Mapping the Snout

Subjects

science

math

physical education

Skills

measuring

cooperative action

inferring

map reading

data interpretation

questioning

Materials

- rulers
- *Mapping the Snout outline map and worksheet**
- twenty-six 8 1/2 X 11 signs with year written on both sides

** provided*

Learner Outcome

Students will map and graph the advance and retreat of the Nisqually Glacier and state the relationship between weather patterns and terminus movement, as well as the impacts of climate change on Mount Rainer's glaciers.

Background

Mount Rainer has 25 major glaciers, making it the largest number of glaciers on a single peak in the continental U.S. Together these glaciers cover 35 square miles. Emmons Glacier has the biggest area of 4.3 square miles and Carbon Glacier is at the lowest elevation at 3,600 feet.

The Nisqually Glacier is the most visited and most studied glacier on Mount Rainer, with 150 years of recorded data. Data has shown that the Nisqually Glacier has undergone dramatic changes in size in the last 100 years. Nisqually Glacier was first measured in the 1850's and the fist photograph was taken in 1884 by Allen Mason. This photo became the foundation of a 150 year photographic history of the glacier. In the 1930's Tacoma City Light the United States Geological Survey (USGS) began measuring the surface of Nisqually Glacier to determine the impact that the shrinking glacier would have on the water supplies needed for hydropower.

Photos taken in the early 1900's show the Nisqually Glacier near the highway bridge, but by the 1950's the glacier had retreated 1.2 miles and was no longer visible in photos taken from the highway. In the early 1960's the glacier was once again visible from the bridge but retreated again soon after. Sine then there have been minor advances and retreats. Currently a thickened ice layer has been moving towards the terminus suggesting a possible minor advance (http://www.glaciers.pdx.edu/Projects/LearnAboutGlaciers/MRNP/Glc01.html).

At the end of the last ice age, glaciers continued to expand over the next 3,000 years, reaching their largest size in the last 700 years. During the Little Ice Age in the mid-17th to mid-19th century there was a major glacier expansion. However, since the 1850's glaciers all over the world have been retreating. This retreat of the world's glaciers coincides with the Industrial Revolution and the dramatic increases in human generated carbon dioxide emissions. Larger glaciers have retreated for miles, while smaller glaciers have disappeared completely.

Glacier sizes fluctuate in response to changes in the climatic environment. Yearly changes are influenced by the amount of snow accumulation in the winter and the level of melting in the summer. Climate scientists have predicted that the climate in western Washington will have an increase in annual average temperature. The annual temperature is predicted to increase 2°F by the 2020's, 3.2°F by the 2040's and 5.3°F by the 2080's. Some climate models also predict that fall and winter will have increased amounts of rain precipitation and less snow. Summers will also become drier.

How will the changing climate impact the Nisqually Glacier?

<u>Procedure</u>

Session 1

Distribute the *Mapping the Snout* worksheet to the students and have them work in teams to complete Parts A and B.

<u>Answers to Part B</u>

1.) 1840

2.) 2011; 2598 m

3.) retreat; from 1961-71 the glacier advanced, it retreated in 1976, advanced in 1980 and retreated again in 1986

4.) 295 m

5.) 675 m

6.) 1956-61; 448 m; decreased snowfall in the winter and warmer temperatures in the summer; 1946-51

7.) 1978-80; 164 m; increased snowfall and cooler summer temperatures; 1966-70

8.) retreat; 2030's

Procedure

Session 2

Bring up this link and explore the glacier tab with your students, specifically the temperature and precipitation tabs. Then select the Nisqually Glacier. Click on the QuickTime video to show time-lapsed photography of the Nisqually Glacier.

http://www.glaciers.pdx.edu/Projects/LearnAboutGlaciers/MRNP/Atlas00.html

After looking at the website and video, have students answer the worksheet questions in Part C.

Answers to Part C

1.) As you get closer to Mount Rainer, the elevation increases and air temperatures decrease with and increase in elevation; 40° F or 5° C (answers may vary); this is determined by matching the purple areas on the map where Paradise is located to the temperature scale.

2.) As you get closer to Mount Rainer the elevation increases. Rising air cools and expands, creating clouds. Cloud cover increases over high elevations, leading to high amounts of precipitation; anywhere between 120-140 in or 300-350 cm (answers may vary); this determined by matching the blue area on the map where Paradise is located to the maps precipitation scale

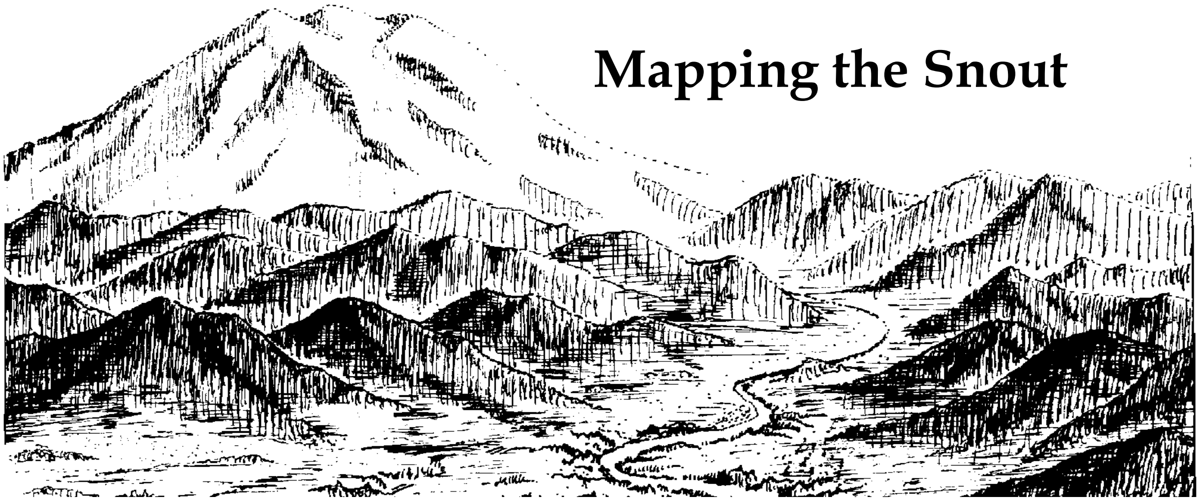
3.) As the snow and ice melt it moves downhill (or down slope) and the water produced from this melting flows into the Nisqually River and out into Puget Sound, where this once freshwater mixes into the ocean and becomes saltwater.

<u>Procedure</u>

Session 3

Take the class outside to demonstrate on a large scale the advance and retreat of the Nisqually Glacier which the students just mapped and graphed. Using chalk, mark a line of the pavement at one end of the outdoor space to represent the 1840 terminus location. Line students up along this line. Explain that the students will be walking together shoulder to shoulder with arms linked, as if they were the terminus of the Nisqually Glaciers, to track the advance and retreat of the glacier from 1840-2011. To advance they will walk forwards. To retreat they will walk backwards. To measure the distances they will be counting their steps, with one small step equals ten meters. At each terminus location leave behind one student from the end of the line, holding a sign indicating the year the terminus was at that spot. Consider using different colored paper for advance and retreat years to make the advance years more obvious. By the end of this activity all of the students in the class, each holding a sign for their year will spread out along the outdoor space, representing the advance and retreat of the Nisqually Glacier (depending one your class size you may run out of students, so you may need to exclude some years or place signs on the ground). See the next page for number of steps per year.

Year they are starting from	Take this number of steps	Go this direction	Year they'll reach
1840	3	Up Valley	1857
1857	14	Up Valley	1870
1870	3	Up Valley	1885
1885	5	Up Valley	1892
1892	7	Up Valley	1896
1896	16	Up Valley	1905
1905	3	Up Valley	1910
1910	14	Up Valley	1918
1918	6	Up Valley	1921
1921	12	Up Valley	1926
1926	9	Up Valley	1931
1931	11	Up Valley	1936
1936	12	Up Valley	1941
1941	11	Up Valley	1946
1946	13	Up Valley	1951
1951	8	Up Valley	1956
1956	45	Up Valley	1961
1961	9	Down Valley	1966
1966	1	Up Valley	1971
1971	4	Up Valley	1976
1976	16	Down Valley	1980
1980	8	Up Valley	1986
1986	10	Up Valley	1994
1994	21	Up Valley	2002
2002	2	Up Valley	2006
2006	21	Up Valley	2011

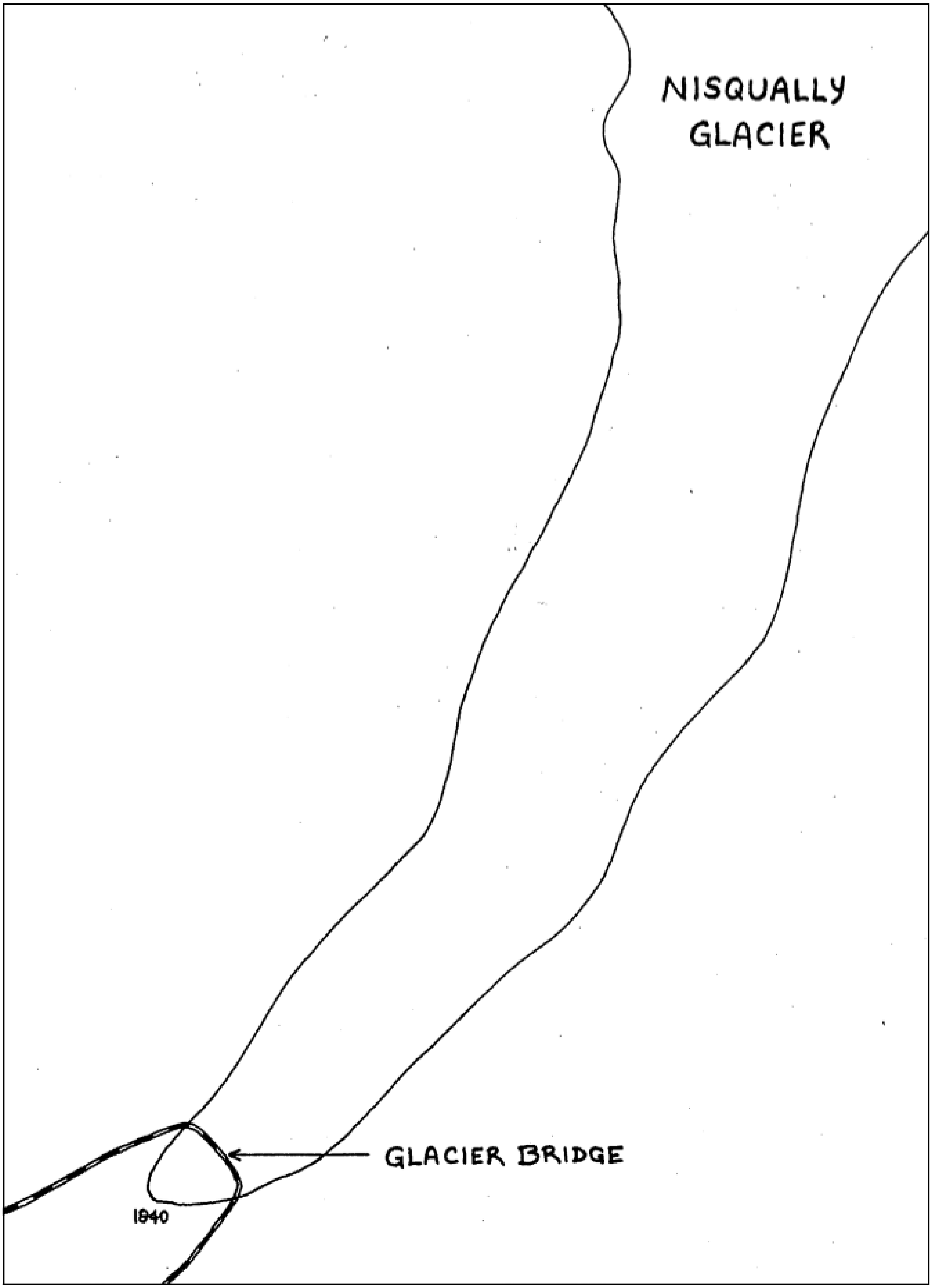


Mapping the Snout

PART A

Using the following information, plot the terminus of the Nisqually Glacier on the outline map by drawing a small (5mm) line and writing the year next to it. Measure all distances from the 1840 terminus shown on the map. Use the *scale* of 1 centimeter = 150 meters to determine distances (this is so all the measurements will fit on the outline). It will be easier if you convert all the meters into centimeters before measuring, by dividing by 150. All marks should be made up valley from the 1840 terminus.

1857	295	1946	1518
1870	434	1951	1648
1885	462	1956	1725
1892	513	1961	2173
1896	578	1966	2087
1905	742	1971	2098
1910	770	1976*	2142
1918	913	1980	1978
1921	970	1986	2062
1926	1085	1994	2164
1931	1177	2002	2370
1936	1286	2006	2391
1941	1409	2011	2598


NISQUALLY
GLACIER
GLACIER BRIDGE
1940

PART B

Answer the following questions based upon the terminus you just plotted on the map :

1.) During which year was the Nisqually Glacier most advanced? _______________

2.) During which year has the glacier retreated farthest up valley? ________How far up valley from the 1840 terminus was it in that year? _______

3.) Between 1840 and 1951did the glacier advance or retreat? _______What did the glacier do from 1961-1971? ___________________ How about in 1976? ____________ How about in 1980? _____________What did the glacier do in 1986? _______

4.) How many meters did the Nisqually Glacier retreat between 1840-1857? ___________

5.) How many meters did the Nisqually Glacier retreat between 1857-1921? ___________

6.) During which five year span since 1951 did the glacier retreat the farthest? _________ How many meters did it retreat? _______What might be the reason for this rapid retreat? ____________ If there is a ten year gap between weather patterns and glacier activity, when might the weather pattern having cause this retreat occurred? ___________________

7.) During which five year span since 1951 did the glacier advance the farthest? ________ How many meters did it advance? ___________ If there is a ten year gap between weather patterns and glacier activity, when might the weather pattern having caused this advance occurred? ____________

PART C

Answer the following questions based upon the Nisqually Glacier webpage and video:

1.) Based on the air temperature map, why do you think the average annual air temperature is lower the close you get to Mount Rainier?________________________
____
____
____

What is the average air temperature at Paradise?________________________

How do you know this?____
____
____

2.) Based on the precipitation map, why do you think the average annual precipitation is higher the closer you get to Mount Rainier?________________________________
____
____
____

What is the average amount of precipitation at Paradise?______________________

How do you know this?____
____
____

3.) In the Nisqually Glacier time lapse video, why does the glacier look like it is advancing forward (up valley) when it is actually retreating (moving down valley)?_
____
____
____
____

	Nisqually River Education Project and Next Generation Science Standards	
PERFORMANCE EXPECTATIONS	**Summary**	**Mapping the Snout**
5-PS-1	**Matter and Its Interactions**	
5-PS2-1.	Support an argument that the gravitational force exerted by Earth on objects is directed down.	X
5-ESS2	**Earth's Systems**	
5-ESS2-1.	Develop a model using an example to describe ways in which the geosphere, biosphere, hydrosphere, and/or atmosphere interact.	X
Science and Engineering Practices		
Developing and Using Models	Develop/use a model to describe phenomena	X
Planning and Carrying Out Investigations	Make observations and measurements to produce data to serve as the basis for evidence for an explanation of a phe-	X
Engaging in Argument from Evidence	Support an argument with evidence, data, or a model.	X
Using Mathematics and Computational Thinking	Measure/Describe and graph quantities such as weight, area, etc. to address scientific and engineering questions and problems.	X
Analyzing and Interpreting Data	Represent data in graphical displays (bar graphs, pictographs, and/or pie charts) to reveal patterns that indicate relation-	X
Obtaining, Evaluating, and Communicating Information	Obtain and combine information from books and/or other reliable media to explain phenomena or solutions to a design problem.	X
	Summary	
Disciplinary Core Ideas		
ESS2.A: Earth Materials and Systems	Earth's major systems are the geosphere, the hydrosphere, the atmosphere, and the biosphere. These systems interact in multiple ways to affect Earth's surface materials and processes. The ocean supports a variety of ecosystems and organisms, shapes landforms, and influences climate. Winds and clouds in the atmosphere interact with the landforms to determine patterns of weather.	X
ESS2.C: The Roles of Water in Earth's Surface Processes	Nearly all of Earth's available water is in the ocean. Most fresh water is in glaciers or underground; only a tiny fraction is in streams, lakes, wetlands and the atmosphere.	X

	Summary	Mapping the Snout
Cross Cutting Concepts		
Cause and Effect:	Cause and effect relationships are routinely identified, tested, and used to explain change.	X
	Standard units are used to measure and describe physical quantities such as weight time, temperature, and volume	X
Energy and Matter	Matter is transported into, out of, and within systems.	X
Systems and System Models	A system can be described in terms of its components and their interactions.	X
Patterns	Similarities and differences in patterns can be used to sort, classify, communicate, and analyze simple rates of change for natural phenomena.	X
Connections to Nature of Science		
Scientific Knowledge Assumes an Order and Consistency in Natural Systems.	Science assumes consistent patterns in natural systems	X
Science Models, Laws, Mechanisms and Theories Explain Natural Phenomenon	Science explanations describe the mechanisms for natural events.	X
Science Addresses Questions About the Natural and Material World	Science findings are limited to questions that can be answered with empirical evidence.	X
	Total number:	**18**
	Percentage coverage:	33.96%