

I. The Great Glaciers

adapted from North Cascades Institutes Mountain School ELC Curriculum Spring 2011

II. Goals:

- a. Discover an understanding of glacial formation
- b. Develop an understanding of glacial affects on the North Cascades landscape as well as their local landscape

III. Objectives

From this lesson, students will be able to:

- a. Describe the formation process of a glacier
- b. Describe the difference between alluvial and glacial valleys (if alluvial valley was covered in previous lesson)
- c. Identify the following signs of glaciers in their mountain models:
 - i. glacial valley
 - ii. alluvial valley (if covered in previous lesson)
 - iii. glacial erratic
 - iv. terminal and lateral moraines
- d. Describe the process of glacial flour's effect on Diablo Lake
- e. Describe the effects of glaciers on their local landscape

IV. Audience

- a. 5th Graders
- b. Mountain School
- c. 6-10 students

V. Duration

- a. Lesson will be approximately 65 minutes
- b. Minimal prep time necessary- camp tender will bring supplies out
- c. Travel time to site will vary

VI. Location

- a. North Cascades Learning Center campus
- b. Lesson will be taught on the beach on Diablo Lake below the participant parking lot
- c. If multiple groups are at beach, spread out, using both sides of Sourdough Creek drainage

VII. Content & Methods

David Sobel Design Principles Used: Fantasy and Imagination, Small Worlds, Hunting and Gathering

a. Introduction to the Beach: 5 Minutes

The students will be eager to throw rocks into the lake. To reduce this distraction during the lesson, give the students 5 minutes to throw rocks.

- i. Give the students the following safety guidelines:
 1. Rocks must be able to fit in palm of hand
 2. Must keep feet at least 2 feet from the waters edge
 3. Must make sure no one is directly behind and to the left or right of you before throwing
 4. Students must stay between two given points on the beach
- ii. Ask school chaperone and/or teacher to ensure the students are following these safety guidelines.

b. Introduction to Lesson: 5 Minutes

- i. Tell the students that you will give them a riddle about what they will be learning about during this lesson. Give the students the first line of the riddle. If they seem to be having trouble getting the answer, give them the second line. The following is a riddle that can be used:

Learning Style: Auditory

I am heavy and sometimes blue. From here I am within view.

When there is lots of snow, I tend to grow.

- ii. After the students have gotten the correct answer give them an outline of what they will be doing and learning during the lesson. Today we will learn:
 - a. How glaciers are formed
 - b. The effects glaciers have on land by making our own mountains and becoming glaciers ourselves
 - c. How glaciers affected the landscapes of where we live
- iii. Assessment: Ask the students what they already know about glaciers to get an understanding of the students' prior knowledge. Build off of and refer back to this prior knowledge throughout the lesson.

c. Glacier Formation: 10 Minutes

- i. *Student Questioning: 5 Minutes*

Ask students if they have any ideas of how glaciers formed.

Using questioning, guide students to the following answer:

1. More snow accumulates in winter than melts or evaporates during the following summer
2. Layers and layers of snow compacts into ice from pressure.

- ii. *All Hands In Glacier Formation Game: 5 Minutes*

Learning Style: Kinesthetic

Have students gather in a small circle. Tell the students that

their hands all represent precipitation, specifically snow on a mountain top. Have several of the students put a hand in the middle, stacking the hands on top of each other. This represents a snowfall. Continue having students stack their hands on top of the previous “snowfall.”

When each student has a hand in the middle, ask the students questions about how it feels, such as;

1. “Does it feel heavy or light?”
2. “Is there pressure?”
3. “For the students on the bottom, what happened when more snow fell?”

Continue having students stack their hands. Throw in some “summer months” and have some students remove their hands from the stack. After all the students’ hands have made it onto the “glacier” it is time to review.

iii. Assessment:

1. Ask the students to describe again how a glacier is formed?
2. Ask the students what they think glaciers, with all that pressure, can do to a landscape? This will transition into the next section of the lesson.

d. Glacial Effects On A Mountain Landscape: 40 Minutes

i. *Building a Mountain Range: 15 Minutes*

Learning Style: Kinesthetic

1. Tell the students that this is their opportunity to change the landscape. They are all going to get the opportunity to build a mountain range and learn first hand what glaciers can do to the mountain landscape.
2. Break students into groups of 2-3 students per group. Each group will create several mountains to contribute to the overall mountain range. Have students do this in a section of the beach with sand and smaller sized rocks. This will make the mountain building easier for the students. Before sending the students off to build their mountains, ask them what they see in the mountains around them. Is it just rock? Are there trees? Encourage the students to be creative and use lots of materials and to name their mountains. Remind them that they may only use plant material that is dead and down.
3. Give the students a boundary of where they may go to collect materials and have teacher/chaperone assist students. Give the students approximately 10 minutes to build their mountains.

ii. *Becoming Glaciers: 15 Minutes*

Learning Styles: Auditory, Kinesthetic

1. Gather the students around the mountain range, keeping the groups near their constructed mountains. Ask the students to share the names of their mountains. After each group has shared their names, name the range after their school.
2. To review how glaciers form, tell the students you will tell them a story and have them close their eyes. Read the following dialogue to the kids. During the reading place each half of the glacier upon the tops of two mountains.

You are on top of a tall mountain peak. The views are endless and it seems as if mountains extend for miles in all directions. You are thousands of feet above the thin sliver of a river below. The air is bitterly cold and the piercing wind howls all around numbing your body and turning your cheeks bright red. The once bright sky begins to darken as your once endless views are swallowed by a blizzard of white. Heavy, wet snow begins to fall. The snow begins to fill the mountain top basins. Hours, Days, and Months go by with nothing but a blizzard of snow falling from the sky. Year after year, the mountain gets exposed to long, snow filled winters and cool summers. The layers upon layers of snowfall create immense pressure and begin to form ice. After many, many years of this weather the mountaintop is now home to a glacier.

Have the students open their eyes at the end of the reading.

3. Give each group a chance to move a glacier slowly down the sides of their created mountains. If several students want to move a glacier together, have them stack hands on the glacier to create more pressure. Explain that glaciers flow similar to a river, but it may take centuries to creep down mountain valleys.
4. After each group has been able to impact their mountain with a glacier, break the students up into their original mountain building groups. Give the groups several minutes to explore the impacts that the glaciers had on their mountains. Tell the students that each group will be sharing a few impacts that they observed.
5. After giving each group a chance to share their findings, use questioning to guide the students to the following observations if not already discovered:
 - a. **Glacial Valley:** a long, narrow u-shaped depression formed by a glacier moving down a v-shaped river valley.
 - b. **Glacial Erratic:** rocks carried by glaciers and deposited in areas of different rock type

- c. **Moraine:** very large piles of deposited rock and sand left by a glacier
- d. **Terminal Moraine:** moraine at the end of a glaciers path
- e. **Lateral Moraine:** moraine on the edge of a glacier
- f. **Glacial Flour:** sediment that has been ground into fine particles by glacial erosion of rocks and impacts the color of creeks, rivers, and lakes
- g. **Makeup of a glacier:** ice, rocks, water, trees, debris, etc.

Assessment: After all impacts have been identified, ask students to point out each impact again on the mountain models and describe that impact.

iii. *Glacial Impacts Around Diablo Lake: 5 Minutes*

- a. Have the students take a look around across Diablo Lake.
 - i. Ask the students if they can see anything that might be a glacier. Identify Colonial Glacier.
 - ii. Assessment: Ask the students if they can see any of the glacial impacts that they have just learned. Guide the students to identifying these impacts.

iv. *Glacial Impacts Near Home: 5 Minutes*

Learning Styles: Auditory, Visual

- a. Show the students the “Pacific Northwest During the Last Ice Age” map. Explain to the students that this map shows what the Pac NW was like during the last ice age, 15,000-12,000 years ago.
- b. Ask the students if they can identify where their hometowns may be.
- c. Once identified, ask the students how they think the ice sheet that once covered much of the region has shaped the landscape around their hometowns.
- d. This ice sheet impacted the landscape near their homes in the following ways:
 - i. Carved out the Puget Sound
 - ii. Left behind glacial erratics
 - iii. Melt water from the ice sheet caused the Pacific Ocean to rise about 300 feet
 - iv. Olympia sits near the terminal moraine of the Puget Lobe
 - v. At this time Mount Vernon and Bellingham were under thousands of feet of ice.

e. Conclusion: 10 Minutes

i. *Assessment: 5 Minutes*

- a. Split students back into their mountain building groups. Assign each group the following questions to discuss:
 - i. How were glaciers formed?
 - ii. How was a glacial valley formed?
 - iii. How does Diablo Lake get its color?
- b. Give the students several minutes to discuss the question together as a group. Let the students know that they will soon be sharing the answer to their question. They can simply choose a spokesperson to share the answer or use creativity to share the answer in another way.
- c. Ask the whole group of students to list signs or remnants of glaciers?

ii. *North Cascades Glaciers: 5 Minutes*

- a. Explain to the students that glaciers have greatly impacted the landscape in North Cascades National Park. These glaciers and their impacts are one reason why this is such a special place.
 - i. Over 300 glaciers are in the park. The current number is 312.
 - ii. Over half of the glaciers in the lower 48 states are concentrated in the mountainous region called the North Cascades.
- b. Encourage the students to remember the impact of glaciers throughout their time here, and encourage them to search for glacial impacts throughout the campus while hiking.

VIII. Management & Safety

a. Management

- i. Groups 'community agreement' will have been previously established
- ii. Chaperones will understand their role of helping keep group managed
- iii. Boundaries should be established to keep students within safe distance of instructor while; skipping rocks and collecting during mountain building
- iv. During discussions, use 'magnetic circle' to manage students

b. Safety

- i. Establish the following rules during rock skipping:
 1. Rocks must be able to fit in palm of hand
 2. Must keep feet at least 2 feet from the waters edge
 3. Must make sure no one is directly behind and to the left or right of you before throwing

4. Students must stay between two given points on the beach
- ii. Establish safe boundaries during collection;
 1. 10 ft from Sourdough Creek bed
 2. 10 ft from lake shore
 3. Well away from any other trail groups
- iii. Foul Weather
 1. Students should have rain gear and warm layers
 2. Instructor should have spare warm layers

IX. Equipment

- a. (1) glacier from beach cooler
- b. "Pacific NW During Last Ice Age" map
- c. Picture of Colonial and Neve Glacier

X. Foul Weather Alternative:

- a. Lesson will continue outdoors unless;
 - i. Program Coordinator calls groups indoors
 - ii. Students are too wet or cold to continue
- b. If Sourdough Creek is really running, keep students 20 ft away

XI. Evaluation

Assessment questions and discussions are underlined throughout lesson. Before moving to next steps, unsure that students have a grasp of the current material.

XII. Follow Up

Encourage students to remember the impact of glaciers throughout their time here, and encourage them to search for glacial impacts throughout the campus while hiking.

XIII. References

- a. Mountain School ELC Curriculum, North Cascades Institute Spring 2011
- b. Sobel, David. Childhood and Nature: Design Principles for Educators. Stenhouse Publishers. 2008
- c. Weisburg, Saul. North Cascades: The Story Behind the Scenery. KC Publication, Inc. 1988