

Wonder Water Walk: Examining Runoff and Infiltration Areas

Lesson Summary: (Grades 4-12)

This lesson will provide guidelines and techniques for taking a walk on a school campus and/or adjoining area in order to observe interactions between the hydrosphere's water cycle and the geosphere's topography. During the walk students identify the pathway of stormwater runoff and areas where water will infiltrate to replenish groundwater. They will compare and contrast permeable and impermeable land cover. Along the way students may identify the wide assortment of nonpoint source water pollution picked up and carried by stormwater.

Missouri Learning Standards:

4.ESS2.A.1 Plan and conduct scientific investigation or simulation to provide evidence how natural processes (e.g. weathering and erosion) shape Earth's surfaces.

5.ESS2.A.1 Develop a model using an example to describe ways the geosphere, biosphere, hydrosphere, and/or atmosphere interact.

5.ESS3.C.1 Obtain and combine information about ways individual communities use science ideas to protect the Earth's resources.

6-8.ESS2.C.1 Design and develop a model to describe the cycling of water through Earth's systems driven by energy from the sun and force of gravity.

9-12.ESS2.C.1 Plan and conduct an investigation of the properties of water and its effects on Earth materials and surface processes.

Related Vocabulary:

Watershed / Water Cycle	Nonpoint Source Water Pollution	Hydrosphere / Atmosphere
Runoff / Infiltration	Point Source Water Pollution	Geosphere / Biosphere
Erosion / Sediment	Household Hazardous Wastes	Topography / Elevation
Permeable / Impermeable	Fertilizer / Pesticides / Insecticides	Saturated

Related Web Links / Background Information:

[Missouri Department of Natural Resources \(arcgis.com\)](http://arcgis.com) This MDNR GeoPlatform page has links to numerous maps. Find the Missouri Watershed Map link on the GeoPlatform page.

[No MOre Trash! | Missouri Department of Transportation \(modot.org\)](http://modot.org)

[After the Storm \(epa.gov\)](http://epa.gov) This PDF brochure explains nonpoint source water pollution that occurs after rain.

[Thermal Impacts | UNH Stormwater Center](http://unh.edu) Describes how runoff gets heated from impermeable surfaces.

[The Water Cycle \(PNG\) | U.S. Geological Survey \(usgs.gov\)](http://usgs.gov) High School diagram

[The Water Cycle for Schools | U.S. Geological Survey \(usgs.gov\)](http://usgs.gov) Lower Grades Diagram

Required Materials:

Student Footwear: Shoes that can be gotten wet (river sandals, old tennis shoes, crocks, rubber farm, or rain boots). *Flip flops are NOT recommended for they can slip and slide easily and they do not provide enough side and sole protection.*

Jackets: Depending on the season and weather conditions, jackets or coats may or may not be required.

Clothing: In warm weather it is best if students wear shorts so not to get their pant legs wet.

Plastic Bags: Have students bring a plastic grocery bag or provide them yourself in case students need one for wet shoes or boots to return home.

Technology: Teachers need to take their cell phone in case of emergency and to take desired pictures. It is up to the teacher and school policy if students take cell phones. There is the possibility of them being accidentally dropped in the water.

Optional Materials:

- Walking sticks for students (for balance stability)
- Assorted pails, water magnifier and assorted nets (to catch floating objects or examine found critters)
- Thermometers (to take the temperature of water channels, mud puddles)
- Trash bags and grabbers (to collect trash)
- Work gloves (for collecting trash)
- Sunscreen, small first aid kit (for protection of ultra violet rays, insect bites, and cuts)
- Small pocket notepads and pencils for students or for a designated recorder of observations
Laser Gun Thermometer for taking surface temperature readings. *See important information under safety considerations if using a Laser Gun Thermometer.*

Safety Considerations:

- Obtain administrative permission to conduct the activity.
- Determine any hazards that exist in the area to be walked.
- Conduct water walk after a rain event, not during. If a rain event has not occurred, students can still determine the paths of water runoff and infiltration based on less direct observations.
- Students all have appropriate footwear and dress available ahead of time and know what to bring on the day of the activity.
- Explain and discuss potential safety hazards before taking the trip with students.
- Obtain parent permission if the walk goes off of the school campus.
- Have a cell phone on with the school's office phone number.
- Notify the school office of your departure and return time.
- Be aware of any students with insect or food allergies (or any health concerns) and methods for avoiding and handling any potential health emergencies.

Laser Gun Thermometer Use: School and Student Safety Considerations IMPORTANT!

*Note: Medical thermometers and laser gun thermometer are NOT the same thing.
Laser gun thermometers should not be used to take body temperature
for they would cause tissue damage.*

**Laser beam from these thermometers can damage the lens and cornea of eyes
just like looking directly at the sun can. Infrared laser guns are NOT medical devices!**

*Laser thermometers should not be used by young children or older students
who are not responsible or who can't consistently follow instructions and rules.*

Safety Precautions During the Activity:

- Direct students where to walk and the designated boundaries.
- Do not let students cross any roads or streets without you being the crossing guard.
- Do not enter flooded channels that are more than ankle or calf deep for students. Avoid swift moving flood waters at any depth. Avoid water you can't see through.
- Inform students to keep a constant eye out for threatening objects that have washed into the area such as glass, assorted metals, and rusted objects.

Time Requirements:

Preparation:

- Assess the area to be walked (time will vary according to campus and teacher familiarity).
- Collect required and desired optional materials (time will vary according to accessibility).
- Get all necessary permission.

Wonder Water Walk Lesson:

- Warm Up: A week before the anticipated water walk tell students what to bring so they can make plans and prepare accordingly. This may take 30 minutes if the water cycle is reviewed and the school's watershed is introduced or reviewed.
- Wonder Water Walk: Approximately one class period (includes leaving and returning in time to clean up).
- Wrap Up: The wrap up occurs the following class period.

Lesson Warm Up:

1. Ask the students about their experiences walking in the rain either purposely or accidentally. Let them share with each other briefly. Have them use words that describe all their five senses when sharing their experiences. Once they have briefly shared their experiences, this is a good time to remind students that being outdoors during a thunderstorm is not safe due to the threat of lightning.
2. Lead students into a review about the water cycle and the sun's power behind it. Review the water cycle steps: evaporation, condensation, precipitation, transpiration, runoff, and infiltration. Use a familiar diagram with the students or the ones provided under weblinks in this lesson. Emphasize that all of these steps in the water cycle overlap the hydrosphere, atmosphere, geosphere, and biosphere. Introduce these spheres at this time if students are unfamiliar with them.

3. Explain that one way the hydrosphere and geosphere interact is when water runs off the Earth's surface to lower elevations or infiltrates into the ground during the water cycle. Explain that the amount of precipitation of a weather event coupled with topography and land covering determine whether or not water runs off or gets infiltrated into the ground.
4. Explain that land cover is either **permeable** or **impermeable**. Impermeable surfaces like cement and asphalt do not allow water to soak in or infiltrate into the ground. Surfaces that are permeable like lawns, fields, forests allow water to infiltrate into the ground unless they are saturated. If they are saturated, they can't hold anymore water at the time and so water then runs off those surfaces. All runoff that doesn't soak into the ground or evaporates will eventually run off into a waterway at the nearest lowest elevation. This is how freshwater eventually makes it out back to sea.
5. Introduce or review the term **watershed**. Using the information below show the students the school's watershed. [Missouri Department of Natural Resources \(arcgis.com\)](http://arcgis.com)

This MDNR GeoPlatform page has links to numerous Missouri maps. Find the "Missouri Watersheds" map link on the GeoPlatform page (link above). After you open the map, you need to Click OK to leave MDNR website before the map loads. Click on the X in the black box when it appears. Next, enter the school address in the search box. Zoom in and out with the plus (+) and minus (—) icons and drag your curser to show the watershed for the school district. Using the "Basemap Gallery" (icon with four boxes under the search box) to change the background to topographic so student can see the topography.

6. Explain to the student that they are going to be going on a **Wonder Water Walk** on a designated date to specifically examine the runoff and infiltration steps of the water cycle in their school's watershed. Tell students that they will get a firsthand look at runoff areas and infiltration factors.
7. Give specifics about the planned dates. If a permission slip is needed provide that to students at this time. Include the following information that is relevant for the trip.
 - a. Explain how to dress for the water walk.
 - b. Explain the potential hazards to keep an eye out for.
 - c. Explain what other supplies will be taken and why.
 - d. Have the students predict or "wonder" what they may observe.
Consider having a student make a list of these predictions.

Wonder Water Walk Activity:

Conduct the trip when the weather conditions and time constraints are aligned.

- Have the students put on their required footwear.
- Remind students of ALL safety considerations and designated boundaries.
- As the walk occurs have students report and share observations.
- Take pictures of all nonpoint source pollution that the students observe. Include students in the pictures!
- Have students take turns collecting trash and carrying the trash bags. Be sure collectors wear work gloves. Remind them NOT to leave anything behind.
- Look for the following occurrences below during the walk. The list below is a general guideline.

NOTE: Depending on the campus and conditions only part of the list may be observed. If the trash is excessive then a collection should be arranged for another time. Other related observations may be made that are not listed. Use questioning that encourages the students to make the observations on their own. When conducting questions and observations acquire student attention with a predetermined signal. If desired, assign a student or two to be recorders of the classes observations and create list of observations on a small pad. Keep your phone handy. Picture opportunities will certainly arise!

Observe, Describe, and Discuss these Occurrences:

Topography

- How does the slope of the land change throughout the walk?
- Describe gradual and abrupt changes.

Land Use

- How is the area being used by humans?
- What are the manmade structures besides buildings?
- How are all the manmade structures designed to deal with rainwater? [Such as gutters, storm drains, ditches, pipes, rain gardens, low lying catchment basins]
- Find and describe locations and areas for wildlife. Include any wildlife observations or evidence of wildlife (scat, tracks, carcasses).

Land Cover

Compare and contrast **impermeable** surfaces such as concrete, asphalt, and roofs with **permeable** surfaces such as lawns, gardens, fields, or other natural areas. Notice whether or not they are covered in vegetation or bare ground.

If taking a Laser Gun Thermometer, take the temperature of the different surfaces. Report the temperatures and discuss how different surfaces absorb radiant energy from the sun differently. All impermeable surfaces will be hotter than natural groundcover. Runoff will be at a higher temperature from these areas and can stress aquatic life on hot summer days. This is especially true for cold fisheries, sensitive aquatic environments or already impaired waterways.

Water and Water Pathways

- Identify areas that are likely to allow infiltration and areas of runoff.
- If available to observe, note stormwater runoff. Note its color, odor, relative amount, direction of movement, elevation changes, and pathways. Discuss all the substances that are put on the ground that can travel along with runoff.
- Examine any mud puddles or evidence of mud puddles. Note their size, location, dissolved matter in the mud puddle, the water color, and odor. Discuss how the mud puddle disappears.

- Examine any storm drains and their size, location, and any debris caught in the grates. Predict their pathways underground based on the topography.
- Explain that stormwater from places like parking lots and construction sites can carry nonpoint source water pollution to a waterway.
- Depending on circumstances students may or may not be able to wade in water drainage areas.

Nonpoint Sources of Water Pollution

- Keep track of the type, quantity, general condition, and pathways of movement of all litter. Give volunteer students plastic bags, gloves or grabbers to collect trash. Discuss why people litter and how to avoid it. Observe the types of litter. Look out for household hazardous wastes litter such as motor oil or antifreeze containers. Explain the importance of following disposal instructions.
- Watch out for pet waste and explain why it should be bagged and trashed. Explain that too much pet waste becomes excessive nutrient pollution as well as possibly containing disease pathogens. No one likes to see, smell, or step in pet wastes!
- Note any lawns and gardens that are considerably greener than natural vegetation. This may be due to fertilizer use. Explain that following instructions is important when using any fertilizer. Fertilizer runoff can add to nutrient pollution which can create algae blooms in waterways.
- Note that household hazardous wastes that we can't see evidence of maybe used in yards, such as pesticides and insecticides. If these products are used it is important that they are used and disposed of according to instructions. Otherwise they could run off and enter the waterway and cause harm in numerous ways.
- In parking areas look for automobile fluids on the ground. Explain that vehicle maintenance is an important part to keep a vehicle running and protecting water quality.
- Look for eroded areas near any construction zones or areas not covered in vegetation. Explain any observed efforts to decrease erosion of exposed soil. Such methods could include black plastic fences or hay bales to catch and slow soil erosion in construction zones.

Return to classroom in ample time for students to change footwear and wash up as needed. Tell the students to make future observations on their own when on the playground or traveling to and from school. Tell them that you will wrap up the lesson and observations during their next class period.

Lesson Wrap Up:

1. Have a slide show of pictures from the Wonder Water Walk set up to be seen by the class.
2. Using the photos, summarize the observations related to the area's topography, land use, land cover, water and water pathways, and nonpoint sources of water pollution.
4. If trash was collected, include a summary of its contents.
5. Discuss how these nonpoint sources of water pollution could be prevented.

Modifications:

The lesson difficulty could be decreased by making the following adaptations:

- Narrow the scope of the observations
- Shorten the time of the water wonder walk

The lesson difficulty could be increased by making the following additions:

- Provide students a map of the campus (contact superintendent's office). Have them create a key for all types of their observations and label them on the map.
- Have students make a quantitative list of all the litter collected and graph their result.
- Have students use the Internet to estimate the quantity of nonpoint source pollutants (sediments, pesticides, insecticides, automobile fluids) which are released into waterways in Missouri or the United States annually.
- Visit the local waste water treatment plant. If a field trip cannot be arranged, consider getting a self-tour and taking pictures to share with students.

Extensions:

Repeat water wonder walks but add observations:

- Seasonal and diurnal location changes of the sun
- Moon phases that are visible during school hours at various times
- Weather variables: precipitation, clouds, temperatures, humidity, wind direction
- Seasonal changes in plants and animals, known as phenology.

Assessments:

To assess the students' learning, have them answer one or more of the following questions.

- Explain how the geosphere and hydrosphere interact in the water cycle. Include key terms.
- Explain under what conditions rain or melted snow and ice would do which of the following:
 - a. Run off
 - b. Infiltrate
- Construct a table of nonpoint water pollution sources. Include in the table a column for the type, description, and possible method of elimination.