**Lesson 2**

**Nooksack Watershed Orientation**

**Learner Objectives:**

* Learners will locate and orient themselves in the Nooksack River watershed using a map and compass.
* Learners will collectively create a model of the Nooksack River watershed using compact snow.
* Learners will explore through their model how different physical and weather characteristics affect the watershed and its snowpack.
* Learners will hypothesize how climate change may affect the Nooksack River watershed.

**Lesson Goals:**

* Learners will understand where they are in relation to the Nooksack River watershed.
* Learners will understand what a watershed is and how it collects water, stores snow and flows from source to mouth.
* Learners will understand how physical and weather characteristics affect the watershed and its snowpack.
* Learners will understand how climate change will affect the Nooksack River watershed.

**Materials:**

* *14 Mt. Shuksan* Green Trails topographic map
* Compass
* *Elevation Zones and Orographic Effect in the Pacific Northwest* handout

**Assessment:**

* Assessment is embedded in the activity as it progresses. Inquiry-based teaching techniques are recommended. Questions posed to the group will lead to answers and discussions the educator can use to assess student connection and content understandings.

**Time Frame:**

* 20-30 minutes

**Background Information:**

The Nooksack River watershed encompasses approximately 825 square miles of diverse landscape in northwest Washington and southwest Canada. The Nooksack River begins as a trickle at the East Nooksack Glacier. These headwaters are located in the glacial-carved valley known as the Nooksack Cirque (elev. 3,620’), situated on the eastern side of Mt. Shuksan. The Nooksack River travels approximately 75 miles, where it empties into Bellinhgam Bay in the Salish Sea. During the journey from the Nooksack Cirque to Bellingham Bay, this unique river collects large amounts of water from its 825 square miles of landscape contained in its watershed. Students will explore and orient themselves to the upper reaches of the Nooksack watershed through map and compass, building a model of the watershed and a discussion regarding climate change.

**Map Orientation Activity:**

1. Pull out the topographic map and compass. Ask for student volunteers to place the map on the ground so everyone can see it, and orient it using the compass. Assist as necessary.
2. Ask student to complete the following, assisting as necessary:
	1. Identify and trace the highway they traveled up to get to snow school.
		1. *Hwy 542*
	2. Identify the river the highway follows.
		1. *Nooksack River*
	3. Locate their current location on the map.
		1. *White Salmon Lodge or Heather Meadows Lodge, Mt. Baker Ski Area*
	4. Determine the elevation of their current location.
		1. *3500 feet (WS) 4250 feet (HM)*
	5. Locate nearby mountains on map and by sight (if visibility permits).
3. Ask students to identify boundaries they see labeled on the map. These may include:
	1. *US/Canada border*
	2. *Mt. Baker Snoqualmie National Forest boundary*
	3. *North Cascades National Park boundary.*
4. Ask students if there are other boundaries not represented on this map. Answers may include:
	1. *Native American traditional territory*
	2. *Private property*
	3. *Or even animal territories!*

**Watershed Activity:**

1. With the map still oriented on the ground, begin this next activity with the following question:
	1. What is a watershed?
		1. *A watershed is an area of land that collects all the runoff and feeds it into a larger body of water. A network of streams, creeks and rivers progressively drain into larger bodies of water. Topography determines where and how water flows. Ridge tops surrounding a body of water often determine the boundary of a watershed.*
2. Gather students in a circle and use the snow to create a model of the Nooksack watershed. Compact the snow to build mountains, ridges and other features of the Nooksack watershed. Encourage students to include features like Mt. Shuksan, Mt. Baker, the Nooksack Cirque, the Nooksack River and Bellingham Bay. Suggest the students use the map to help create and orient the watershed. Once the model is complete, ask students to:
	1. Demonstrate where water flows when it rains in certain areas of the watershed.
	2. Trace the path snow melt will take as it melts during the spring and summer months from different mountains and ridges.
3. Use the *Elevation Zones and Orographic Effect in the Pacific Northwest* laminated handout in your instructor kit to emphasize and inquire about the following characteristics in the context of the watershed model:
	1. Elevation – How does elevation affect snow or rain accumulation?
	2. Treeline - What elevation is the treeline generally found at in the North Cascades? Do trees affect snow accumulation? Do you think trees affect snow’s relationship with wind?
	3. Aspect - Are there aspects that receive less direct sunlight during the day? How about more? Does this have an effect on the snowpack and snow melt? Which aspect is the beginning of the Nooksack watershed facing (the Nooksack Cirque)?
	4. Freezing level - Can we look around and determine visually where the freezing level is?
	5. Orographic Effect (ask students if they are familiar, and if not, provide a definition) - How does the orographic effect influence this particular watershed?

**Climate Change Discussion:**

1. Begin a discussion about climate change with your students either at the watershed model or as you are moving on the trail to your next destination. Tell the students:
	1. Scientists believe climate change will have significant impacts on our (the Nooksack) watershed. There are several different predictions of snowpack levels for the future. Although scientists’ predictions differ on how much the snowpack will decline, there is little doubt that it will decline.
2. Ask students to think about and respond to the following questions:
	1. Based on your understanding of how snow accumulates in the mountains and in this watershed in particular, will climate change decrease the amount of snow in the mountains? Why? Answers may include:
		1. *Warmer temperatures will raise the freezing level, therefore snow will fall as rain.*
		2. *Warmer temperatures will shorten the winter months.*
		3. *Warmer temperatures will melt off snow earlier in the spring instead of the summer.*
	2. What impact will this have on our watershed and our communities? Answers may include:
		1. *Decrease in water for farmers in the summer*
		2. *Decrease in water for spawning salmon*
		3. *Increase in forest fires*
	3. What are some ways we can adapt our way of life to deal with a smaller mountain snowpack? Answers will vary.

**Key Terms:**

* **Cirque**: A large, carved-out valley created by glacial erosion.
* **Nooksack Cirque**: The glacial-carved valley (elev. 3,620’) situated on the eastern side of Mt. Shuksan. The Nooksack River headwaters originate here.
* **Mt Shuksan**: A 9131’ mountain in the North Cascades. Snow school takes place at 3500’ on the Shuksan Arm and has a view of the NW face of Mt. Shuksan.
* **Topographic Map**: A map representing the elevation of physical features through contour lines.
* **Watershed**: A watershed is an area of land that collects all the runoff and feeds it into a larger body of water.
* **Treeline**: The upper limit of trees, approximately 6000’ in the North Cascades.
* **Timberline**: The upper limits of continuous cover of upright trees.
* **Aspect**: The direction (N, S, E, W) an object or specific feature faces.
* **Orographic Effect**: As a warm air mass from the Pacific Ocean moves onto land, it gains elevation as it follows over the rising terrain. As the air mass gains altitude to pass over the mountains, it quickly cools down, condenses into clouds and sometimes precipitates.
* **Climate Change**: The long-term change in weather patterns.