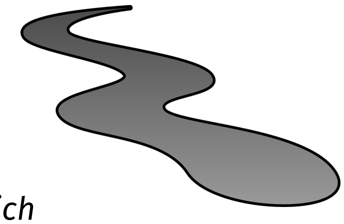
Learning Cycle 1

We All Live in a Watershed



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About this Lesson

In this lesson, students will learn what a watershed is, and how humans and natural factors can impact watersheds. They develop and use a scientific model to test their ideas about how water flows in a watershed, and compare their models to how actual watersheds work.

Materials, Resources, & Advance Preparation

For each student:
Copy of What is a watershed? friendly talk probe
Post-it notes

For each group:
Copies of maps of your local watershed.

Bellingham Schools:
Lake Whatcom Watershed:

- The City of Bellingham provides this map of the Whatcom County Watershed and the Lake Whatcom Management Program also provides several resources, including maps. Another image students might find useful is this map of the watershed showing elevation changes in color.

Note: *If students are having trouble identifying human factors in watersheds, you can use additional city maps showing the same area to help them build the connection to the roads, buildings, etc. that are found there.*

Supplies for building a 3-D model of a watershed
****Have enough material such that every group has access to the materials below.***
Base of Model:

- Large plastic garbage bag to cover each table/for clean-up
- Large bin to set model in and catch water (foil baking pan, shallow tray, baking sheet, etc.)

Materials to represent human and natural features:

- Cardboard scraps
- Paper bags
- sponges/foam scraps
- Qtips and cotton balls
- Toothpicks & popsicle sticks
- Blocks (nonporous material, such as styrofoam, plastic, etc.)

- Tape (masking or painter's tape type)
- Wax paper
- Aluminum foil
- Tissue paper
- Gravel

Engage Phase

Ask students to complete the sentence, "We live in a…." with as many possible answers as they can. Examples might include:

- City (Bellingham)
- County (Whatcom)
- Country (US)
- State (WA)
- Neighborhood
- House/Apartment/Trailer/etc.
- Region (PNW)
- Century
- Solar System
- Universe
- Year/Decade/Century

TEACHER TIP
If NSEA has already come, most students will already know what a watershed is. You may want to begin this lesson prior to their visit.

Ask students whether the word "watershed" is a viable option to complete the sentence. Some students may be familiar with that term, and some may not– use that as an opportunity to find out more about what they *think* that means. (Do not provide a definition to students at this point– focus on eliciting *their* ideas)

Project and/or provide copies of *What is a watershed?* to students as well as a post-it. Read through the friendly talk probe together, then ask students to respond individually.

Instruct students to write the name of the person they most agreed with on their post-it note, then collect these. After all the post-it notes are collected form a bar graph of the class's responses to the probe by grouping/stacking similar responses.

Teacher Tip: *Take a snapshot or put the graph in a space where you can keep it up and refer back to it later.*

Ask students: *What do you notice about the graph of our responses?*
Discuss patterns responses such as most/least chosen or not selected by anyone and invite volunteers to provide a reason why they did or did not choose a particular friend's idea.

Teacher Tip: *You may already use sentence starters and discussion norms with your class to encourage friendly disagreement and respect for one another's ideas– use those here!*

Students will most likely have had different ideas about which friend had the best thinking about what a watershed is–this is OK. Indicate that you will be doing some activities in this lesson to help them develop their understanding of watersheds, and that you'll be revisiting their responses at the end of the lesson after they have more information.

Teacher Tip: *Some students may 'know' what a watershed is and some may not– they may want to know who is 'right'. This is an opportunity to focus on norms of science– Do scientists vote on what is the best idea or take the word of other scientists? No– they relay on EVIDENCE. Students will be gathering evidence to help them understand what a watershed is in the activities that follow.*

Exploration Phase

Introduce the four maps of the Lake Whatcom Watershed (or your local watershed). You might wish to project the map and/or provide groups of students with printed copies, or have them pull up a map on their own device.

Teacher Tip: *Depending on your students' prior experiences with maps, you may want to introduce parts of the map such as the scale and legend.*

Tell students that this is a *map* of the "Lake Whatcom Watershed" and that you'd like them to observe this map for clues as to what a watershed might be. Prompt students' observations with questions:

- What do you notice on the map? What landforms are shown?
- What marks show the boundaries of the watershed? What do you notice about where are these located?
- What do you notice inside the watershed? Is there a body of water?
- What does this make you think a watershed might be?

Encourage students to locate familiar landmarks/places they have been, your school, etc. As a class, create a list of what is found in your local watershed. Examples include:

- Roads (Dirt/Asphalt)
- Mountains/hills
- Hills
- Creeks/Streams/Rivers/Lakes
- Buildings/Houses/Schools
- Trees/Plants
- Railroads
- Bridges
- Dirt, Rock/Gravel
- Parking lots
- Parks

Point out that the map shows water. Ask students whether they think the water stays in one place or moves? Invite them to explain where they think water moves using their maps. For example, water in a creek may flow into the sea.

Teacher Tip: *Boost students' word association– Take a moment to emphasize the word 'shed' in watershed - what does it mean for water to shed? If water is 'shedding', where is it flowing?*

Point out that a map is a 2-dimensional or flat model, so the movement of water can only be shown north/east/west/south– do students think that water can move in other directions? (flowing downhill, etc.) To be able to examine that, students will be building a **3 dimensional model** to answer the question *How do different features within a watershed affect the flow of water?*

Explain that students will be working as a TEAM (review norms for group work/discuss what that means and how scientists also collaborate) and that after their model is built, each group member will need to explain one idea they contributed to their model.

Explain that **planning** is an important part of the process for their team. Explain to students that they can represent *a part of the watershed* shown on the map (model this) or the whole watershed- they should decide as a group. In their model, they will include everything EXCEPT the water (which you will add later).

Tell students they will also need to make a decision about **materials** they want to use. Look at the available materials together as a class and brainstorm which materials could be used to represent different features of the watershed. For example, the paper grocery bags could represent the ground, because it absorbs some, but not all, water. Tape could represent roads, since the water flows over them, but doesn't soak in. Cotton balls could represent plants, which soak up water, etc.

Before students begin building their model, you can have them (as a group) develop **sketches** of what their models may look and the materials they plan to use. We suggest putting materials at a central station and allowing groups to send a representative to pick out the materials their group included on their list; however, you may also wish to prepare a set of materials in advance for each group.

Provide time for students to build their models. Circulate around the room to observe groups and support their thinking and collaboration.

- What features are you building in your model? What material did you choose for that feature? Why? How did you decide on that as a group?

Note: *Either keep the models after they are finished or plan for them to build new models/replicas for the extension phase.*

Explanation Phase

Hold a Gallery Walk in which each group explains their model and what each material represents in their model. Be sure to ask all group members to contribute.

At each model, ask students to predict what will happen when rain falls (you spray water over it). For example, students might predict water will soak in certain places or flow down others, and collect in low areas.

Ask students to observe as you spray water on the model.

- What did you notice happening?
- Where did the water end up? Why do you think so?
- How did that match your predictions?
- Do you think your model represents what happens in real life? Why or why not?
- What might you do to improve your model?

As you get to each new group, ask them to consider:

- How does your watershed model compare to other groups' models?

Tell students that all scientific models are similar to the thing they represent, but also different in some ways. Explain that you will be watching a video about watersheds, and that you want students to be able at the end to answer the question: How does your watershed compare to the video?

Show the video, *A Watershed Tells a Story:* https://youtu.be/RcUbL-N0Llc

Afterwards, ask groups to discuss similarities/differences between their model of a watershed, and an actual watershed, and to think about how they might improve their model to make it function more like a real watershed.

Examples of similarities shared by students:

- We had features like roads/buildings that water didn't pass through
- Water flowed downhill and collected in the lowest point

Examples of differences shared by students:

- The headwaters/source was the ice melt from a mountain in the video; in our model it was the spray bottle
- We had a lake where water collected, not the open ocean

NGSS Note: *All scientific models have limitations and ways that they differ from the actual object or phenomena they represent. Students' engaging in constructing, using, and critiquing/evaluating models are important parts of scientific modeling.*

Extension Phase

Each group will be assigned a human factor that can impact their watershed (assign randomly by drawing from a hat or rolling dice, etc.). Ask each group to discuss and predict how that factor will impact the watershed.

Explain to students that they will be testing their predictions using their model. Explain that **models** can be a useful tool for scientists to test predictions that would not be feasible to test in real life (e.g., you wouldn't want to intentionally pollute water to see what happens).

Human factors:

- Pollution (glitter,food coloring, koolaid powder, etc.)
- Logging (removing plants/trees upland)
- Planting trees
- Adding buildings

- Adding impervious surfaces like roads, parking lots
- Diverting water/building dams

Hold a Gallery Walk of the models! Travel as a class, to each model, explain and model their impacts and identify the pieces of their models. Ask students to discuss whether their predictions were correct and how their model provides evidence.

Option: *If you recorded tests of student's models, you can have them make video presentations of how their human factor impacts the flow of water in a watershed.*

Evaluation Phase

Revisit students' initial responses to the *What is a watershed?* Probe and the sticky bar graph. Small groups should engage in discussion of the friends' ideas again and which they think has the best idea.

As an exit slip: **Individually**, ask students to explain in their own words, whether their ideas have changed.

Optional: *Have students use the sentence stems*

- *I used to think.... Now I know....*

TEACHER TIP *An important part of **sensemaking** is reflecting on how their initial ideas have changed.*

Bring groups back together to discuss as a class:

- Who do you think has the best answer now? Why?
- Why do you disagree with the others' answers?
- Did your ideas change? Why or why not?

*Note: Students might want to add additional clarification to the 'best answer' based on what they have learned in this lesson; this is OK!

BIG IDEA: Ask students to think about the question "***Is there anywhere in the world that is not in a watershed?***" Provide think time for students to jot down ideas or pair/share with peers before asking for responses. Probe students' reasoning as they share ideas.

At this point in the lesson, students should recognize that all water that falls on earth ends up draining into a watershed! That is, *we all live in a watershed.* In the next lesson, students will learn about one of our neighbors in the watershed– salmon.

References & Related Resources

Keeley, P. (2018). Formative Assessment Probes: Uncovering Students' Ideas About Watersheds. *Science and Children*, *55*(8), 20-21.

Science 101: What is a watershed?

Lesson Updated 2.3.24

Connecting to Indigenous Knowledge and Since Time Immemorial (STI) Curriculum

The OSPI *One With the Watershed* story-based curriculum includes Indigenous knowledge of watersheds through teaching of the FIVE HELPERS (pp17-24)

The story "Komo Kwelshan" and Culture-based curriculum was developed by Lummi Nation and connects to many components of the Nooksack River watershed.

The video "The Nooksack River: Nature of Change" incorporates natural and human components of the Nooksack River watershed and is narrated by a Nooksack Tribal Member and storyteller.

The activities in this lesson are complementary and support those in the Since Time Immemorial Unit: STI Elementary Unit 1: Exploring the Pacific Northwest Prior to Statehood: Tribal Homelands. Specifically, there are a variety of maps showing Tribal regions, and maps showing political boundaries that connect to the mapping components of this lesson.

Connecting to the Next Generation Science Standards

Performance Expectation(s):

4-ESS2-2. Analyze and interpret data from maps to describe patterns of Earth's features. [Clarification Statement: Maps can include topographic maps of Earth's land and ocean floor, as well as maps of the locations of mountains, continental boundaries, volcanoes, and earthquakes.]

5-ESS2-1. Develop a model using an example to describe ways the geosphere, biosphere, hydrosphere, and/or atmosphere interact. [Clarification Statement: Examples could include the influence of the ocean on ecosystems, landform shape, and climate; the influence of the atmosphere on landforms and ecosystems through weather and climate; and the influence of mountain ranges on winds and clouds in the atmosphere. The geosphere, hydrosphere, atmosphere, and biosphere are each a system.] [Assessment Boundary: Assessment is limited to the interactions of two systems at a time.]

3 Dimensions of Learning	Activity Connections
Science and Engineering Practices	
Developing and Using Models Modeling in 3–5 builds on K–2 experiences and progresses to building and revising simple models and using models to represent events and design solutions. ● Develop a model using an example to	Students use maps and build physical models to understand and represent the flow of water in a watershed. They use their models to make and test predictions about the interaction of water and human/geographic features.

describe a scientific principle.	
Analyzing and Interpreting Data Analyzing data in 3–5 builds on K–2 experiences and progresses to introducing quantitative approaches to collecting data and conducting multiple trials of qualitative observations. When possible and feasible, digital tools should be used. ● Analyze and interpret data to make sense of phenomena using logical reasoning.	Students analyze maps to identify features of a local watershed.
Disciplinary Core Ideas	
ESS2.A: Earth Materials and Systems Earth's major systems are the geosphere (solid and molten rock, soil, and sediments), the hydrosphere (water and ice), the atmosphere (air), and the biosphere (living things, including humans). These systems interact in multiple ways to affect Earth's surface materials and processes	Students use maps and models to understand the interaction of water with the geosphere/biosphere in a watershed.
Crosscutting Concepts	
Systems and System Models A system can be described in terms of its components and their interactions.	Students describe the watershed in terms of its components and interactions– for example, how water soaks into some features (forests) and flows over others (roads, parking lots).
Patterns Patterns can be used as evidence to support an explanation.	Students look for patterns across different maps representing the same watershed to explain what a watershed is.