WATER QUALITY

Understanding watersheds

Focus questions	How might we model a watershed? What are the impacts of various human activities on a watershed?
Learning target	Students develop an understanding of what factors impact water quality within watersheds.
Vocabulary	Watershed, watershed boundary

MS-ESS Earth and Human Activity

Performance expectation MS-ESS2-2	**Classroom connection:** This lesson helps students understand the concept of watersheds and how water travels across the earth's surface.

Science and engineering practices

Constructing Explanations and Designing Solutions	**Classroom connection:** Students will construct a model of a watershed to understand how water moves.

Disciplinary core ideas

ESS2.C: The Roles of Water in Earth's Surface Processes	**Classroom connection:** Students observe the physical properties of water as they investigate the ability of water to transport materials.

Cross-cutting concepts

Scale, Proportion and Quantity **Cause and Effect**	**Classroom connection:** Student models will show the effects of various human activities within a watershed.

This activity in addition to the two following investigations: *Watersheds and soil profiles* and *Watersheds and erosion* focus on constructing explanations and designing solutions to determine the effects of water on soil. The effect of water acting on the earth's surface results in runoff and erosion of soil particles that may carry additional materials into water sources. The sediments and whatever is attached to them may have multiple impacts on surface water, both on biotic and abiotic factors. The activity titled *Effects of nutrients on water sources* may be used as an extension of these lessons.

Background

We can't speak about water ecology without including discussions on erosion, watersheds, climate change, and human activities, such as construction and development, impermeable surfaces, and agriculture. In this set of lessons, we will be examining a large watershed, the mighty Mississippi River, and human impacts to the localized regional waterways and to the Gulf of Mexico. Students will learn about **watersheds,** areas of land that funnel drainage water into a water system such as a river, stream, lake, or ocean, and the **watershed boundaries** that divide them. Water flow is governed by gravity, not directionality, therefore all water runs downhill. **Runoff** commonly refers to the drainage of water from a land surface, be that a yard, a parking lot, roads, a farm field, feedlot, or other surface. When water runs off of a land surface, many materials may be picked up and moved with the water. This action is called **erosion.** Erosion might be due to water, or wind or glaciers. Water erosion can be of many types depending on the quantity of water running off and the elevation.

The water cycle incorporates surface water, groundwater, and water in the atmosphere. Surface water is what we see in lakes, rivers, streams, and the ocean. **Groundwater** is stored in aquifers that provide underground water for drinking and it may feed surface water sources. Precipitation recharges aquifers. The hydrologic cycle is constantly recycling water through the processes of precipitation, evaporation, and condensation.

Materials

- Slide deck "Understanding watersheds"
- Student lesson pages

Prior knowledge

Students should have some basic background and knowledge about:

- How soils are formed (physical and chemical weathering, soil profiles, parent materials, etc.)
- The general types of sediment that make up soils (sand, silt, clay)
- The difference between runoff and groundwater and aspects of the hydrologic cycle
- The types of erosion and how they may impact water systems (surface vs. groundwater)
- See `qld.gov.au/environment/land/management/soil/erosion/types` for information related to types of water erosion.

Teacher preparation

1. Use a Driving Question Board to help students focus on questions they would like to investigate.
   - Here is a video to describe how to develop a driving question: youtu.be/vehRN_cQp7k (up to 1:30)
   - See this video for an DQB example: youtu.be/Rag-RnLvE8c
2. Show Slide for DQB. If students have trouble generating questions, here are some sample questions to get them started:
   - How has human activity (construction, manufacturing, agriculture) contributed to runoff into streams, waterways, and other water sources?
   - How have these activities contributed to acidity, nutrient enrichment, and turbidity in water?
   - What organisms are most affected in regions where impacts are high?
   - What needs to be done to improve water quality within watersheds, and how will this help to potentially improve the ecosystems in these bodies of water?
   - Finally, what technology is available to aid agricultural producers to create a more sustainable means of food production?
3. Depending on the questions different groups decide to pursue, the following activities can be used to increase their knowledge and understanding of watersheds.
4. Show slide deck “Understanding watersheds and impacts on ecosystems”.
   This deck includes key terms that students may need to know. There is also background information on erosion, soils, nutrients and various aspects of watersheds to help students understand the impacts to watersheds. This deck may be used as an introduction to each of the activities: Watershed and Soil Profiles, Watersheds and Erosion, and Effects of Nutrients on Water Sources.

Differentiation

Other ways to connect with students with various needs:

- **Local Community:** Students may investigate local aquatic ecosystems to predict the health of the system and observe possible causes for that quality assessment.
- **Students with special needs (language/reading/auditory/visual):** Students may investigate real aquatic ecosystems. Teachers can also create copies of the phenomena slides to pass out to the students so that they can write on the slides as they identify the potential harm and possible remediation to that harm on that slide.
- **Extra support:** Volunteer Stream Monitoring, A Methods Manual: epa.gov/sites/production/files/2015-06/documents/stream.pdf. Nebraska Department of Environmental Quality, Stream Monitoring: deq.ne.gov/NDEQProg.nsf/OnWeb/SBMP
- **Extensions:** Students can observe real-time data in Nebraska through USGS: nrtwq.usgs.gov/ne/. Students can help to solve real water problems within their community. Take part in organizations such as Give Water a Hand: erc.cals.wisc.edu/gwah/.

Student handout

Reflection

Describe your model to another person at your table.

1. Where does the water pool?

Answers will vary.

2. Where does the water flow?

Possible answer: Water flows down from the ridges in the paper to the pools.

3. What does the water look like on either side of the centerfold? Which watershed has more effects from runoff (darker-colored water)?

Answers will vary depending on their model.

4. What do the blue marker lines indicate?

Possible answer: The blue line represents the watershed boundary or the divide between watersheds.

5. How many watersheds was your model divided into? Are there differences or similarities between each side? Each watershed?

Answers will vary. The differences should be related to where the locations of the housing, farm, city and factories.

Rubric for self-assessment

Skill	Yes	No	Unsure
I can describe relevant components of a watershed and the relationships between components			
I can identify the limitations within the model.			
I can describe patterns observed from the model.			
I can use the model to predict outcomes/impacts.			

Assessments

Rubric for assessment

Skill	Developing	Satisfactory	Exemplary
Develop and use a model	Developed a model of a watershed that shows how water flows.	Developed a model of a watershed that shows how water flows and discovered the impact of various human activities.	Developed a model of a watershed that shows how water flows and discovered the impact of various human activities with relevant components, including inputs and outputs.

Rubric for self-assessment

Skill	Yes	No	Unsure
I can describe relevant components of a watershed and the relationships between components			
I can identify the limitations within the model.			
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I can use the model to predict outcomes/impacts.			