

Investigation: When will there no longer be glaciers in Glacier National Park?

Introduction: You know about glaciers and their effect on alpine landscapes. In this investigation, we'll estimate how long it will be before there are no longer glaciers in Glacier National Park, based on historical records. These historical records are summarized on a map of Grinnell Glacier, on the eastern side of the Garden Wall in Glacier National Park. (The map is from U. S. Geological Survey Professional Paper 1180: Grinnell and Sperry Glaciers, Glacier National Park, Montana: a Record of Vanishing Ice, published by the USGS in 1980. This paper is only one of many scientific studies of glaciers in the park, dating back to the early 1900's.) Grinnell Glacier is one of the largest remaining glaciers in the park, even though it is less than a square mile in area. Once again, this (final!) investigation is intended to build your skills and experience analyzing and interpreting real geological data.

Part I: Small group discussions, followed by class discussions:

- Scientists have been studying the glaciers at Glacier National Park for quite some time. Why do you suppose they have done so? With your lab partners, list as many realistic reasons as you can.
- The reading for today stated that the rate of recession for the terminus of a glacier is not the best indication of how quickly it is losing volume. List as many reasons as you can why that is so. In your lab group, work to re-phrase those reasons in your own words. (The reading, by the way, was an excerpt from the same USGS paper as the map we will be using later.)
- Brainstorm: what else could we measure, that should be related to glacier volume, and might be a better proxy for it?

Part II: Make an initial prediction.

Consider the aerial photo of Grinnell Glacier, showing the areas it covered in 1850, 1937, 1968, and 1993. Based on only this evidence, approximately how many years do you think it will be until Grinnell Glacier is completely melted? How did you come up with your estimate?

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Part III: Data collection.

Each lab group will choose a year (1887, 1937, 1946, 1960, 1968, or 1993). Using the photocopies of the USGS map, outline the extent of Grinnell Glacier for your year. Then carefully cut out your glacier outline. Trace it onto the graph paper provided. Then count the number of squares of graph paper contained within your traced outline. Count every full square and any square that is more than halfway in your traced outline. The total should be very close to the surface area of Grinnell Glacier that year, in “squares.” But how big is each square of your graph paper? Compare the squares of the graph paper to the map scale. Convert your measured area to a more practical unit of measurement. Record your answer in a chart on the blackboard. (If you are the first ones done, set up the chart.)

Part IV: Analysis.

What shall we do with this data, now that we have it? As a lab group or as a class, choose a method of analyzing this data to determine your best answer to the investigation question.

Part V: Interpretation

Now it is time to answer the question, “What does it mean?” I would like you to formulate a hypothesis, relating the rate of glacial retreat to some other variable. Then, see whether you can dig up any data on that other variable. (I may have the data you need, or be able to help you find it; don’t hesitate to ask.) Finally, see whether there is, in fact, a correlation between the rate of glacial retreat in Glacier National Park and the variable you have selected. Whether there is or not, report your findings. (So-called “negative results,” where things don’t turn out to be what we expected them to be, are often as important in science as “positive” results.)

Writing your report:

As with earlier reports, you may write this report either individually or as a group. The usual requirements apply. Remember that I will drop your lowest investigation report grade of the semester, so you may choose not to write this report if you are satisfied with your earlier grades.

Your report should be a written summary of *the investigation question*, *how* you went about answering it, and *your answer* to the question, along with the results of your further investigation in part 5. **For the sake of brevity, please focus on parts 3, 4, and 5 of this exercise: data collection, analysis, and interpretation.** Be sure to include your raw data and graphs, along with any other diagrams that would help your reader. I will be looking for clear explanations of why you chose the method of analysis you used and how you came to the conclusion you did. I will also be looking for signs of thoughtful reflection on what you learned in part 5. For a reminder of my grading criteria, refer to the general grading rubric.

Finally, the most important thing: try to keep the written portion of your report (that is, not counting data and figures) to **less than 2 type-written pages**. This will require you to be concise, and will allow me to read all of the reports (from my 3 sections of GL 110) and give you feedback on them quickly. **This report is due one week from today.**