1900s. You and your spouse have just arrived on your homestead claim which is located on flat, treeless prairie, 20 miles from the nearest town and three miles from a creek. You have a team of horses, a wagon, a few household furnishings, some food staples, and \$100. What will you do? How will you use your money? How will you use your time and how would you set up your homestead? With your teammate, plan your first few weeks, months, even first year as homesteaders. Discuss and then share with your campmates the decisions you made and why you made those particular decisions and plans.

Activity 2: A Family Homestead

There are six people in your family. Figure out what provisions you have to purchase at the store. Your budget allows \$.30 per person per week. It is 20 miles to the store, and you go only four times a year. You and your family raise and sell wheat, from which you can make bread yourselves and have a small income. As a class, discuss the following questions to help plan your homestead provisions:

1. Decide what time of year it is. [Why is that important to your shopping?]
2. What is the maximum amount of money you will have available to spend?
3. What supplies do you have available now?
4. What provisions do you raise or do you expect to get through hunting, gathering, or barter?

5. How many meals will be eaten by the six people in the time between trips to town?
6. How many non-food supplies will you need? What will they cost? How much money will you have left for food?
7. Using the Food and Provisions List on the page that follows, plan what you are going to buy on this trip to the store.

Extension: Today's Cost

How much the items you selected for purchase would cost today? Estimate then discuss with your campmates.

Activity 3: Buying Food and Supplies

Use the Food and Provision List on the following page to help answer these questions:

1. It is 1877 and your mother sends you to the general store. How much would you pay for a gallon of milk, a pound of salt, three pounds of beans, ten pounds of apples, and a box of matches?

2. How many eggs could you buy for \$1.00 in 1877? _____
3. The homesteaders' primary sweetener was molasses. White (refined) sugar was rarely purchased because of the price. You have \$5.00 to buy supplies, including molasses. How many pounds of molasses would you buy if you also had to purchase coffee, flour, bacon and potatoes?

How much of each of those supplies would you buy to help feed your family?

4. In addition to food, you need to other supplies, including soap, shoes or boots and pants for your family of four. You buy 3 chunks of soap and have \$12 left. How will you supply yourself and your family with clothing? How much of each do you buy and can you think of other ways to save money than buying clothes? What would you do? _____

FOOD AND PROVISION COSTS in 1877

Bacon \$.10 per lb.	Apples .05 per 10 lbs.
Beans .06 per lb.	Crackers .30 per lb.
Butter .10 per lb.	Herring .10 per strip
Cheese .25 per lb.	Rice .05 per lb.
Coffee, green berries .40-.60 per lb.	Salt .05 per lb.
Eggs .06 per doz.	Sugar, refined .50 per lb.
*Flour, white 7.00 per 100 lbs. 2.80 per 48 lbs.	
Ham .10 per lb.	Milk .10 per gal.
Molasses .40 per gal.	Potatoes .25 per bushel
Sugar, heavy brown .18 per lb.	
*Price was dependent upon distance from mill	
Boots, fine \$ 6.00	Coal Oil \$.35 per gallon
Mittens, sheepskin 1.00	Matches .05 per box
Pants 1.50	Soap, large chunk .25 each
Shoes 2.00	Shoe nails .10 per dozen

On the Stream Team!

Objectives:

Students will learn that the type of insects which live in water reflect the quality of the water. They will identify common aquatic insects which indicate water quality conditions of the Upper Missouri River and understand the tax grouping as it relates to water quality and understand the need for scientific protocol in water sampling.

Materials Needed:

- *Stream Insects & Crustaceans Chart* (one copy per student or team) – chart provided on last page (laminates the bug cards for use near water)
Stream Insects & Crustaceans Chart (cut out individual bugs from four copies)
- Scissors
Rulers
Plain paper
Pencils
Large box or container
- White ice cube trays for each group of students to have one.
- A kick net seine for each group. Kick nets can be made by stapling a 3'x3' section of fine nylon screen wire to two dowel rods 1 ¼" diameter by 4 ½' long.
Tweezer (per student)
Magnifying glasses

Procedure: (Note: This activity can be done with students working individually or in teams.)

1. Thoroughly mix critter cutouts in a large box or container.
2. Have each team draw out 10 critters and determine the general water quality using a copy of the Stream Insects & Crustaceans Chart with a rating of good, fair or poor.
3. To determine water quality, students will assign a value to each critter based on taxa group number. Group One taxa critters = 1, Group Two = 2, and Group Three = 3. The lowest sum equals better water quality.
4. Tell students to draw a timeline to represent three samplings.
5. Record the water quality sum on the timeline for each sampling (determined by three separate drawings).
6. Note: Be sure all critters are returned to box for each sampling. On the third sample, take out all Group One Taxa without students' knowledge to show poor water quality.
7. Determine the trend in water quality from the time line.
8. Have students discuss what factors in the watershed are responsible for trend changes.
9. Have groups share their findings.

Procedure for Stream Activity in the Field:

1. Locate a suitable site with a riffle. Be sure to keep safety in mind and don't choose a riffle more than knee deep to your smallest students.
2. Collect three net sets of invertebrates from three different microhabitats. This ensures a complete picture of what lives in your stream and more accurately reflects stream health.
3. If possible, take all three net sets from different areas within a stable riffle.
4. Microhabitats to sample include differences in: rock size, flow, leaf packs, and emergent vegetation.

5. Always work in an upstream direction so that sampling activities do not disturb portions of the riffle to be sampled later.
6. If, and only if, you do not have a riffle at your site, or the riffle is too small to get three net sets out of it, you may also want to sample root mats and/or woody debris.
 - o Prioritize sampling of macrohabitats as follows:
 - Riffles
 - Root mats
 - Snags
 - Non-Flow
 - o Whatever you decide to sample at your site (e.g.: two riffle net sets and one root mat), always sample those same three microhabitats at the site every time you sample there. This will ensure that the data you collect remains consistent over time.

Sampling Streams With Riffles

Sampling requires at least two people; one to hold the net and the other to dislodge invertebrates from the substrate or two students on the net and two rubbing rocks and (stream dancing) works even better. The rest of the team will pick bugs from the net and sort into the ice trays

1. **Place** the net in the riffle facing upstream and tilted enough to provide a “pocket.”
2. **Ensure the bottom of the net** is on the stream bottom leaving no room between the net and substrate (prevents organisms from washing under net).
3. **Rub all large stones** in the 3’x3’ area immediately upstream of the net to dislodge invertebrates and wash them into the net.
4. **Dance and kick** with your feet in the 3’ x 3’ area until you have disturbed all of the substrate 3-6“ deep to dislodge the invertebrates into the net.

Streams Without Riffles (or without riffles not large enough for 3 net sets)

Sample collection from Root Mats – Adequate sampling requires two people.

1. Have one student place the kick net against the bank on the downstream side of the root mat.
2. Make sure that the net is anchored at the bottom.
3. The other student will then kick the root mat in a swirling motion with one foot to create a circular current in order to dislodge the invertebrates from the root mat. The circular motion of the sampler’s foot will drive the invertebrates into the net, **even if there is not a current.**

Sample Collection from Snags – Adequate sampling requires two people.

1. Have one student hold the net in a horizontal position 6-12” under the water.
2. The 2nd student will remove the snag from the water. When removing snags from the water, pull the snag out of the water quickly. If the snag is removed too slowly the invertebrates may swim off.
3. Brush the snag down with a brush above the net to dislodge invertebrates.

Sample non-flow area in the same manner as a riffle, collecting three separate samples. However, the samplers will need to use a swirling motion with the foot to create a current to move debris into the net. Although this habitat can be sampled using a kick net, it is easier with a D-frame net. Scoop the net forward after disturbing the substrate and take the net to the bank and begin picking the bugs from the net and sort them into the ice cube trays. After each method, identify the invertebrates and determine if they are sensitive, somewhat sensitive or tolerant. Based on the absence or presence of the sensitive

organisms you can get a general idea of the long term quality of the stream. Any bugs not identified can be taken back to class and researched for identification.

Evaluation Strategies:

- Have students infer where they would find the different pollution tolerant and intolerant insects.
- Have students make a list of watershed land use practices that would increase or decrease intolerant aquatic macroinvertebrates.

Extension Activities:

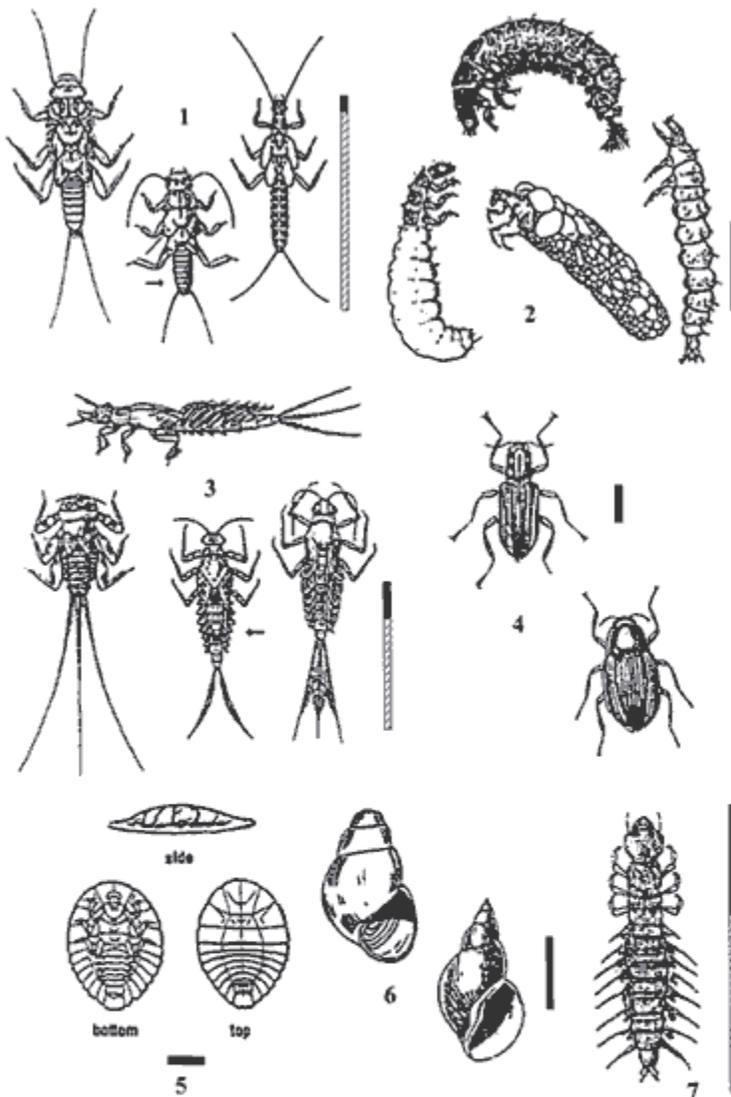
- Have students write a summary of the field trip and make their own inferences as to the quality of the stream monitored.
- If you have small clear vials and alcohol available, the students can start a reference collection by preserving specimens.
- Keep record of the data collected from year to year.
- Create a Volunteer Water Quality Monitoring Program – adopt a local stream, begin monitoring, and report findings to county commissioners and Montana DEQ.

Activity Source: http://www.mostreamteam.org/activity_guide/water_quality/captured_critters.htm

Stream Insects & Crustaceans

GROUP ONE TAXA

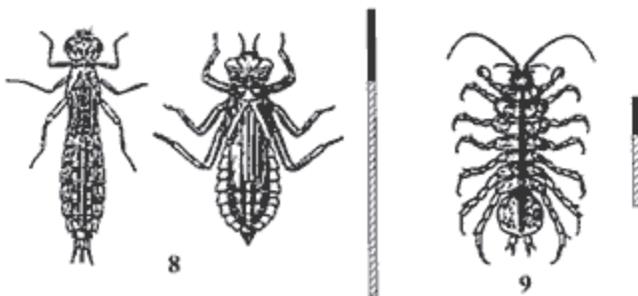
Pollution sensitive organisms found in good quality water.



- 1 Stonefly nymph: Order Plecoptera. 1/8" - 1 1/2"; 6 legs with hooked tips; 2 hairlike tails. Smooth (no gills) on abdomen (see arrow). May have gills on thorax under the legs.
- 2 Caddisfly larva: Order Trichoptera. Up to 1"; 6 legs on thorax; 2 hooks at end of abdomen. May be in a stick, rock, or leaf case with its head sticking out. May have fluffy gill tufts on lower half.
- 3 Mayfly nymph: Order Ephemeroptera. 1/4" - 1"; brown, moving, platelike, or feathery gills on abdomen (see arrow); 6 large hooked legs; antennae: 2 or 3 long, hairlike tails. Tails may be webbed together.
- 4 Riffle Beetle: Order Coleoptera. Adult: Tiny, 6 legged beetle; crawls slowly on the bottom. Larva: Entire length of body covered with hard plates; 6 legs on thorax; uniform brown color. Combine number of adults & larva when reporting total counts.
- 5 Water Penny larva: Order Coleoptera. 1/4"; flat saucer-shaped body, like a penny; segmented with 6 tiny legs underneath. Immature beetle.
- 6 Gilled Snail: Class Gastropoda. Shell opening covered by thin plate called operculum. When pointed up and opening facing you, the shell opens to right. Do not count empty shells.
- 7 Dobsonfly larva (hellgrammite): Family Corydalidae. 3/4" - 4"; dark-colored; 6 legs, large pinching jaws; eight pairs feelers on lower half of body with paired cottonlike gill tufts along underside of lateral filaments; short antennae; 2 tails and 2 pairs of hooks at back end.

GROUP TWO TAXA

Somewhat pollution tolerant organisms can be in good or fair quality water.



- 8 Dragonfly nymph: Suborder Anisoptera. 1/2" - 2"; large eyes, 6 hooked legs. Wide oval to round abdomen, masklike lower lip.
- 9 Sowbug: Order Isopoda. 1/4" - 3/4"; gray oblong body wider than it is high, more than 6 legs, long antennae, looks like a 'roly poly.'

Save Our Streams

*May be larger.

-Solid bar indicates approx. minimum size. Combined solid and striped bar is approx. maximum size.-



The Sounds of Solitude – Listening to Nature

Nature can be very noisy, but in a different way than the sounds of people and human activity, particularly in urban settings. Birds and other animals use their calls to communicate with one another. Ever hear a squirrel chattering? It's probably scolding you, telling you to get away from its territory. Some animals cry out a warning when danger approaches; for example, prairie dogs warn one another when a hawk flies overhead or a coyote or human approaches. Even though you may mean them no harm, they will presume you are a danger to them because you are bigger than they are.

You can have an interesting experience by just listening to nature. While in camp, sit quietly for 5 or 10 minutes, close your eyes and listen to the sounds of nature. Do this once in the morning and once in the evening. Do you hear the same sounds or do you hear different ones? Listen not only for birds and other animals, but also listen to the wind and the river. Are tree leaves rustling in the breeze? Do you hear frogs croaking nearby? Maybe the buzz of insects? Write down what you hear. Can you identify what makes each sound. List as many as you can. Did you hear a sound you could not identify? How might you learn what those sounds are? Compare notes with your campmates.

The Sounds of Solitude

Write down what you hear, where you hear the sounds, and the time of day that you heard them. What type of creature or object may be making the sound? Can you also see it as well as hear it?

Morning

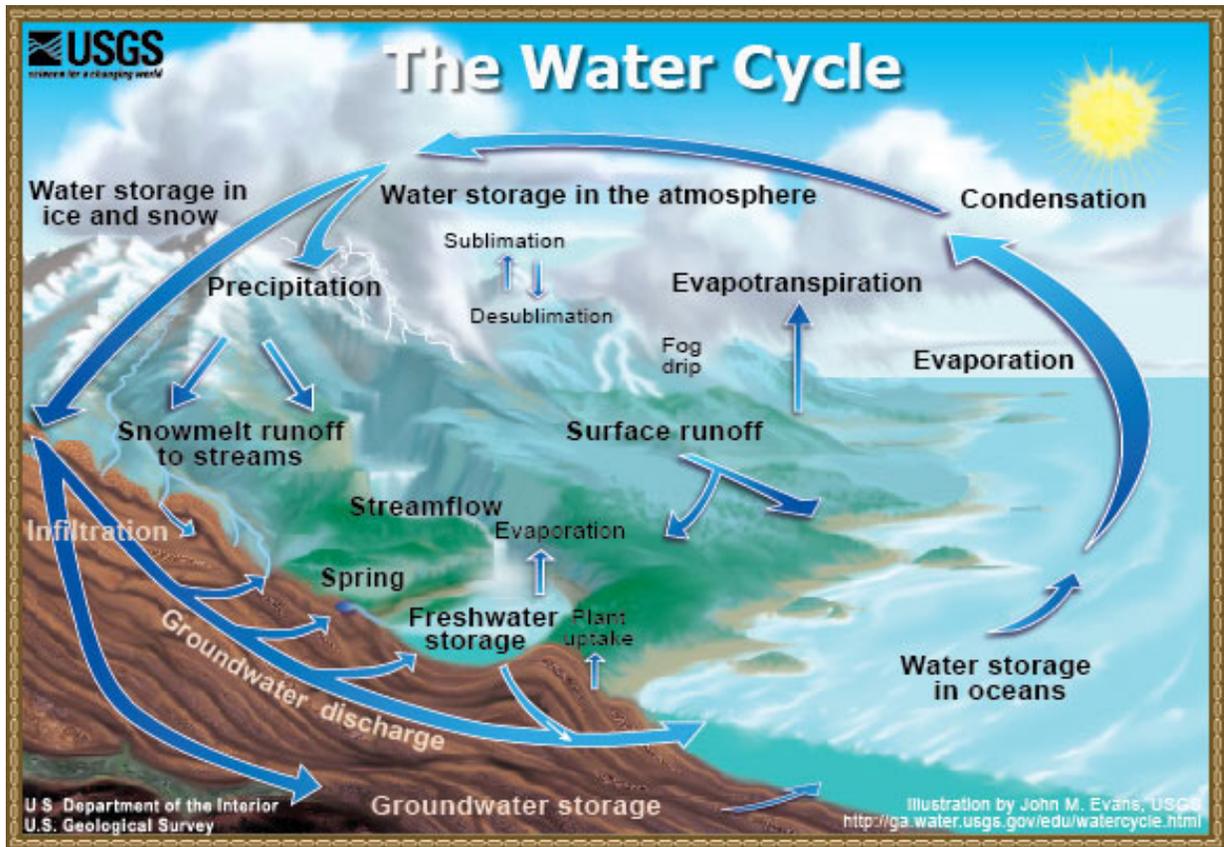
Afternoon

Evening

Activity based on “The Sounds of Nature” activity from “The Book of Stuff to do Outside” by DiscovertheForest.org.

The Water Cycle

Graphics Source: U.S. Geological Survey



Thirsty Plants – Classroom Activities to Do Before the River Trip

Objectives:

Using this adaptation of a Project WET activity students will:

- explain how plants transport water through transpiration,
- describe the role of transpiration in the water cycle,
- explain how plants can affect the quantity of groundwater.

Materials:

- Copy of the Water Cycle Diagram
- Celery stalks or white carnations
- Paper towel tube
- Paper that is cut into a series of connecting circles
- Clear plastic bag and twist tie for each
- An area that has different types of plants
- Small food scale
- Clear container with water colored with red or blue food coloring

Background:

Most people are familiar with plants and gardens and understand the need for watering plants to ensure successful growth. Students may have observed that plants wilt or die because of lack of water. How plants take in and transport water throughout their structure may be less understood. Learning how water moves through plants helps students appreciate the role of vegetation in the water cycle.

Activity 1: How Water Moves Through Plants

Instructions:

1. Cut several pieces of celery or white carnations and place them in a container of water with food coloring in it. Allow the food coloring to soak into the plants before showing the students.
2. Have students review their copies of the water cycle diagram. Ask students to share what they know of the water cycle and then review how water moves through the environment. Note whether or not they include plants.
3. Show the students the celery or carnations that have been soaking in the dyed water. Ask them to make a list of possible explanations for how the water traveled through the cuttings.
4. Ask the students to consider a 20-foot tall tree; how do its leaves get water?
5. Show the students the paper towel tube with the cutout circles inserted. See diagram. Explain that the tube represents part of the tissue inside a plant (xylem), similar to veins inside our bodies. The paper circles represent water molecules. Water molecules remain inside the tube because they are attracted to each other and to the sides of the tube.
6. Point out the water molecule near the top of the tube. Explain that this represents a molecule at a stoma or pore in a leaf. During the day, increased heat energy will cause water to evaporate. Evaporation occurs when the energy of movement (caused by heat energy) is stronger than the forces holding the molecule to other water molecules.
7. To show evaporation pull on the top circle to draw the next circle near the top, then tear off the top circle. Explain that this represents a water molecule being evaporated from the leaf (transpiration). When the top molecule leaves the plant, it must break away from surrounding

water molecules. This creates a pull on those water molecules, drawing them further up the xylem.

Activity 2: Build a Tree

Instructions:

1. Ask the students to list the parts of a tree.
2. As they are listing the parts, assign several students to be various parts.
3. Depending on the size of your class, assign one student to be the heartwood of the tree. This is the inner core, the strength of the tree. Ask this student to stand tall and strong and to say, “Thump, thump,” like a beating heart.
4. The next three students will be the taproots. They will sit at the base of the heartwood and will draw water into the tree. They also anchor the tree to the ground. Point out that not all trees have taproots, but this one does. Ask these students to make sucking sounds.
5. The next several students will be the lateral roots. They will lie on their backs with their feet up against the trunk and their bodies extending away from the tree. Tell them there are hundreds and hundreds of them, thousands of miles of roots to slurp up water. Ask them to make slurping sounds. (Students with long hair make excellent examples of the many long lateral roots a tree can have.)
6. The next students will be the sapwood. They will form a complete circle around the heartwood, facing inward and holding hands. They are the xylem and draw water from the roots up into the tree at speeds of up to 100 mph. They will make “Wheee” sounds.
7. The next students are the cambium or phloem layer. They will form a circle facing the sapwood. They are the growing part of the tree. They are the part of the tree that carries the food manufactured by the leaves to the rest of the tree. Ask them to stand with their arms up and their wrists and fingers interlaced. They will make “Whooo” sounds.
8. Ask the remaining people to be the tree bark. How do they protect the tree? They can act like a football blocker and they should bark. These are all of the parts of a tree and will represent how water moves through various parts of the tree and eventually gets transpired back to the surface.
9. At your command ask the students to act out their parts and watch the tree in action.

Activity 3: How Much Moisture is Transpired by a Plant?

Instructions:

1. Divide the class into small groups; giving each group an empty plastic bag and have them record its weight.
2. Identify trees, shrubs, grasses, or small plants located on the school grounds. Houseplants within the class could also work. Assign each group a plant of a different type i.e.: one grass, one tree, one shrub, etc. (More than one group to a plant type also works.)
3. Have each group carefully place its bag over part of the plant (a limb of a tree or shrub) facing the sun. Tie the bag with a twist tie or string. Each group should count and record the number of leaves or blades in its bag.
4. Challenge the students to develop a method to estimate the number of leaves on the tree or plants in a square foot. After the groups have recorded their estimates; ask each group to carefully examine its bag for changes.
5. After 30 minutes (it can be longer, but all bags should be removed at the same time), carefully remove the bag from the plant; take it to the class and weigh it. If leaves or debris are in the bag, remove them before weighing the bag, trying not to remove any of the moisture.
6. Have each group measure the amount of moisture accumulated in its bag by using the following formula: $\text{weight gain} = \text{total weight} - \text{starting weight}$.

7. Pool the class data and have each group answer the following questions based on the data collected by the class:
- Which plant transpired the most water?
 - Which plant transpired the least water?
 - Estimate the mass of water each plant would transpire during seven hours of sunlight. Assume a constant rate of transpiration.
 - How would plant cover affect the amount of water that can filter through the soil to become part of groundwater.

Plant name or description	Transpiration Rate (ounces or grams per 30 minutes)	Transpiration Rate per seven hour day
Plant 1 Plant 2 Plant 3		

Discussion:

- Have students summarize the process of transpiration.
- How did the water get into the plastic bags?
- Discuss the amount of water transpired by plants in the schoolyard and where water goes after it leaves the plant.
- Students should have found that some plants transpired more water than others did.
- Discuss the effect different plants would have on the watershed, water entering groundwater, and water entering a cave system.



Water Poetry

Water is essential to all life; it covers more than three-quarters of the earth's surface. Water has been the catalyst for settlement and hostility. As you explore aspects of the Missouri River, by canoe and by observation, think about the importance of water to you, your family, your community, your state, your world.

Complete the page titled "What is Water?" and "Missouri River Poetry". From these pages, you will create various types of poems, including a cinquain, a 5-stanza poem featuring a noun, adjectives and verbs (action words).

Read the examples of river poetry found on the next few pages of this booklet. Then, in a notebook write a few different types of poems about your experiences and thoughts on the Missouri River, such as free-style poem or a haiku, whatever style you'd prefer to write. Share your work with your campmates. Then, discuss why you think water stirs writers to write and painters to paint. Also, after you and your class have completed your river trip, you may want to submit your river poetry to River of Words, a website dedicated to students who write poetry, particularly poetry about water:

<http://www.mo-row.webs.com/>

Low Anchored Cloud

By Henry David Thoreau

Low-anchored cloud,
Newfoundland air,
Fountain-head and source of rivers,
Dew-cloth, dream-drapery,
And napkin spread by fays;
Drifting meadow of the air,
Where bloom the daisied banks and violets,
And in whose fenny labyrinth
The bittern booms and heron wades;
Spirit of lakes and seas and rivers,
Bear only perfumes and the scent
Of healing herbs to just men's fields!

River Roads

By Carl Sandburg

Let the crows go by hawking their caw and caw.
They have been swimming in midnights of coal mines somewhere.
Let 'em hawk their caw and caw.
Let the woodpecker drum and drum on a hickory stump.
He has been swimming in red and blue pools somewhere hundreds of years
And the blue has gone to his wings and the red has gone to his head.
Let his red head drum and drum.
Let the dark pools hold the birds in a looking-glass.
And if the pool wishes, let it shiver to the blur of many wings, old swimmers from old places.
Let the redwing streak a line of vermillion on the green wood lines.
And the mist along the river fix its purple in lines of a woman's shawl on lazy shoulders.

The River Flows

By Kailey Jennings

The river flows quiet and swift
It twists and turns as the waters drift
It branches and breaks—its fingers entwine
It grows and grows—snakes like a vine.

The river with the soft scent of a calm day
With the smell of clean—hanging—still—in the grey
And sweetness carried on the breath of morning
It caresses the river—the waters flowing.

The river—crystalline from winter melt
And sweet with the summer soon felt
It tastes of springtime—the season between
And flows the river—so blue and clean.

The river—its lazy trickle of water
The musical rhythm—the ocean's daughter
It whispers and murmurs—a song of its own
Playing over and over—in continuous drone.

The river—so clear and cool
The water flows—the color like a jewel
Its soft arms embrace the shore
The river surging from the days before.

The river flows quiet and swift
It twists and turns as the waters drift
It branches and breaks—its fingers in twine
It grows and grows—snakes like a vine.

Prairie Waters by Night

By Carl Sandburg

Chatter of birds two by two raises a night song joining a litany of running water—
sheer waters showing the russet of old stones remembering many rains.
And the long willows drowse on the shoulders of the running water, and sleep from
much music;
joined songs of day-end, feathery throats and stony waters, in a choir chanting new psalms.
It is too much for the long willows when low laughter of a red moon comes down;
and the willows drowse and sleep on the shoulders of the running water.

WHAT IS WATER?

In the space below, list 10 nouns that deal with water and/or water use.

1. _____
2. _____
3. _____
4. _____
5. _____
6. _____
7. _____
8. _____
9. _____
10. _____

From the list above, choose your favorite word (this will be the subject of your poem).

Now, choose any two adjectives you can think of to describe the noun you listed above:

Next, choose three words which express the noun's action (past, present or future):

Choose four words which describe your feelings about the subject:

Pick a word that is a synonym to the subject:

Now, put the words you've chosen all together and create a cinquain poem. Write it on the back of this page. See the example below:

Ocean
Gray, rough
Smashing, crashing, roaring
I'm half afraid, you
Sea

Missouri River Poetry

Write some observations, experiences and feelings about your day canoeing the Missouri River. Think of adjectives and verbs which describe your experience on the river. Write down your thoughts and create a poem about your experience on the Missouri.

THE MISSOURI RIVER

In the space below, list 6 nouns that could be used for the Missouri River.

1. _____
2. _____
3. _____
4. _____
5. _____
6. _____

From the list above, choose your favorite word (this will be the subject of your poem).

Now, choose any two adjectives you can think of to describe the Missouri River:

Next, choose three words which express the noun's action (past, present or future):

Choose four words which describe your feelings about the Missouri River:

Pick a word that is a synonym to the subject:

Now, put the words you've chosen all together and create a cinquain poem; or write a different style of poem.

EXTENSION:

Think of the many ways people use water, specifically, think about how you and your family use water. List those ways below. Then, think about the value of water to your community, your state, your nation, and throughout the world. Water is a precious commodity, and during times of drought, it can be a scarce resource. Think of ways you can conserve water and how you might encourage others to do so.

WATER USE

WAYS I USE WATER:

1. _____
2. _____
3. _____
4. _____
5. _____
6. _____
7. _____
8. _____
9. _____
10. _____

WAYS I CAN SAVE WATER:

1. _____
2. _____
3. _____
4. _____
5. _____
6. _____
7. _____
8. _____
9. _____
10. _____

How can you encourage others in your family and community to conserve water?

"Water Poetry" and "Water Use" activities based on activities from Great Basin National Park Educator's Guide:
<http://www.nps.gov/grba/forteachers/curriculummaterials.htm>

What Rock Am I?

Objectives:

Students will learn about the three types of rocks (*igneous*, *metamorphic* and *sedimentary*), the rock cycle, the earth's dynamic nature (rocks are ever-changing), and that the Missouri River Breaks has all three types of rocks (sedimentary being the most abundant). Additionally, students will explore an area of the Breaks to discover the rock types represented.

Materials:

- Signs for rock cycle game
- Examples of different rock types
- Notebook for Observations recorded

Background Information:

Rocks are continually changing. Wind and water wear them down and carry bits of rock away. Rock deep below the surface of the earth is being heated to the melting point. Movement of the plates exerts heat and pressure, metamorphosing existing rock. Modern geologists have *classified* rocks into three groups according to the major Earth processes that formed them: *igneous*, *sedimentary*, and *metamorphic*. You can see all three rock types within the Missouri River Breaks National Monument.

Igneous rocks are formed from melted rock that has cooled and solidified. When rocks are buried deep within the Earth's crust, they sometimes melt because of the high temperatures forming an underground mass of molten rock known as a magma chamber. This *magma* may rise to the surface and cause a volcanic eruption, or it may cool slowly underground. When *magma* cools slowly underground, large crystals grow from the molten liquid, and a coarse-grained rock, such as *granite*, forms. This is called an intrusive *igneous rock*. When *magma* erupts onto the earth's surface the molten rock cools quickly. This rapid cooling does not allow time for large crystals to form, therefore the crystals are small and a fine-grained rock, such as basalt, is formed. This is called extrusive *igneous rock*, and is also known as volcanic rock.

Sedimentary rocks are formed at the surface of the Earth, either in water or on land. They are layered accumulations of sediments – fragments of rocks, minerals, or animal or plant material. If a layer of sediment is buried beneath overlying rock, the layer becomes compacted and may form a layer of *sedimentary rock*. The sediment becomes cemented together by minerals and chemicals or is held together by electrical attraction. Sand and gravel *deposits* on beaches or in river bars look like the sandstone and conglomerate they may become. Compacted and dried mud flats harden into *shale*. Mud and shells settling on sea floors can cement into *limestone*.

Metamorphic rocks are formed when *sedimentary* or *igneous rocks* are subjected to pressures so intense and/or heat so high that they are completely changed. The process of metamorphism does not melt the rocks, but instead transforms them by reorganizing and changing their crystalline structure. New minerals are created either by rearrangement of mineral components or by reactions with fluids that enter the rocks. Pressure or temperature can even change previously metamorphosed rocks into new types of *metamorphic rock*.

Make sure students understand that this is the rock "cycle." Any rock that is broken down through weathering and *erosion*, melted, or changed by heat and pressure, may become another rock type. Rocks can also undergo change and still remain part of the same rock type. For example: granite, an igneous rock, can be re-melted and released as lava from a volcano; forming a different igneous rock.

Activity based on "Which Rock Am I?" created by the National Park Service, Grand Canyon National Park.

Instructions:

1. Explain to your students that there are many rocks that make up the earth's crust, however, science has categorized all the rocks into three types: igneous, metamorphic and sedimentary.
2. Define an igneous rock and show an example. Igneous rock is molten material that has *cooled and lithified* (hardened into rock). Igneous literally means 'fire' rock, so ask students what some words are that have 'ign' in them that mean fire (*ignite, ignition*).
3. Define metamorphic rock. Metamorphic rock is rock that has been *changed* through the process of *extreme heat and pressure*. 'Morph' means change. Caterpillars *metamorphose* into butterflies. Show an example of a metamorphic rock.
4. Define sedimentary rock. First define sediment, then explain sedimentary rocks are created from sediments that *deposited* and then *cemented* together, creating a rock. It is good to show sandstone for the example because it is easier to see the individual grains.
5. Ask students if an igneous rock today will always be an igneous rock. Ask if it can erode (break down) and become something else. Ask if it can become sedimentary rock (through weathering, *erosion*, deposition, cementation). Ask if it can change into a metamorphic rock (subject it to extreme heat and pressure-plate tectonics). Do this with each rock type until you have completed the entire "rock cycle." Make sure that it is clear that these processes take millions of years.
6. Print out the six Rock Cycle Cards (cardstock is best).
7. Evenly space the rock cycle cards in a large, clockwise circle in the following order: **S – Thermometer – M – Volcano – I – Cloud**. The circle size will vary depending on number of students and space available. The cards can be attached to sticks, posts, or taped on classroom walls. This activity is best done outdoors or in a gym, but can be done in the classroom, if space permits.
8. Break the students into three groups. Start one group at each rock type: I for igneous, S for sedimentary and M for metamorphic. There are two choices for each rock type which will direct the students to a different part of the rock cycle.
9. Hold up the number one or two (using fingers) and/or say the number to indicate which path the students should take (each rock type card has two choices listed for the students).
10. When the students get to the process cards (cloud for weathering/*erosion*, thermometer for heat/pressure, a volcano for volcanic activity) they will follow the instructions on the card (**acting out the process**), then proceed to the rock type indicated on the process card represented by a letter (I, S, or M).
11. Again, hold up one or two fingers and/or say the number.
12. Continue until each group has traveled each path represented on the rock cycle diagram. The following sequence covers all the paths represented on the rock cycle diagram: 1, 2, 2, 1.

Follow-up questions:

1. What drives the rock cycle? (Plate tectonics)
2. Does the rock cycle ever stop? (no)
3. What are the 3 categories of rocks? (sedimentary, igneous, metamorphic)

Extension:

Take students on a hike in the area and talk about the geology observed. Have students record in their notebooks/journals what they observe: What types of rocks do they see? How were they formed? Are there animals? If so, what kinds? What plants use this area and how do they survive?

I

You started as magma and either cooled quickly above ground or cooled slowly underground. You are an **igneous** rock.

Go to the number your teacher tells you.

1. Go to the Cloud.
 2. Go to the Thermometer.
-

S

Little pieces of rock and sand are cemented together. You are **sedimentary** rock.

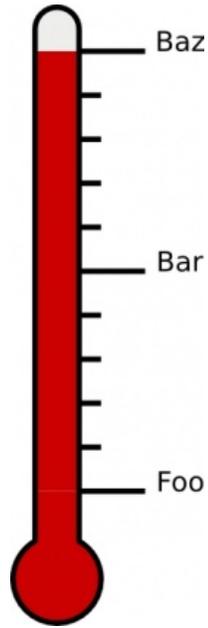
Go to the number your teacher tells you.

1. Go to the Thermometer.
 2. Go to the Volcano.
-

Rain, snow and ice are beating down on you. You break into little pieces. Act like you are getting wet from rain, snow and ice, then act like you are breaking into little pieces. **Go to the S.**



Two tectonic plates collide and you are feeling tremendous heat and pressure. Act like you are being squeezed and are getting really hot!
Go to the M.



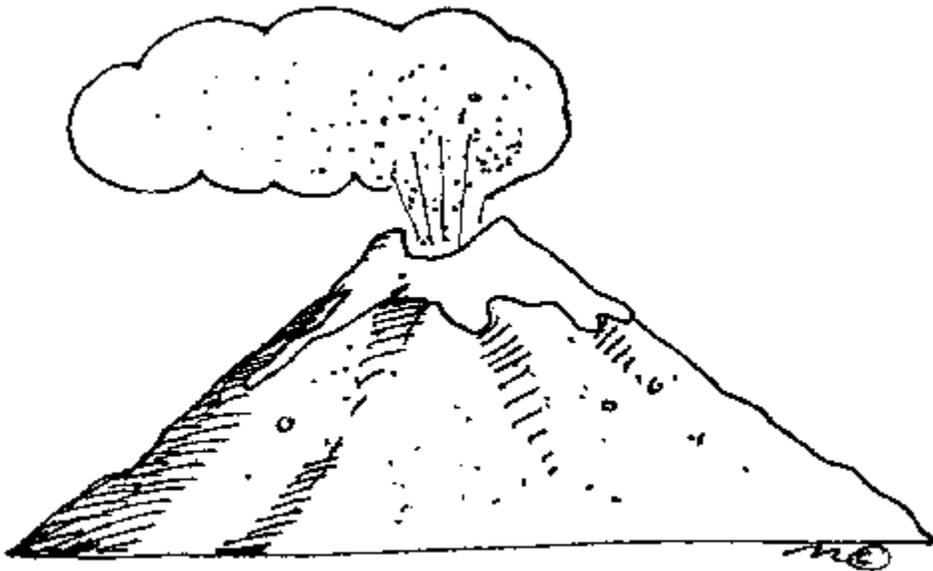
M

Heat and pressure have caused you to undergo a change or metamorphosis. You are a **metamorphic** rock.

Go to the number your teacher tells you.

1. Go to the Volcano.
2. Go to the Cloud.

One tectonic plate is pushed downward under another plate. You start to melt and become magma. Act like a volcano. **Go to the I.**



Every Which Way?

Objective:

Students will explore the practical uses of a compass and learn to understand how a compass works. Using basic orienteering skills, students will participate in a scavenger hunt and apply their knowledge in a discussion about the compass and America's western history.

Materials Needed:

Compasses for students

Student worksheet

Writing materials, including notebook and pen/pencil for each student

Procedure:

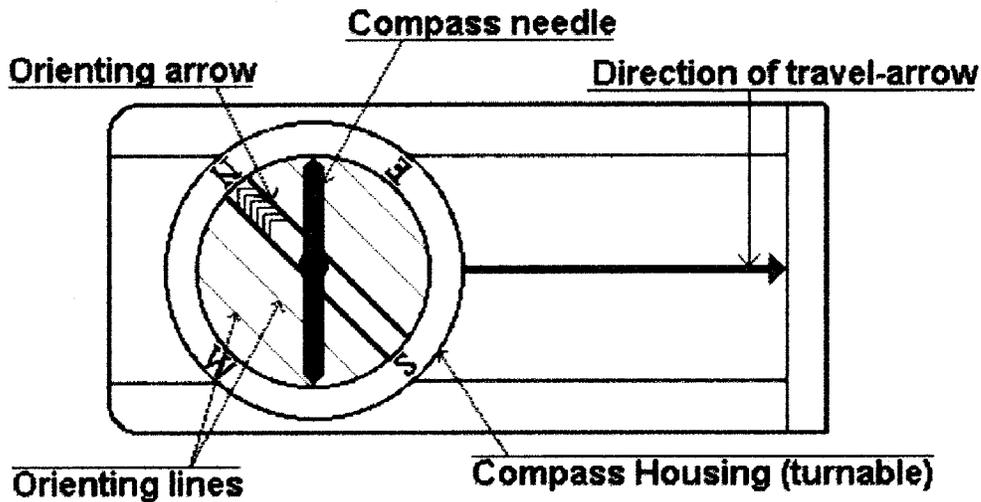
1. Discuss with students the basic function of a compass. Observe students to make sure everyone understands the term "bearing" (determination of position in degrees).
2. Set up a course with 10 consecutive places. The second location should be within line of sight of the first. The third location should be within the line of sight of the second, and so on. Or, after the first three points, the other locations can be out of the line of sight. You can have the students go around objects, such as trees then get back on course to find the next specified point.
3. Instruct students to keep their compass away from metal objects such as belt buckles and pocketknives as those objects will affect compass readings.
4. Ask students to find and chart the 10 points in the orienteering course you set up earlier.
5. Then, have students use their worksheet to apply the concept of compass "bearing".
6. Lastly, hold a group discussion about how the compass assisted explorers and fur trappers and traders in the 1800s and how the compass might have helped in the "settling of the West".

Activities (except Extension) from "Which Way is North?", a Mississippi River Social Studies activity from Iowa Public Television.

Which Way? Student Activity Sheet

“Bearing” is the direction in which any point lies from a point of reference. It is measured in degrees from north, south, east or west on the compass.

Find North. Orient your compass by setting the dial to 360 degrees. Match the needle to the imprinted arrow inside the base of the compass; you are now facing magnetic north. (see drawing below)



For correct directions, the magnetic needle and the red arrow of the compass’ movable ring must always be the same. At magnetic north, you should be facing the direction that has the compass ring close to 360 degrees matched with the magnetic arrow.

Position the compass at approximately stomach level (arms at 90-degree bend) close to the body. All movements must be with the body, not the arms. This will assure you are pointing in the proper direction. Point your compass to north (360 degrees or zero). You will know you are correct if you see the red arrow (magnetic needle) in the compass pointing north.

In your small group, locate the orienteering points your instructor set up earlier. At each point, identify the location and bearing. Write those in the chart below.

LOCATION	BEARING
1.	
2.	
3.	
4.	
5.	
6.	
7.	
8.	
9.	
10.	

Using your compass, insert the correct bearing for the following directions:

DIRECTION	BEARING
North	
South	
East	
West	
Northwest	
Northeast	
Southwest	
Southeast	
North-Northwest	
North-Northeast	
South-Southwest	
South-Southeast	
East-Southeast	
East-Northeast	
West-Northwest	
West-Southwest	

Extension:

Discuss with your campmates how having a compass probably helped explorers like Lewis and Clark and trappers and traders of the fur trading days and how the compass might have assisted in the westward migration of American-Europeans in the 1800s.

Upper Missouri River Breaks Word Search

The words below describe many things that are part of the Upper Missouri River Breaks area, both in history and today. Can you find all the words that are listed below the puzzle in the puzzle? The words may be found backwards, forwards, and diagonally.

Missouri River Breaks

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

BIGHORN
CANOE
EAGLE
FUR
MONUMENT
RATTLESNAKE
TRAIL

BISON
COTTONWOOD
ELK
LEWIS
NEZPERCE
RIVER
WHITECLIFFS

BLACKFOOT
DEER
FORT
MISSOURI
PADDLEFISH
STEAMBOAT
WILD