EXPLORE YELLOWSTONE
MARTIN CHILDREN'S DISCOVERY CENTER

WATER

EDUCATOR GUIDE

MONTANA OUTDOOR SCIENCE SCHOOL

MUSEUM OF THE ROCKIES

600 W. Kagy Blvd.
Bozeman, MT 59717
406-994-2251
museumoftherockies.org
visitmor@montana.edu

Updated March 2013

March 1, 2013

Dear Educator,

Thank you for choosing to bring your students to the *Explore Yellowstone* Martin Children's Discovery Center at the Museum of the Rockies (MOR), where our mission is to inspire visitors to explore the rich natural and cultural history of America's Northern Rocky Mountains. A visit to the Discovery Center is a great way to help your students visualize concepts and spark their curiosity about a new topic.

Studies have shown that learning in museums is not limited to the time spent within their walls, but is heavily influenced by prior knowledge and experiences and continues long after the visit has ended. For these reasons, preparing your students for their museum visit and then extending their experience afterward will enhance the educational aspect of the field trip experience.

To aid you in linking this museum visit to your curriculum, the Museum of the Rockies' Education Department has created this guide. Inside, you will find details on the *Explore Yellowstone* Martin Children's Discovery Center, including a map of the exhibit and education goals. We have also assembled complementary classroom activities for various grade levels. We hope that these resources will help you prepare pre- and post-visit activities for your students that tie into your curriculum.

MOR is committed to providing the richest possible learning experience for your students and welcomes your questions and feedback. We look forward to seeing you at the Museum of the Rockies soon!

Sincerely,

Education Department
Museum of the Rockies

EXPLORE YELLOWSTONE GENERAL OVERVIEW

Exhibit's Appropriate Age Levels: Birth through 8 years of age (or 2nd grade)
Curriculum is appropriate for preschool through 5th grade students.

Exhibit Overall Goal:
Introduce children to the wonders of Yellowstone National Park in a hands-on, immersive environment that empowers children to discover a lifelong passion for nature, science, and the Yellowstone experience.

Exhibit Description:
Explore Yellowstone is an immersive exhibit. From the moment kids enter through the Roosevelt Arch, they are surrounded by landscape scenes from Yellowstone. Murals surround them while overhead clouds float in the blue sky. In one area, children can "fish" with magnetic fishing poles for cutthroat and lake trout that have ball bearings sewn in their snouts and learn which fish to return to the "lake." Mammoth terraces and bubbling mud pots help teach the concepts of thermal features and a "smell tube" lets them get a whiff of hydrogen sulfide. In the campground kids learn campground etiquette like bear-proofing food and removing litter or listen to stories and sing songs around the "campfire."

A tot area, framed by murals of the Grand Canyon of the Yellowstone, gives infants a safe place to play while their parents watch from benches made of polished logs. Older kids can climb the fire tower and use binoculars to look for smoke, or play in a life-size eagle's nest and learn about habitats.

In the lodge, children can dress up and pretend to be people working in Yellowstone. They can "cook" with an authentic wood stove that has a fake fire burning in the coal box or sit on child-size lodge pole furniture in front of the fireplace and read. A big clock over the fireplace helps them time the next eruption of "Old Faithful," the largest of three cloth geysers. At the end of their visits, children can make post cards or drawings to take home before they exit through the Roosevelt Arch.

Exhibit Layout:
Eight discovery zones, each with a focus on different area of Yellowstone, provide just enough design, detail and props to suggest a time and place for children to become a part of Yellowstone.

HOT AND COLD ALGAE

Grow your own algae and experiment to see what helps it grow

APPLICABLE AGES:
Pre K – 5th grade

LOCATION:
At the museum, in your classroom or outdoors

RESOURCES AND MATERIALS:
- Container to put water in
- Window or source of light
- Water from a fish tank, pond or outdoor dog bowl
- A thermometer and pH strips or meter
- Pictures of microbial mats and information on water conditions from various hot springs in Yellowstone National Park

PURPOSE:
Students will observe how well plants grow in varying conditions

OBJECTIVES:
Students will:
1. Make observation on the needs of plants
2. Speculate on the extreme range of conditions in the GYE and on plant adaptability

VOCABULARY:

Algae	Tolerance
Extremophiles	Adaptability

ACTIVITY:
Take a water sample from a fish tank, pond, or even an outdoor dog bowl or water trough. Try to find a place where you can see some green slime growing. Better yet, try and find a small rock with some green slime on it. If you can, get two samples from two different locations.

Put the samples in small containers with some room temperature water and place them near a window where they can get lots of sunlight.

Try putting more rocks and a small piece of lettuce in one of the containers. This will help the algae grow. Watch the algae for two weeks. Did the algae grow? What happened in the containers?
You can also try this experiment with two types of water: tap water and bottled water.

Compare the water conditions and algae in the containers to water conditions and microbial mats in the various hot springs in Yellowstone National Park. Are there overlaps in conditions in the two environments? Are there similarities and/or differences in characteristics of microscopic organisms?

TYING IT ALL TOGETHER:
Experiment with different water temperatures, pH and salinity in different containers. Hypothesize what the results might be for algae growth.
Examine photos of thermophiles in thermal areas around the world. Observe correlations between temperatures and pH of water and colors of thermophiles.

Adapted from MSU Extended University: Science Zone:
http://eu.montana.edu/pdf/outreach/msuscizone17.pdf

Additional Resources:
Thermal Biology Institute http://tbi.montana.edu/

CRUMPLE A WATERSHED

Students crumple paper to create a mini-mountain range, draw in the watersheds, spray them with water and watch the water flow

APPLICABLE AGES:
Grades 3-7th

LOCATION:
At the museum, in your classroom or outdoors

RESOURCES AND MATERIALS:
- White paper, (can use recycled paper that is blank on one side, cut in ½ or ¼ sheets)
- Cardstock (cut into ½ sheets or ¼ sheets, to match the white paper size)
- Water-based markers in blue (and possibly purple)
- Permanent markers in brown and/or black and green
- Tape such as scotch tape
- Spray bottle with mist setting and water
- An area that can withstand some wetting as the papers are sprayed

PURPOSE:
This lesson will show students a three dimensional picture of watersheds and their associated topography

OBJECTIVES:
Students will be able to:
1. Articulate the definition of a watershed
2. Describe the characteristics of a watershed

VOCABULARY:

Watershed	Tributary
Ridgeline	Main stem

ACTIVITY:
Discuss the concept of a watershed- come up with a definition everyone understands and agrees to.

To start: gently crumple a sheet of white paper. Gently un-crumple papers, leaving lots of up and down folds (so it looks like a mountain range) and tape the corners down to the cardstock paper.

With one color (earth tone) and a permanent marker, trace all of the upward pointing folds/crumple lines, which represent peaks, hill tops and ridge lines. These are the divides, the boundaries between the different watersheds created on the paper.

With the blue water-based marker, draw a line in the crease of the downward pointing folds. These represent the paths and depressions where water flows

Use a spray bottle and water to gently mist the paper and notice which way the color moves down each of the watersheds. The color movement may take a few minutes, but it should show branching patterns as the colors move from the brown ridge tops to the tributary streams to the main stems.

Some color possibilities students can use are: Green for the riparian zones along water corridors, brown for the mountain tops and ridge tops

Let everyone's papers dry before they are transported.

TYING IT ALL TOGETHER:
Take a tour of everyone's paper mountain ranges and watersheds. Analyze as you go the shape and size of the watersheds and identify where the boundaries are. Note how many watersheds are indicated on the various papers. Were they accurately drawn? Compare paper watersheds to real-life watersheds.

EXTENSIONS:
Do this activity first with a long piece of butcher paper with the whole group, and then have students create their own, either individually or in small groups.
Examine large and small scale maps of your local area to delineate your local watershed

ADDITIONAL RESOURCES:
Discover a Watershed: Watershed Manager Curriculum Guide

Adapted from: Branching out! Project WET Activity Guide (1995) pg. 129

CRUMPLE A WATERSHED WITH HUMAN IMPACTS

Students crumple paper to create a mini-mountain range, draw in the watersheds with human impacts, spray with water and analyze the results

APPLICABLE AGES:
Grades 3-7th

LOCATION:
At the museum, in your classroom or outdoors

RESOURCES AND MATERIALS:
- White paper, (can use recycled paper that is blank on one side, cut in ½ or ¼ sheets)
- Cardstock (cut into ½ sheets or ¼ sheets, to match the white paper size)
- Newspaper - for clean-up (place under the model)
- Permanent Markers (red, green, etc.) - for drawing landforms and native vegetation
- Water-Soluble Markers (blue, black, brown, etc.) - for drawing water flow and point-source impacts
- Spray Bottle - For creating the precipitation
- Tape, used to tape white crumpled paper to cardstock
- spray bottle with mist setting
- Water

PURPOSE:
This lesson will show students a three dimensional picture of watersheds along with the associated topography, and illustrate the impacts of human activity within the watershed.

OBJECTIVES:
Students will be able to:
1. Define a watershed and its characteristics
2. Hypothesize the impacts of human and natural effects on the landscape

VOCABULARY:

Watershed	Run-off
Ridgeline	Pollution

ACTIVITY:
Share Watershed Definitions:

"A watershed is more than an area of land defined by its ridges with one outlet for water to flow. A watershed supports a variety of resources, uses, and activities in such a way that eventually all things are affected by everything else in the watershed. A watershed contains the history of all that went before and the spirit of those who touched it remains." George Wingate

A watershed is an area of land that sheds its water into a common body of water.

A watershed is a water-shed (noun): stores water {groundwater}, and
A watershed is a water-shed (verb): sheds water {surface water}.

A watershed is the gathering ground for a body of water.

Create the Model
Using a piece of crumpled paper, students create a watershed model to demonstrate the geographical flow of water across the landscape, and the relationship of natural/cultural activities to water quality impacts. This model is a birds-eye watershed view and should develop watershed awareness and landscape ecological literacy

Explain to participants that they will create a watershed model with a simple piece of paper. They will be able to see the ridges, slopes and drainages that make up a 3-D watershed landscape. Be sure to demonstrate and explain each step so that there is understanding of how and why to do each step.

Crumple a piece of paper into a ball. Gently un-crumple the paper so that it will sit on a table but still maintain the folds and creases that will represent peaks ridgelines, valleys and watercourses. Tape the corners of the crumpled paper to the cardstock paper, leaving the paper crumpled into a 3-D shape.

Use a permanent red marker to outline the surrounding watershed divide. If desired also delineate all upward-pointing creases, which are ridges. Explain that although mountains and landforms are not permanent they are a more durable aspect of the watershed.

Use the green permanent marker to indicate areas of native forests or other native vegetation types.

Using the water-soluble blue marker, define the watercourses. These drainages are the creases on the page that bend down toward the table, and should represent where water will flow on the model.

With a water-soluble black marker or other color(s) define patterns of human development and use, such as: roads, industry, residence, and schools. You should place them appropriately on the model.

With a water-soluble brown marker, create other ground disturbances. These can be human caused or naturally occurring impacts (clearcuts, skid-trails, landslide, intensive agriculture & grazing). The most significant pollution of surface water is sediment/soil.

Hypothesize: What do they think will happen when it "rains"?

Lightly and evenly spray the models. Explain that this is precipitation. Students should carefully watch and note how water flows across the landscape and how it affects the entire watershed, not just the watercourses and channels.

TYING IT ALL TOGETHER:

Take a tour through all the paper watersheds:
What general observations did you make?
Did water flow as anticipated?
Did you place your developments on a flood plain? What resulted?
Water cohesion allows for less impact (spread) on flatter surfaces than on slopes. Is this true in the real world?
Where did most of the impact/pollution come from?
Discuss the definition of point source and non-point source pollution.
How would our own watershed look as a model?
Where would the impacts be?

EXTENSIONS:

Do not add the human element to the watershed model and keep the focus on defining watersheds alone.
Use a topographic map to discover and define watershed in a specific geographical area.
Examine large and small scale maps of your local area to delineate your local watershed

ADDITIONAL RESOURCES:

Discover a Watershed: Watershed Manager Curriculum Guide

Adapted from: Water Institute: http://oaecwater.org/watershed/crumpled-paper-watershed-exercise
Crumpled Paper Watershed Model by Rob Wade of Adopt-a-Watershed

FLOAT OR SINK?

Students hypothesize and experiment with floating common objects in water

APPLICABLE AGES:
Pre K – 2nd grade

LOCATION:
At the museum, in your classroom or outdoors

RESOURCES AND MATERIALS:
- Large deep plastic tray filled with water
- Objects to try floating:
- Suggested objects: wooden block, crayon, lemon, nut in shell, metal jar lid, pencil, golf ball, cotton ball, plastic comb, twist tie

PURPOSE:
Students will determine the floatability of various objects and hypothesize why.

OBJECTIVES:
Students will be able to:
1. Determine that some objects float and others don't
2. Hypothesize why some float and others don't

VOCABULARY:
Float
Weight
Density
Buoyancy

ACTIVITY:
Begin by creating a chart with the experimental objects listed with a column to mark if students think it will sink or float, and a column to mark results of floating attempts.

Hold a group discussion on the floatability of each object, marking down the consensus (hypothesis).

Try to float each object, observing the results as a group, and writing down results. Discuss how the results matched their guesses, and why or why not the objects floated.

Have students look around and pick out other objects to try to float, having them hypothesize about the results before they try.

TYING IT ALL TOGETHER:
Have the group come up with some general rules, or observations, about what kinds of objects float and which ones sink. Use scientific terms such as density and buoyancy to identify properties of the objects that either float or sink.

EXTENSIONS:
Have students bring in objects from home to try to float. Ask them to try to fool their classmates
Add salt to the water. Sea water has a proportion of ¼ lb. of salt per gallon. Mix up a similar concentration in the plastic tray and refloat the objects first tried, predicting results beforehand.
Try to float an egg in fresh water, and then begin to add salt; predicting what might happen as you go.

Adapted from Project Seasons, Shelburne Farms, pg 253

HOPPING HOT AND COLD H_2O

Students correlate observations of hot and cold water experiments to geysers and fumaroles

APPLICABLE AGES:
K – 5th grade

LOCATION:
At the museum, in your classroom or outdoors

RESOURCES AND MATERIALS:
- 3 similarly shaped clear containers, at least one that can handle hot water
- Water to fill the containers in three different temperatures – ice water, tap water, and hot water
- Food coloring
- A white board or paper to record predictions and results
- Pictures of geysers erupting, or video of erupting geysers

PURPOSE:
This lesson will allow students to observe the properties of different temperatures of water

OBJECTIVES:
Students will be able to:
1. Describe some of the properties of hot water vs. cold water
2. Hypothesize about the action of the food coloring in the different temperatures
3. Correlate how the properties of hot water might account for the action of geysers and fumaroles

VOCABULARLY:

Temperature	Geyser
Molecule	Fumarole

ACTIVITY:
Fill the containers, one with ice water, one with tap water, one with hot water. Allow the containers to sit until the water is still.

Explain to the students that you are going to drop food coloring into each container. Ask the students what they think will happen to the drop-will it stay in one place, will it move around, will there be a difference in the three containers?

Record what their predictions are.

Drop one drop into each of the three containers. Observe what happens. Ask why the food coloring moves as it does…. Do they have any ideas? Does the action match their predictions?

TYING IT ALL TOGETHER:
Explain that all things are made up of little building blocks called molecules. The molecules sometimes move around faster or slower, based on how hot they are. The hot water molecules are clearly moving faster in their container, carrying the food coloring around with them.

Ask if anyone has seen steam coming out of a teapot. Point out that the water in the teapot became so hot that it turned into water vapor and began moving very quickly. The molecules began pushing away from each other, creating a lot of pressure and causing the water vapor to try to escape through any opening available.
This is the pressure that causes geysers to explode with hot water and steam.

EXTENSIONS:
Have students act out water molecules being heated and cooled.

Explore the geyser connection with information and pictures of hot springs and the geology that creates hot springs regions.

Adapted from Project Seasons, Shelburne Farms, pg 259

ADDITIONAL RESOURCES:
Yellowstone National Park website: http://www.nps.gov/yell/index.htm

WONDERFUL WATER CYCLE

Acting as a drop of water, students move through the water cycle, tossing a dice to go from station to station

APPLICABLE AGES:
1st – 5th grades

LOCATION:
At the museum, in your classroom or outdoors

RESOURCES AND MATERIALS:
- Poster board signs for stations
- Marking pens
- Gift boxes (coffee cup size) to make dice for the game (One possible example for the sides is located on the Water Cycle Table, found at this link: http://files.dnr.state.mn.us/education_safety/education/project_wet/sample_activity.pdf)
- (You may want to include pictures for younger students.)
- Paint stirring sticks or long metal skewers (to stick in the ground for stations outside)
- Packages of colored beads (each a different color; try to match bead color to station, i.e., deep blue for ocean, light blue for lake, white for clouds, etc)
- Package of pipe cleaners (one for each student)
- Hand outs or signs indicating what station each

PURPOSE:
This lesson will increase students' awareness and knowledge of the water cycle.

OBJECTIVES:
Students will be able to:
1. List where in the world water is found
2. Explain the process of how water moves from one state to another
3. Explain how water moves from one location to another in the world
4. Identify the basic features of the water cycle
5. Identify the states of water as it moves through the water cycle
6. Write a story describing your journey as a water molecule

VOCABULARY:

Precipitation	Molecule
Condensation	Cycle
Evaporation	Respiration

ACTIVITY:
Preparation:
Signs for the stations and dice need to be made before starting this activity. The stations could include the following: Soil, Plant, River, Clouds, Ocean, Lake, Animal, Ground Water, and Glacier; or you can design your own water cycle, adding stations such as wetlands, or human impacts such as sewage treatment plants, hydroelectric plants and cooling stations.

Set up the stations in various areas around the classroom or in a grassy area, generally in a large circle, by placing a stake in the ground with the station name and a bowl of beads at the base.

Each station will have the color of beads for that station (white for clouds, blue for ocean, etc). The dice for each station will be placed beside the bowl of beads. Leave plenty of room between stations.

Action:
Tell the students that they are going to become water drops or molecules moving through the water cycle. Have students identify the different places water can go from their station in the water cycle. Discuss the conditions that cause the water to move. Explain that water movement depends on energy from the sun, electromagnet energy, and gravity. Sometimes water will not go anywhere. In this game, the roll of the die determines where the water will go.

Put roughly the same number of students at each station. Have students take a bead from this first station and put it on their pipecleaners, then line up behind the station sign. *(Water molecule option: At the cloud station they will line up in single file; at the other stations they should line up in pairs.)*

The game will begin with the sound of a whistle or bell. When it is their turn at the front of the line, students roll the die and go to the location indicated by the label facing up on the dice. If they roll stay, they pick up a bead out of the bowl to put on their pipe cleaner, and move to the back of the line.

When students arrive at the next station, they get a bead for their pipe cleaner, get in line, roll the die, and move to the next station unless they rolled stay, then they pick up a bead out of the bowl to put on their pipe cleaner, and move to the back of the line.

After all the students have visited enough stations to have collected 8-12 beads, call a halt to the game by blowing a whistle or ringing a bell. Usually no one has visited all the stations.

Do not let the students re-arrange their beads on their pipe cleaners! The beads are the way that the students keep track of their path along their journey. Students will need to keep the order of the beads they picked up at each station so they will be able to tell their stories.

TYING IT ALL TOGETHER:
Gather all the students together and have them sit down in front of you. Hold up one of the bead bracelets, either your own or borrow one from a student. Tell the students that you are going to tell the story of this water drop journey through its own personal water cycle. Post the sign with bead color representations next to you as you tell the story.

Starting with the first bead:
Say "I started as a drop of water in the ____ (ocean, lake, soil etc., based on the color of the bead) Then I _____ (evaporated, fell as snow, fell as rain, flowed into the river or lake, etc, whatever the process was to get you to the next station) and now I am in the _____(clouds, plant, ocean, lake, etc., based on bead color). Then I _____ (melted, froze, precipitated as rain, etc) and went to the _____(glacier, lake, ocean, animal, etc., depending on next bead color). Then I ____(evaporated, precipitated, was urinated, flowed, etc.,) and went to _____ (ocean, lake, cloud, etc.,) so on....." - continuing through all the beads.

As you tell the story make sure to tell the process of how you as a water droplet moved through the different stations.

Now have the students pair or group up in small groups and tell their water droplet story to each other. Make sure students tell the process of how they got to each station as well as how they left each station, using their science vocabulary. For example: A fox drank the water from the river and as it was running the water evaporated from his skin into the clouds. Have students compare their journey with a partner's journey. Compare and contrast their findings.

EXTENSIONS:

Have students write their Incredible Journey Story as a water drop or molecule using their pipe cleaner as a guide, starting with the first bead. Have students read their stories and discuss their journey.
As a class, design your own dice, determining which stations to have in the water cycle and what should be on each side of the die.
Use a sheet of paper to record your journey instead of beads and pipecleaners.

Adapted from: The Incredible Journey, Project WET Activity Guide, pg. 161

ADDITIONAL RESOURCES:

Dice Templates available:
Water Cycle Dice Info:
http://files.dnr.state.mn.us/education_safety/education/project_wet/sample_activity.pdf
Water Cycle Dice Info and Graphics: The Blue Traveler: Conserve Water Educator's Guide, pg. 43
Graphics for dice: http://cals.arizona.edu/arizonawet/resources/adapt-and-apply.html

A version using regular dice:
Project Learning Tree Activity Guide: Water Wonders, Activity #44; pg. 188

ON THE MOVE – SOLIDS, LIQUIDS AND GASES

Students act out the motion of atoms in the three states of matter

APPLICABLE AGES:
Pre K – 5th grade

LOCATION:
At the museum, in your classroom or outdoors

RESOURCES AND MATERIALS:
- An ice cube
- Glass of water
- A cold spoon
- An open area that students can move around in

PURPOSE:
This lesson will introduce students to the three states of matter.

OBJECTIVES:
Students will be able to:
1. Explain the three states of matter
2. Demonstrate the atomic structural differences between the three states

VOCABULARY:

States of Matter	Gas
Solid, Liquid	Vapor
	Temperature

ACTIVITY:
Discuss the three states of water: solid, liquid, gas. Show them an ice cube, glass of water, and use your breath on a cold spoon as an example of gas (the condensed water droplets on the spoon). Tell them that a solid holds its shape, a liquid takes the shape of the container it is in, and a gas evenly fills whatever container that is holding it. Ask the students what is the difference between the three examples of water you just showed them. Guide them to the observation that each is different temperature. Introduce temperature changes and explain how it affects atoms. Heat causes the atoms to move faster and be farther apart, so a solid becomes a liquid and a liquid becomes a gas.

Have the children stand up and tell them that they are now going to be molecules of water and act out the different states of matter, specifically how the structure of atoms of the three states of matter are different. Stress that they will do all these actions gently!

Start with solid. Tell the children that it is very cold, so cold they have become water drops in an ice cube. Have the children stand right next to each other, touching as much as they are comfortable, and very slightly moving. Let them do that for a minute or two.

Now turn up the heat. Tell the students it's warming up and the ice cube has melted. Have the students act as liquid water by holding their arms out and being far enough apart so their hands and arms touch. They should also be gently moving around each other, touching arms and hands but not colliding.

Now the heat is really high and they have become water vapor – a gas! Spread them out enough so they are not touching at all. Have them move among each other, colliding gently.

Now turn the heat down, and have students become liquid water again, and finally solid water (ice) once more.

TYING IT ALL TOGETHER:

Have students take a seat. Discuss and observe the solids, liquids and gases in the world around them. Ask, is there anything that isn't in one of these states of matter? Review what it takes to have matter change from one state to another.

Adapted from: Water Match, Project Wet Activity Guide, pg. 50

THE GREAT WATER CHALLENGE: FOUR EVENTS

Students will put drops on pennies, float paper clips, fill cups and run drops down strings to observe the properties of water

APPLICABLE AGES:
K-6th grade

LOCATION:
At the museum, in your classroom or outdoors

RESOURCES AND MATERIALS:
- A number of eyedroppers
- A large handful of pennies
- 5-10 paperclips or more
- A couple of forks (plastic or metal)
- A couple of lengths of string, Clear cups (plastic or glass), Several large basins or trays to place the cups in
- Towels for spills and to keep the surface dry under the pennies
- A flat surface that can get wet
- Water

PURPOSE:
This lesson will provide opportunities for students to observe and hypothesize about the properties of water

OBJECTIVES:
Students will be able to:
1. Make observations and predictions about water properties
2. Apply their observations to actions in the world around them

VOCABULARY:

Surface	Adhesion
Tension	Float
Cohesion,	Sink
Molecule	Meniscus

ACTIVITY:
Divide the class into as many groups as there are stations. Have each group go to a station and experiment with the water challenge there, and then switch on a signal from you.

Or: Split the class into two teams (or however many instructors there are), inform them the Water Challenge is now commencing. They need to create team names, so that you can write down pretend scores.

Event 1: Is the Cup Really Full? : fill a clear cup with water until it is completely full to the rim. Drop paper clips, pennies, or something similar into the cup, keeping count to see how many objects can be dropped in the water before it spills over. (Object: try to see who creates the biggest bubble over the top of the water.

Event 2: The Most Drops Wins! Give each student a penny and an eye dropper to see how many drops of water can be placed on a penny. Note: the size of the dropper end of the eyedropper is the key to number of drops, try to have same sizes to compare or compete.

Event 3: Floating Objects: Get paper clips to float. (They do, it's tricky for some kids). Using a fork to lower the paper clip onto the water can help quite a bit.

Event 4: Runaway Drops: tie one end of a (cotton) string high up on a post, or have a team member hold one end higher than the other, so the string is angled. Have drops from a person's fingers land on the string and run down. Hold races to see whose drop races down the string fastest. Experiment with string angle, string wetness, size of drop.

TYING IT ALL TOGETHER:
After everyone has completed all the events, gather together to discuss what they observed. Ask how such phenomena could occur. Are there special properties of water that allow a paper clip to float; or drops to stay on string or on a penny? Introduce the concepts of cohesion, adhesion, surface tension.

EXTENSIONS:
Have students make predictions before attempting the challenges
Have students attempt the pennies challenge or the floating paperclips, and then place a drop of detergent or soap into the water. Observe the results NOTE: once detergent or soap is introduced into the water, the surface tension will be broken and any further challenges will no longer work. Soap and detergent are very hard to get rid of on surfaces, so this should be the last experiment attempted.

ADDITIONAL RESOURCES:
Similar activities can be found in many sources. Here are a few:
Project Wet: H2Olympics Activity pg. 30
Project Seasons: Water Wizard Learning Stations, pg 243

WATER CYCLE ADVENTURE – A PLAY

Students act out the roles a drop of water can take in the water cycle

APPLICABLE AGES:
Pre K – K

LOCATION:
At the museum or in your classroom

RESOURCES AND MATERIALS:
- Copies of the script to hand out, either to share or to have individually

PURPOSE:
Students will know the forms water can take, note how water can change form, and act out the stages in the water cycle

OBJECTIVES:
Students will be able to:
Describe events in the lifecycle of a water droplet
Explain the stages in the water cycle

VOCABULARY:
Evaporation, Water vapor, Condensation, Precipitation, Gas, Solid, Glacier, Sewage treatment plant

ACTIVITY:
This 10-minute readers' theater play traces water in its never-ending cycle. Students read the script as they perform the play. Neither props nor scenery is necessary. There are 19 characters, but in a small class, students can easily play more than one part. The students could even write their own water cycle adventure.

Cast:		
Sun (who is also the narrator) Ocean water drop 1 Ocean water drop 2 Water vapor 1 Water vapor 2 Cloud Snowflake 1	Snowflake 2 Glacier ice 1 Glacier ice 2 Stream water 1 Stream water 2 River water 1 River water 2	Reservoir water 1 Reservoir water 2 Tap water 1 Tap water 2 Water in drain pipe Sewage processing plant

WATER CYCLE ADVENTURE – A PLAY SCRIPT

The Sun: Our story starts in the ocean. We are watching two drops of water.

Ocean water drop 1: It's getting hot here in the ocean - I don't think I can swim any more. I'm feeling light and airy! I think the Sun's doing it to me.

The Sun: I can't help it - I'm hot and full of energy. That's what I do, and I do it so well, don't I?

Ocean water drop 2: Yes, you do, but I think I'm getting dizzy and there isn't even a whirlpool here. I'm feeling so strange! I think I'll just float for a while - no more swimming for me.

Ocean water drop 1: Uh oh! You're not floating in the water anymore, you're floating in the air - you're not a drop of water either - you're water vapor now.

Water Vapor 1: What's water vapor?

Water Vapor 2: It's water, but it's a gas. You've evaporated and turned into a gas - and so have I. Let's fly up high!

Water Vapor 1: I feel like joining the others and forming a crowd.

Water Vapor 2: I think you mean a cloud, not a crowd. Okay, let's condense.

Water Vapor 1: What does that mean?

Water Vapor 2: Condensing means that we'll change back into a liquid (water, of course). Then we'll be part of a cloud.

Cloud: Okay, now we're a beautiful, fluffy cloud. Let's fly over the land and watch the goats. Take a look at those beautiful mountains! But now I'm feeling heavy and cold. I think I'm going to snow!

Snowflake 1: Hey, what's got six arms and there's nothing exactly like it in the whole world?

Snowflake 2: Me - I'm so special. You are too, of course. We're both snowflakes. Hey, where are you going now?

Snowflake 1: I can't stop falling - you're falling too. But where are we going?

Snowflake 2: Down.

Snowflake 1: Thanks - I knew that. It looks like we're taking a trip to the mountains. I hope you know how to ski.

Snowflake 2: Well, it looks like we're stuck on a glacier - I wonder why they're called rivers of ice.

Glacier Ice 1: I'm getting crushed here. Now I'm ice - this is NOT my favorite part of the water cycle.

Glacier Ice 2: We're only moving at about one foot a year. This is going to be soooooo boring - it's a long way to the bottom.

Glacier Ice 1: You'd better get used to it; we're stuck on this glacier for a while.

The Sun: A long, long, long time later, two very bored drops of water emerge from the bottom of the glacier. I haven't been much help to them lately.

Stream water 1: Wow, I've finally melted!

Stream water 2: Me too - I'm free at last. What a change, we were practically standing still, and now we're shooting the rapids.

Stream water 1: Watch out for that rock! And that waterfall!

Stream water 2: Ouch! I've had enough of this. Can we go home now?

Stream water 1: We don't have a home. At least we're out of the mountains. The water's getting deeper. What's going on here?

River water 1: You can slow down now - we're in a river. And we're getting warmer.

River water 2: I like this. Not too fast and not too slow.

River water 1: Let's go down this side stream - it looks clear and clean.

Reservoir water 1: Okay. We're in a reservoir now - we'll be flowing through huge pipes soon - I've been here before.

Reservoir water 2: Here they are. It's dark and spooky in these pipes. How do we get out of here?

Reservoir water 1: Just go with the flow.

Tapwater 1: There's a light at the end of the tap - we're in a sink. Eew - that kid is brushing her teeth!

Tapwater 2: I hope she doesn't drink us - it's really weird when that happens.

Tapwater 2: Whew, that was a close call. Looks like we're whirlpooling down the drain; Hold your nose!

Water in drain pipe: More dark pipes - but these pipes are really smelly. We must be in the sewer under the city. Boy do I need to take a bath.

Sewage processing plant: I heard that. I'm a sewage processing plant. You've come to the right place. I'm so amazing that I can even give bath water a bath! Now you're all filtered and clean - just take that pipe to the sea.

Ocean water drop 1: We're finally back in the ocean. You know, I've done this trip a million times, and every time it's different.

Ocean water drop 2: I was well water in Washington once.

Ocean water drop 1: I was in a typhoon in Thailand twice.

Ocean water drop 2: I was rain in Rwanda.

Ocean water drop 1: I was snow in Siberia.

Ocean water drop 2: We've all been snow in Siberia. But I was in a puddle in Pakistan.

Ocean water drop 1: I was in a lake in Louisiana.

Ocean water drop 2: I was in a swamp in Switzerland.

Ocean water drop 1: There are no swamps in Switzerland. But a long, long time ago, I was sleet that fell on the snout of a T. Rex.

Ocean water drop 2: Showoff. I rained on a plain in Spain, and I seeped through the soil and went into a cave, and was groundwater for 500 years.

Ocean water drop 1: Boooorrrrrring.

Sun: Hi there! It's me again. Did you miss me? I know you did.

Ocean water drop 1: I feel so hot and dizzy!

Ocean water drop 2: Oh no, it's starting all over again!

Ocean water drop 1: I wonder where we'll go this time?

TYING IT ALL TOGETHER:
Gather the class together and debrief the play. Review the three states of matter. How they are represented in the play? Ask: how did the water get around to all the different stages in the lifecycle? What was the main driving force?
Bring the water cycle home to the class by asking how and where water is found around them right now. Depending on the season and location, there could be snow or rain, there could be water pipes and drinking fountains, or there is water in everyone's bodies.

EXTENSIONS:
Students can write a short story about life as a water molecule

Adapted from:http://www.enchantedlearning.com/subjects/astronomy/planets/earth/Watercycle.shtm

ADDITIONAL RESOURCES:
Project WET Curriculum and Activity Guide

WATER CYCLE BRACELET

Students create a simple bead bracelet in the pattern of the water cycle

APPLICABLE AGES:
Pre K – 1st grade

LOCATION:
At the museum or in your classroom

RESOURCES AND MATERIALS:
- Beads in 5 colors: white, clear, blue, green, orange or yellow, enough for at least one per student
- Pipe cleaners to string beads on and wear around a wrist

PURPOSE:
Students will become familiar with the basic form of the water cycle

OBJECTIVES:
Students will be able to:
1. Explain that water is found in many different places on the Earth
2. Describe the places that water is found
3. Offer ideas on how water could move from one place to another on Earth
4. State the three forms of water

VOCABULARY:
Evaporation
Precipitation
Transpiration
Condensation

ACTIVITY:
Students will assemble a bracelet that represents the phases of the water cycle. In this bracelet, they will begin with

- clouds (white bead)
- rain (clear bead)
- rivers (blue bead)
- plants (green bead)
- sun (orange or yellow bead)

Students will string the beads on the pipe cleaner in the order listed above.

TYING IT ALL TOGETHER:
Discuss with students how a water drop could move from the clouds to plants, and what action the sun takes to move the drop around. Ask students where they are, as humans, in the water cycle. How about other animals?

EXTENSIONS:
Students can tell their story to each other about where their water drop went on its journey.
Students can draw a picture of their water drop journey.

FEEDBACK

Please contact the Education Department with any questions, comments or suggestions regarding this curriculum.

MUSEUM OF THE ROCKIES

600 W. Kagy Blvd.
Bozeman, MT 59717
406-994-2251
museumoftherockies.org
visitmor@montana.edu