8. SEDIMENT MOVES ... THROUGH OUR COMMUNITY

MOUNT ST. HELENS INSTITUTE

Learning Experience	In this lesson, students explore the question of how rivers carrying sediment affect different parts of a river around a river bend. Students learn how scientists create hazard maps that show areas that are more or less at risk from volcanic hazards such as lahars. Students make observations of photographs and video of river behavior to learn more about flooding and erosion in rivers. Students design and run their own investigation to test how water and sediment behaves around river bends. In this investigation, students make observations to determine what parts along river bends are more likely eroded and what parts are more likely flooded. Students apply what they learn to create a hazard map for their community of the risk of flooding along the river that flows through their community. Students learn that sediment carried by rivers will accumulate on the inside of river bends and erode the outside of river bends. Students are asked to reevaluate their community design based on what they learn. **Estimated time** 60 minutes (or two 30 min sessions) plus time for the student-led investigation. Investigation can be conducted at home or in the classroom, based on availability of materials and time. Instructions for the investigation are listed in the student Storypack.
Outcomes	**At the end of this activity, students should be able to:** ● Describe how sediment moves when carried by rivers by examining aerial images, including satellite images. ● Be able to explain in a river system: 1. where sediment comes from (erosion) and 2. where it accumulates (deposition). ● Make observations at their home or in their neighborhood of how material behaves when it is moved by water. ● Explain why sediment carried by rivers is a force that presents a risk to communities (potential to damage structures like buildings, homes). ● Design a scientific experiment to test how material such as sediment or other materials are moved by water. ● Incorporate their findings into a map that reflects zones of perceived risk/hazard along the stretch of river by their community ● Discuss what types of locations may be more or less susceptible to flooding and debris flows from volcanoes ● Discuss the implications of the location of their own community along a river near a volcano ● Go back to their original community design and draw in or label places where sediment carried by the river could present a hazard to structures in their community built along the shore.

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Connecting Idea	Rivers that flow from volcanoes carry large amounts of sediment, broken rocks and debris. Rivers can cause erosion and flooding depending on the shape of river bends: Sediment carried by rivers will accumulate on the inside of river bends and erode the outside of river bends. A hazard map is a useful tool for determining the relative risk of different areas in a community. Scientists make volcanic hazard maps to communicate what areas near volcanoes are more or less at risk from lahars. The process of creating a hazard map helps identify which areas are more or less at risk from flooding and erosion from volcanic sediment.
Materials	**Supplies** • **STUDENT STORYPACK** Access to a variety of resources, including short videos and images, are provided in the student Storypack. These materials can be accessed and edited digitally by students or printed. This lesson includes a hands-on investigation that involves creating a model river channel and modeling the flow of a river. This investigation can be conducted by the students at home or in the classroom. A complete list of suggested supplies and recommendations for the investigation setup is found in the student Storypack. Supplies include: plastic tray or stream table, materials to build a 3-D stream channel, food coloring, clay, sand, silt, pebbles or other materials, and water. Experimental design is determined by students and the availability of supplies. For recommendations on how to use FOSS Soils Rocks and Landforms Kit (distributed to schools through Education School District 112 in Washington State) to support the hands-on investigation, please view our "Supporting Sediment on the Move with FOSS Soils, Rocks
	Setup ❏ **In-person**: Students can make observations individually or in small groups by answering questions accompanying each slide in the student Storypack. Students can share their findings in small groups or one-on-one by answering questions accompanying each piece of media in person. The investigation can be done individually by students at home or in small groups in the classroom. See recommendations for setup in the investigation section of the student Storypack for more information. Small groups or individuals can share with each the designs that they develop. ❏ **Remote learning**: Students can share designs, ideas and calculations via groups in a digital learning management system. Encourage students to record what happened during their investigation using video so it can be more easily shared and viewed by their classmates.

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	and Landforms Kit" guide.	

Instructional Sequence

ENGAGE	Begin this lesson by introducing students to a question they receive in a letter from a fictional character, Darryl, who is looking for a safe place in their community to build a school. Students are reminded about the flooding that happened in a town nearby to their community, and, as city council members, are asked to develop a plan to learn more about the risk of this hazard for their community.
EXPLORE	Students learn more about the risk of flooding and erosion from volcanic sediment carried by the river that flows through their community. Students hear from a scientist at the Cascades Volcano Observatory who introduces them to the idea of hazard maps. Students explore and learn how to read real hazard maps created for volcanoes in the Cascades Range. Guide students to work together or individually through the activities in the student Storypack. After making observations of photographs, maps and videos, students are asked to conduct their own investigation. The investigation section can be done by students at home or in small groups in the classroom, depending on the time or availability of supplies. Assist students in designing and leading their own investigation to explore how sediment carried by a river can erode or flood in a river channel. Specifically, students are running their investigation to explore how water and sediment behaves differently around river bends. The student Storypack outlines each step of the investigation. Facilitator can make changes to the investigation based on the desired setup for students. In this investigation, students are asked to construct a model river channel using supplies around their home or their classroom. Students are then asked to then observe patterns when they pour water through the river channel of how the water erodes and floods certain parts along the river bends. Encourage students to be creative with their materials and investigation setup. Depending on where students conduct their investigations, encourage them to share what they did and what they learned with each other and to provide feedback on the experiment setup. Students are asked to run their investigation more than once and to modify their investigation design and setup.

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	We specifically use the language "investigation" vs. "experiment" to encourage students to define their own setup, variables and to be creative in trying to answer the investigation question. The guidelines for this investigation intentionally align with the Next Generation Science Standards.
EXPLAIN	Ask students to share the setup and what they learned in their investigation with each other. Provide some structure for students to provide feedback: post-it notes, digital comments, etc. Remind students how to provide feedback in a supportive way and/or share information about the "feed-forward" model (https://www.cultofpedagogy.com/feedforward/).
EXTEND	Students take what they learned in their investigation and prior activities and apply this to making a hazard map for their community. Encourage students to work in small groups or to collaborate on the maps that they create. When creating the maps, students are asked to map out areas that are at risk from flooding and erosion along the river bends of the river that flows through their community. Encourage students to compare what they create in their own hazard map with the real-world hazard maps created by the U.S. Geological Survey scientists. Students are also asked to create a map specifically for Darryl, to show locations that would be more safe for him to build his school. Students are asked to both create the map for Darryl and write a response letter to him. After responding to Darryl, students are also asked to review their community map to determine whether they should modify the location of existing structures in their community based on what they learned about the potential for flooding and erosion. Throughout this process of synthesis and reflection, encourage students to talk with one another to share ideas and to review what they are learning.
EVALUATE	Conclude by asking students to reflect on what they learned about how the process of creating hazard maps can help keep communities safe from flooding. In the student Storypack, students are asked to review what they learned by taking their findings to their KLEWS chart. ● In the L column, students answer the question: What did you learn about how sediment from volcanoes can damage communities? ● In the E column, students are asked to list at least 3 pieces of evidence, observations, or data to support your explanation. ● In the W column students are asked to write something that they still wonder.

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	• In the S column students are asked to write about two new science words that you learned? What do these words mean? Student ideas, evidence, observations, and further questions apply to the unit question "How can my community live safely with our volcano?"

Standards & Assessment:

All of the activities in this unit support:

- **NGSS Performance Expectation 4-ESS3-2.** *Generate and compare multiple solutions to reduce the impacts of natural Earth processes on humans.*
- **CCSS.ELA-LITERACY.W.4.10** *Write routinely over extended time frames (time for research, reflection, and revision) and shorter time frames (a single sitting or a day or two) for a range of discipline-specific tasks, purposes, and audiences.*

Standards for this activity:

	Standard	Assessment
NGSS Science and Engineering Practices	Planning and Carrying Out Investigations: Make observations and/or measurements to produce data to serve as the basis for evidence for an explanation of a phenomenon or to test a design solution.	
NGSS Disciplinary Core Ideas	ESS3.B A variety of hazards result from natural processes; humans cannot eliminate hazards but can reduce their impacts.	Use student responses from  that they write in their KLEWS chart
NGSS Crosscutting Concepts	Patterns: Patterns of change can be used to make predictions.	
Social Studies Learning Standards	Geography 2 - Understands human interaction with the environment.	

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Common Core ELA	CCSS.ELA-LITERACY.W.4.1 Write opinion pieces on topics or texts, supporting a point of view with reasons and information.	
Common Core Math	N/A	

Modifications/Adaptations

- "Sediment Moves through our Community" is a particularly long Storypack, so it is possible to break up into shorter activity sections based on the discretion of the facilitator.
- This lesson teaches about hazard maps, which are real-world tools developed by scientists and used by community members, emergency managers and many others. Hazard maps are particularly important when teaching about risk assessment for natural hazards. This lesson can be extended to include more time introducing students to the concept of hazard maps, how to read them, what information they include. This lesson includes links to hazard maps created by the U.S. Geological Survey for all of the volcanoes in the active volcanic Cascades Range of the Pacific Northwest (northern California through southern British Columbia). In the Cascade Range, the number of people at immediate risk during eruptions is greater than at any other volcanic area within the United States. Learn more about the work of scientists at the U.S. Geological Survey in creating hazard maps here: https://www.usgs.gov/observatories/cascades-volcano-observatory/volcano-hazards-cascade-range

Credit

The scientist characters in the student Storypack are based on the work of real scientists from the U.S. Geological Survey Cascades Volcano Observatory who work monitoring sediment at Mount St. Helens and other volcanoes in the Pacific Northwest. The names and characters are fictional and are not based on the names of any real USGS employees. Learn more about the work of real scientists at the Cascades Volcano Observatory by watching their web shorts series: https://www.usgs.gov/observatories/cascades-volcano-observatory/web-shorts-videos which highlight the different work of volcano scientists.