

Wetlands and Water Pollution

Target Age: Grade 4
Estimated Time: 3 days/30 mins each

Science Content

Knowing more about the content than you plan to teach allows you to better support students.

When runoff travels over a landscape, it moves from higher to lower elevation under the force of gravity and takes the path of least resistance. As a result, precipitation will eventually end up at the lowest elevation in the area it falls, often a body of water or wetland. This water will ultimately end up in the oceans.

Runoff that travels through urban and agricultural lands can pick up pollutants such as loose soil, animal waste, pesticides, or fertilizers, all of which can be rich in nutrients. When this water enters rivers and other bodies of water, it may harm the health of ecosystems and human populations that rely on those water sources.

Just as extra nutrients help farm crops grow bigger, extra nutrients in runoff cause algae and aquatic plants to grow at faster rates. When too many nutrients are washed into a lake, algae can grow too dense and cause fish to suffocate. Some algae even produce toxins that are harmful to fish and humans. This uncontrolled growth can eventually form harmful algal blooms like the ones that occur in Lake Erie every summer. Excessive sand and soil in waterways decrease visibility for fish and can get trapped in their gills, causing suffocation and death.

Wetlands play an important role in controlling water quality by acting as sponges that filter contaminated runoff, reduce erosion, and prevent flooding. Half of the wetlands that used to cover the continental United States have been destroyed since the 1600s. The state of Ohio alone lost nearly 90% of its wetlands to make way for farming and residential areas. As a result, many of nature's water filters have been replaced with sources of water contamination.

VOCABULARY

Weathering is water, wind, or other forces slowly breaking down rock and soil into smaller pieces (grains).

Erosion is the movement of those grains to another location by water, wind, or other forces.

Deposition occurs when the worn away material(s) is left in a new location.

Groundwater is found underground. It is held in open spaces in rock/soil, such as rock/soil pores or rock fractures.

Nutrients are substances that help living creatures grow. These can be helpful or harmful to an ecosystem depending on how many nutrients are present.

Wetlands are areas of land where soil is saturated with water. Wetlands are important for filtering pollution and flood prevention.

Sediment Pollution is excess soil that is moved from land into water systems.

Harmful Algal Blooms (HABs) form when colonies of algae living in a lake or ocean grow out of control and harm other creatures that rely on that water.

5-E Learning Cycle Procedure

The 5-E approach actively engages students in their own learning by promoting student questions and exploration. Its 5 stages are: engage, explore, explain, extend, and evaluate.

ODE Standards	NGSS Standards
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Earth & Space Science Topic: Earth’s Surface “Earth’s surface has specific landforms that can be identified.”	4-ESS2-1 “Make observations and/or measurements to provide evidence of the effects of weathering or the rate of erosion by water, ice, wind, or vegetation.”
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Learning Objectives

Students will be able to...

- Explain how water travels through a landscape to form wetlands.
- Identify how water moves sediment through a landscape resulting in weathering, erosion, and more.
- Construct inferences regarding how pollutants or excess nutrients impact ecosystems/landforms.

Materials & Lesson Prep

Engage	Explore	Explain	Extend
<ul style="list-style-type: none"> ● Large bucket of water ● Student clipboards & drawing materials 	<ul style="list-style-type: none"> ● Wetland model per group ● Watering can or spray bottle ● Large sponge per group ● Graduated cylinder or measuring cup ● Food coloring ● Exit Slips 	<ul style="list-style-type: none"> ● The Wetland Story ● Wetland model ● Large sponge ● Food coloring 	<ul style="list-style-type: none"> ● Wetland model per group ● Large sponge per group ● 1 Cup of gravel, sand, and soil per group ● 24 oz of water per group ● Food coloring ● Student research sheets (Appendix C)

Engage - 20 minutes

- Take students outdoors. Predict: Ask students what they think happens to water when it’s spilled onto earth’s surface through rain or human actions.
- Demo: Pour a large bucket of water onto the ground, including both grass/dirt and concrete.
- Challenge students to draw what they think happens to the water once they can no longer see it. Use the questions listed in the table on page 5 to support deeper thinking (~ 10 minutes).
- Invite students to share their ideas in small groups and/or as a whole class. Ask for their reasoning and/or what life experiences informed their ideas.

Explore - 15 minutes

- In groups of 3-5, students will explore how wetlands work by experimenting with wetland models (For model building instructions, see Appendix A), water, and sponges.
- Challenge students to explore how water travels through the landscape with and without the sponge. Use the questions provided below. Students may explore the addition of food coloring on the landscape for an added challenge.
- Exit Slip: After the exploration, ask students to answer a question on a half sheet of paper: “What is one new thing you now think you know about water, wetlands, or runoff?”
- Optional: Offer students the opportunity to explore the websites shared in student resources. These are age appropriate sites that can help students answer initial questions about wetlands, groundwater, and water quality related issues.

Explain - 15 minutes

- Gather the class in a circle on a rug or around a large table.
- Using one of the models, explain—with your students’ help—how water on earth’s surface moves through a wetland landscape. You might choose to provide this explanation as a mini lecture or through a story telling, like the Wetland Story provided in Appendix B.
- Move through the steps narrated in the attached wetland story to demonstrate how the sponge acts as a wetland in this model. Use the guiding questions in the table below.
- Optional: To extend this phase, you might share the mini-documentary “After the Storm” (20-min, see Student Resources Table for link). This free video provides real visuals and explanations about how water runoff feeds our wetlands. It also challenges students to begin thinking about what problems may arise.

Extend - 30 minutes

- In groups of 3-5, students explore what natural elements are influenced by or influence water runoff. Offer students an assortment of materials they might add to their models. Hint: Invite students to explore variables one at a time: colored water (nutrient pollutants), soil, sand, rock, or animals/plants. Model this and support students in recording their ideas on the *Student Research Sheet* (see Appendix C).
- Students share what they now know about water runoff and how this can be affected by human actions, pollutants, and changes to a landscape. Compile students’ ideas on a graphic organizer or an interactive whiteboard to support closing discussions.
- 3-2-1: Students check in with how confident they feel about their level of understanding so far. They can show these levels (3-2-1) with their fingers and eyes closed as a class or turn them in on strips of paper for more anonymity. Add learning experiences as needed.
- Optional: Use a SmartBoard or projector to explore the global surface water map and global forest watch map listed in Additional Resources table. These interactive sites will help support meaningful discussions and build on previous observations and inferences.

Guiding Questions	
Engage 20 minutes	What do you now notice about the path the water is taking? How does the water on the blacktop move differently than the water in the grass? What do you know about life underground? How might living things interact with the water?
Explore 15 minutes	Do you notice any similarities or differences when you use the sponge on the model? What do you think the sponge might represent in a wetland landscape? Why? How might the amount of rainfall impact this landscape? What do you think is missing from this model?
Explain 15 minutes	How does this model relate to the water we poured onto the ground yesterday? What do you notice about the path the water is taking? Why might that be?
Extend 20 minutes	Can you predict what you think might happen if we add <u>(sand)</u> to the model? How does the addition of _____ change how the water acts? How does this relate to how humans impact nature? Can you make any connections to things you know about pollution or conservation?

Evaluate: Pre/Post Assessments

Students' initial drawings (Engage) with student explanations provide an excellent pre-assessment. Below are ideas teachers may use to assess students' final understanding.

- **Present:** In small groups, students research one of the ways wetlands have been polluted or removed in the United States. Ask students to share their findings through a poster.
Hint: Challenge students to connect their research area to the wetland model they explored.
- **Reflect:** Journal prompt. *What would happen if we lost all of our wetlands?* Students should use what they learned to plan and write a reflective essay about how the earth could be impacted.
Hint: Students might consider what the cause would be, how humans/animals and the landscape might change, using supporting evidence from the week's work

ADDITIONAL CONTENT RESOURCES TO USE WITH STUDENTS

Extra Resources

Science Trek: "<http://idahoptv.org/sciencetrek/topics/wetlands/facts.cfm>"

Kids Do Ecology: "<http://kids.nceas.ucsb.edu/biomes/freshwaterwetlands.html>"

U.S. Fish and Wildlife Service: "https://www.fws.gov/endangered/esa-library/pdf/what_you_can.pdf"

Videos

After The Storm: "<https://www.youtube.com/watch?reload=9&v=0fIXhs6DzIE>" (21:33)

Interactive Maps & Activities

Great Lakes Coastal Wetland Monitoring Program: <https://www.greatlakeswetlands.org/Map>"

Cuyahoga County Wetland Inventory: "<https://www.cuyahogawcd.org/files/assets/daveymap.pdf>"

Global Surface Water Explorer: "<https://global-surface-water.appspot.com>"

Global Wetlands: "<https://www.cifor.org/global-wetlands/>"

Appendix A – Building a model watershed and wetland

Materials:

1. Modeling clay
2. A long shallow pan, ideally a rolling paint pan (~13 x 9")
3. A large sponge
4. Landscape décor such as small houses, animals, or trees

Instructions:

1. Use the modeling clay to build land over the upper one-half to two-thirds of the pan. The modeling clay can be spread as a thin layer, with different colors representing different components of a watershed if desired (for example, city, farms). Add small houses, trees, animals, etc. to the land for added effect.
2. The lower part of the pan should be left empty to represent a body of water such as a lake or the ocean. A narrow stretch of yellow modeling clay can be placed between the land and water to represent a beach.
3. The clay should gradually slope down towards the bottom of the pan. The clay should be smoothed along the edges to make sure there are no gaps that water can run through.
4. Use a butter knife or other tool to cut out areas of clay to make streams. One suggestion is to make one stream that drains into the lake/ocean and then make a few smaller tributaries that branch away from the main stream.
5. Place a sponge (the “wetland”) in the lake/ocean right in front of the stream so that water from the stream drains into the sponge.
6. Water poured or sprayed onto the land should run off into the streams or towards the water body. If the sponge is present, it will soak up some of the water draining the landscape. You can measure how much water the wetland soaks up by squeezing out the water into a graduated cylinder or measuring cup.
7. “Pollution” such as excess nutrients can be added by placing small drops of food coloring on different parts of the landscape. Water sprayed on the land will then pick up the pollution and carry it towards the streams, wetland, and lake/ocean.
8. Compare what happens to water and pollution with and without the sponge.



Photograph to the left shows an example model that includes land (green clay), beach (yellow clay), a place to put the wetland (sponge), streams cut out of the clay, and landscape decorations including houses, trees, and a farm.

Instructions are adapted from the *Wetland in a Pan* educational activity presented in various forms online and credited to sources including *WOW! The Wonders of Wetlands* by The Watercourse and Environmental Concern (1995) and the *Wading into Wetlands* issue of *NatureScope* (1992).

Appendix B - The Wetland Story

Teacher Dialogue	Teacher Actions
Down at the tip of Florida you will find the Everglades. This wetland region is where the Kissimmee River empties into the great Atlantic Ocean.	
Fertile farmlands, marshes, rivers, and more cover this large area. It is home to countless animals, such as frogs, crawfish, birds, fish, and even alligators. These animals thrive on the abundance of freshwater and aquatic plants growing amongst the limestone bedrock.	<ul style="list-style-type: none"> ● Set 2-3 small model land animals inside the wetland model ● Place 1-2 small model fish into the water channel of the model.
Farm Lands throughout this region sometimes dust or spray their fields with chemicals like fertilizers or pesticides. These help the plants grow but can also unintentionally move beyond the edges of fields.	<ul style="list-style-type: none"> ● Sprinkle 1 tbsp of food coloring across the banks and a small amount into the water channels of the model.
When the rains come, dirt and nutrients along the shores can be washed into waterways. The waters move into the rivers and down into the wetlands, where they enter marshes or shallow bodies of water.	<ul style="list-style-type: none"> ● Pour two cups of water into the model at the top where the water channels start and across the banks using a watering can. Allow the water to pool at the bottom of the model.
Some water enters these wetlands during rain or from nearby rivers/streams, but water also comes in as ground water, water from that is stored in soil and rocks underground. All these sources of water come together to create very wet and fertile ecosystems.	<ul style="list-style-type: none"> ● Draw students' attention to the impact of the sponge by touching the soaked sponge or even squeezing it out into a measuring cup to see how much it adsorbed.
Over time this water may evaporate or move on into other rivers or oceans. Generally, as this water leaves more water enters through rain, rivers, and groundwater, keeping soils most.	<ul style="list-style-type: none"> ● Repeat the cycle as many times as needed to support student understanding.
Discussion Prompts	Teacher Actions
<p>How does this model relate to the water we poured onto the ground yesterday?</p> <p>What do you notice about the path the water is taking? Why might that be?</p>	<p>You might:</p> <ul style="list-style-type: none"> ● Color the water to make its path more visible ● Add dirt or sand to act as sediment ● Invite students to do the actions as you

<p>Why might this water be important in a wetland ecosystem? What does it do?</p>	<p>tell the story</p> <ul style="list-style-type: none">● Start with a saturated sponge to illustrate the groundwater
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Appendix C -Wetland Research Notes

Variable	Observations	Inferences
Model Only (control)		
Food coloring		
Sand		
Other _____		