Glaciers on the Move

ScienceLIVE Lesson Plan

Grades K-8

Summary

In an inquiry base activity, students learn about how glaciers move by observing how a "flubber" glacier slides down a tiny mountain valley. While honing their observation skills, they will learn how slope and basal conditions (roughness of the ground surface) affect glacier movement.

Learning Goals

- A glacier is a large mass of ice that moves.
- Glaciers form from snowfall that accumulates high in the mountains.
- The movement of glaciers has shaped much of the world around us through erosion and deposition, creating U-shaped valleys, hanging valleys, arêtes, horns, and leaving behind glacial erratics.
- Basal conditions and slope affect glacier movement.

Materials

- Flubber: Directions for one “glacier”:
    - Mix together 90 mL glue and 120 mL water
    - Add 80 mL Borax solution [solution is 3% Borax, 97% water] and mix well
- 4 sections of PVC Pipe (cut in half lengthwise), one covered in sandpaper, one covered in small pebbles (fish tank gravel works great for this)
- 4 stands for PVC Pipe, 3 tall, 1 short
- 4 plastic trays to catch flubber at the bottom
- 4 rulers
- Sticky notes to mark glacier travel
- Timer

Experiment Set-Up

Begin by having students come up with a prediction by answering the question, which glacier will travel the fastest and why? Next, divide students into four groups, one at each glacier chute. Use silly putty to connect the glacier chute to the stand and to the plastic trays, so the chute doesn't slip. Designate a student in each group to be the “flubber handler”, and tell all of the students that the “flubber handler” is the only one allowed to touch the flubber until the end of the activity when its time to clean up. Also designate a student to hold the chute still throughout the activity. Do not begin until each “flubber handler” has the flubber in a ball, held at the top of the chute. Instruct the students to not touch the flubber after letting go until the activity is over. Begin the experiment as a class. Every 30 seconds, have students place a small sticky note at the far end of the glacier and measure the distance travelled. After 6 measurements, have students place the chute on the table, and put their hands in their pockets to await cleanup instructions. After cleaning up the activity, have students write up the final distance travelled on the board, and compare results.

Class Schedule

- 20 minutes: Interactive PowerPoint slide show that introduces students to glaciology: what glaciers are, how they form, and the kind of landscapes created by glaciers.
- 5 minutes: Introduce activity, set up each chute, and designate "flubber handler" in each group. Wait until all groups are ready with the flubber held at the top of the chute before beginning experiment.
- 15 minutes: Run glacier experiment.
- 5 minutes: Graph results. Compare class results.
- 5 minutes: Write up conclusions and wrap up.

Prediction

Which glacier will travel the fastest? Why?

Discussion Questions

- Which glacier travelled the fastest? Why do you think so?
- The steep slope, smooth surface glacier travelled the fastest due to higher momentum because of gravity, and lower friction due to the smooth surface.
- Was every experiment run the same? Were there sources of human error?
- Did any groups touch their flubber during the experiment? Did the chute fall during the experiment?
- What is the difference between glacier movement and glacier melt? Can they happen at the same time?
- Glacier movement occurs throughout the year, and is the movement of the entire glacier downhill. Glacier melt usually happens only in the summer or during warm temperatures, and happens more at the bottom of the glacier. Yes, both happen at the same time.

Trouble Shooting Tips

- Classroom management is essential with this activity, as it can become messy fast! Designating a "flubber handler" is an excellent way to keep the activity clean and ordered.
- Flubber temperature and consistency and be variable. Do your best to keep the flubber at a constant temperature (refrigerated), as warmer flubber will travel faster than cold flubber. Acknowledge this as an issue with the kids if the class gets different results than expected.

Sources

https://spark.ucar.edu/activity/model-moving-glacier
http://www.nps.gov/features/romo/feat0001/GlcBasics.html

Glaciers on the Move Worksheet

Name:_____

Objective: To determine how slope and basal conditions affect glacier speed.
Prediction: Which glacier do you think will move the fastest?

① Steep slope, smooth surface
② Steep slope, sandy surface
③ Steep slope, rocky surface
④ Gentle slope, smooth surface

Why?

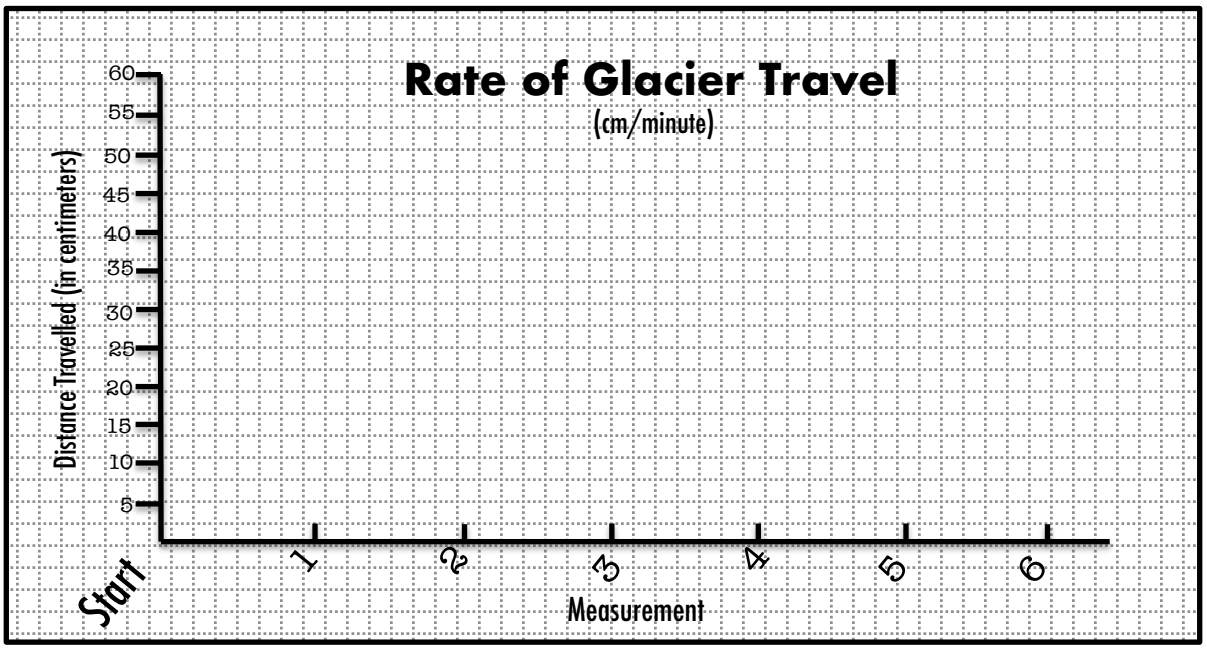
Experiment: Observe and record the movement of your glacier.
Which glacier are you observing? _____

Observations:

Measurement	Distance Moved (cm.)
Start	
1	
2	
3	

Measurement	Distance Moved (cm.)
4	
5	
6	
Final (6-Start)	

Analysis: Using the data your group collected, graph the rate at which your glacier travelled below.



Group Results:

Slope	Surface	Maximum Distance Reached (cm.)
Steep	Rocky	
Steep	Sandy	
Steep	Smooth	
Gentle	Smooth	

Conclusion: In your conclusion, include your original prediction, explain the results of the experiment (include the data!), and write an explanation of why you think you got the results you did. You can also include how you would do the experiment differently if you were to repeat it.

Glacier Mass Balance Worksheet

Name:_____

Background Information: Glaciers are always changing. They move downhill, but also change in size. Glaciers get larger when they accumulate more mass through heavy snowfall, and get smaller when they lose mass due to ablation. At Niwot Ridge Long Term Ecological Research site in the Front Range of Colorado, there is a small glacier, Arikaree, that scientist Nel Caine has monitored for more than forty years! While it is near impossible to measure the actual mass of the ice at Arikaree glacier, Nel is able to measure the accumulation and ablation each year. With that data he is able to calculate a mass balance, that tells us whether the mass of the glacier is increasing or decreasing. Using Nel's data here, see if you can come up with your own conclusion of what is happening to Arikaree glacier.

Scientific Question: Is the mass of Arikaree glacier increasing or decreasing?

Look at the pictures of Arikaree glacier below. What do you observe?

1981

2002

2010

What is your prediction? Is the mass of Arikaree glacier increasing or decreasing?

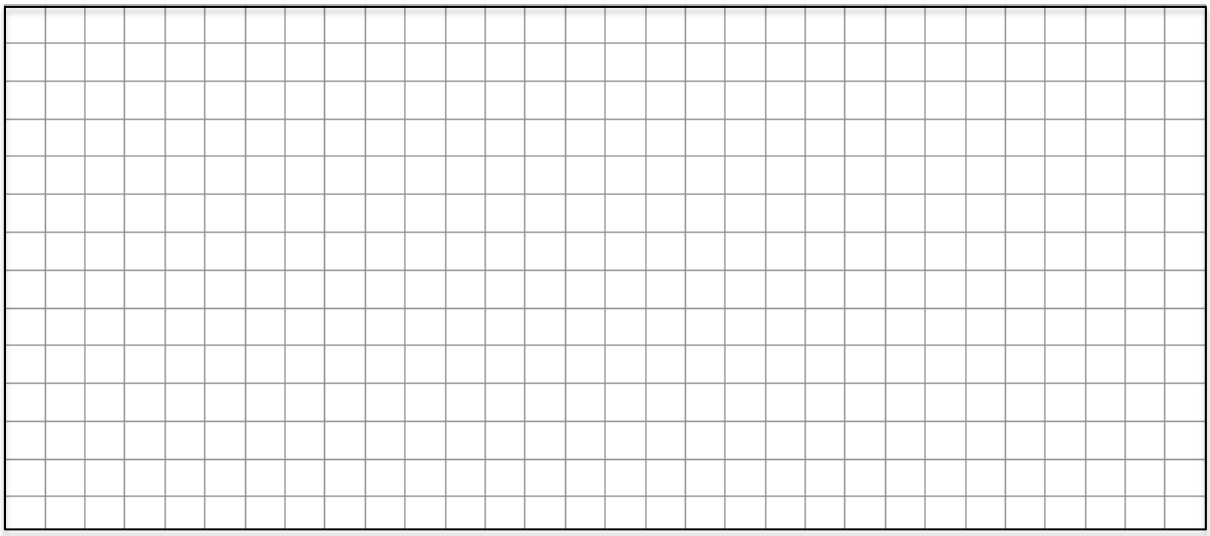
What observations of the photos above support your prediction?

Data: The data for annual mass accumulation and ablation are in a table below. Units are in cm. WE, which is centimeters of water equivalency. Using this data, calculate the mass balance. Next, calculate the cumulative mass balance by adding the mass balance from the previous year to the current year. The first few rows are done as an example.

Mass Balance Calculation = Annual Accumulation – Annual Ablation

Year	Annual Accumulation (cm WE)	Annual Ablation (cm WE)	Annual Mass Balance (cm WE)	Cumulative Mass Balance (cm WE)
2000	292.0	356.0	356.0-292.0 = -64.0	-64.0
2001	189.8	386.3	386.3-189.8= -196.5	-64.0 + -196.5 = -260.5
2002	173.9	471.3		
2003	251.8	349.5		
2004	243.7	280.3		
2005	236.2	363.3		
2006	198.5	388.5		
2007	188.4	419.9		
2008	306.5	308.8		
2009	327.4	302.4		
2010	359.4	376.7		
2011	327.3	312.7		
2012	205.7	404.1		
2013	200.2	353.3		

Using the cumulative mass balances you calculated above, graph the cumulative mass balance below.



Claim: Using the information from your graph, write a statement that answers the scientific question: "Is the mass of Arikaree glacier increasing or decreasing?"

Evidence: What data from the table or graph supports your claim above? Refer to the graph or table to explain your reasoning.

Connections: Why do you think Arikaree glacier is losing/gaining mass? Can you think of an explanation? Brainstorm some ideas and write them below.

Note: Data courtesy of Thomas Nelson Caine, Niwot Ridge LTER, 2013.