

TTCD Lesson Plan (4): Snowpack Study

Unit:	Grade(s): 5-12	Class Size: 1-30	Lesson Duration: 45 minutes	Location: Classroom and school yard
Topic(s):	Soil science, erosion, watershed			
Student Prerequisites:	N/A			
Essential Questions:	• In what ways are we a part of or separate from the watershed? • How might changes in snowfall from year to year impact people, animals, and plants in the watershed?			
Student Objectives:	1. Students will dig their own snow pits to explore the basic properties of snow/snowpack; depth, density, current depth. 2. Students will understand the meaning of watershed and the role snowpack has within it. 3. Students will identify ways their community interacts with their watershed.			
Standards:	Supports NGS Standards: 5-ES2-1: Develop a model using an example to describe ways the geosphere, biosphere, hydrosphere, and/or atmosphere interact. 5-ES2-2: Describe and graph the amounts and percentages of water and fresh water in various reservoirs to provide evidence about the distribution of water on Earth. MS.ESS2-4: Develop a model to describe the cycling of water through Earth's systems driven by energy from the sun and the force of gravity. Relevant NGSS Crosscutting Concepts: Energy & Matter: Tracking energy and matter flows into, out of, and within systems helps one understand their system's behavior. Scale, Proportion, & Quantity: In considering phenomena, it is critical to recognize what is relevant at different size, time, and energy scales, and to recognize proportional relationships between different quantities as scales change. Systems & System Models: A system is an organized group of related objects or components. Models can be used for understanding and predicting the behavior of systems. Supports Cultural Standards: E-2: Culturally-knowledgeable students demonstrate an awareness and appreciation of the relationships and processes of interaction of all elements in			

	the world around them. Students who meet this cultural standard are able to: understand the ecology and geography of the bioregion they inhabit. Supports Math Standards: K-8 Mathematical Domain: Measurements & Data K-8 Mathematical Domain: Geometry K-8 Mathematical Domain: Ratios & Proportional Relationships Mathematical Practice: Reason abstractly & quantitatively Supports Alaska Geography Standards A-1 & A-2: A student should be able to make and use maps, globes, and graphs to gather, analyze, and report spatial (geographic) information. A student who meets the content standard should: 1) use maps and globes to locate places and regions; 2) make maps, globes, and graphs; C-1 & C-2: A student should understand the dynamic and interactive natural forces that shape the Earth's environments. A student who meets the content standard should: 1) analyze the operation of the Earth's physical systems, including ecosystems, climate systems, erosion systems, the water cycle, and tectonics; 2) distinguish the functions, forces, and dynamics of the physical processes that cause variations in natural regions;
Local Context:	Students will conduct a snowpack experiment at their school. Students create a rough model of their watershed out of snow, and discuss connections as a group.
Vocabulary:	Prediction, snow depth, density, snowpack, watershed, runoff, snow water equivalent (SWE)
Dena'ina language words:	
Materials:	• Shovels • Warm clothes, boots, gloves, etc. • Tape measures, probes, or meter sticks to measure snow pits • Clear plastic cylindrical container (with depth markings on the side, or a dry-erase marker to make your own markings) • Water-resistant map of the greater conservation area • Microwave-safe container for snow sample
Instructor Prep:	<i>Added by TTCD or community partners</i>
Introduction:	While inside the classroom, ask the class to predict some answers to the following questions: • How deep do you think the snow is outside?

	• In what spots do you predict the snow will be the deepest? If the snow outside your school all melted at once and we were able to capture it somehow in the schoolyard, how deep do you think that water would be? This is called the snow water equivalent (SWE), and is an important measurement for snow scientists to monitor. You will find out why today! Write down students' predictions on the board.
Directions:	Part 1: Snow Pits Divide students into pairs or small groups, and give each group a shovel and a measuring tool. Instruct students to dig a hole from the top of the snowpack to the ground, taking care to get an accurate depth measurement once their hole or pit is complete. Part 2: Watershed Model What happens to the water when all the snow melts in the mountains? Where does all this water eventually go? Explain the definition of a watershed. Are we a part of, or separate from it? In their same small groups or together as a class, students will make a model of their watershed out of snow. Go around to each group to show them the map of the greater Tyonek region. Are there other areas that are part of this watershed that you want to include in your model? Ask students to discuss the following questions in their small groups: • How does the melting snow affect this ecosystem? • What kinds of positive effects do you think snowmelt has here? • What kinds of negative effects do you think snowmelt has here? Part 3: Snow Water Equivalent Have students observe as you obtain a sample of snow with the clear cylindrical container. (Try to retain the true density of this snow by not packing it into the container). How full will this container be once the snow melts? Try to get a hypothesis from every student. Explain that this measurement is called the Snow Water Equivalent (SWE). <i>If you take a height of snow and melt it, the height of the water within the same base area is the SWE. For example, if 10" of snow falls at 10% density, then there would be 1" of SWE.</i> Bring the container inside with you as you transition back to the classroom. Microwave the container to melt the snow quickly.
Wrap Up:	Once everyone is settled back in the classroom, refer to your chart of students'

	predictions. Was every team's snowpit the same depth? What are some of the factors that contribute to the variability in snowpack depth? Show students the container with the melted snow. Was anyone's SWE hypothesis correct? Ask students to identify ways that human activities may impact snowpack and how water moves through the watershed. (Examples: people walking or driving can pack snow down more densely, plows, snowblowers, or shoveling can move snow around, roads can change the flow of water from melting snow, etc.) <i>Evidence of learning:</i> Looking at the depths of the snow pits, have students identify a location that might have been impacted by human intervention and explain their reasoning. (possible answers: an area with a more shallow depth because people have walked or driven across it, an area with a deeper depth because people have shoveled snow there, etc.) Then have students describe a situation in which human changes to snowpack could have positive or negative consequences for the surrounding ecosystem.
Lesson Adaptations:	When the group is outside, give students some time to think about where the water will go when the snow melts in spring (based on the topography of the ground below). Tell them that as they are working on their snow pit, whenever you shout "spring melt!" they have to imagine themselves as snow melting into liquid water, and flow across the schoolyard in the path they think water would take. Then when you shout "Okay, back to it" they return to their snow pit digging. This is a fun way to get them thinking about how melted snow moves across the very local landscape.
Extensions:	• Have students revisit their snowpits one or more weeks later, and dig a snowpit nearby. How has the depth changed? • Install a post with height measurements in a local stream. Collect data about stream height throughout the winter and spring in order to observe how snowmelt affects stream height.
Reflections:	How did it go? What did students understand most/least? What could change about instruction or lesson plan?
Resources Used:	This lesson was adapted from the Winter Wildlands Alliance National SnowSchool Curriculum for 5th grade: https://winterwildlands.org/wp-content/uploads/2019/11/5th-Grade-SnowSchool-Guide-Surrounded-by-Snow.pdf