



GLACIAL MOVEMENT

Earth Science Tech-lesson Guide Lite

By John Hill

May 2014



Photo: J. D. Beedle

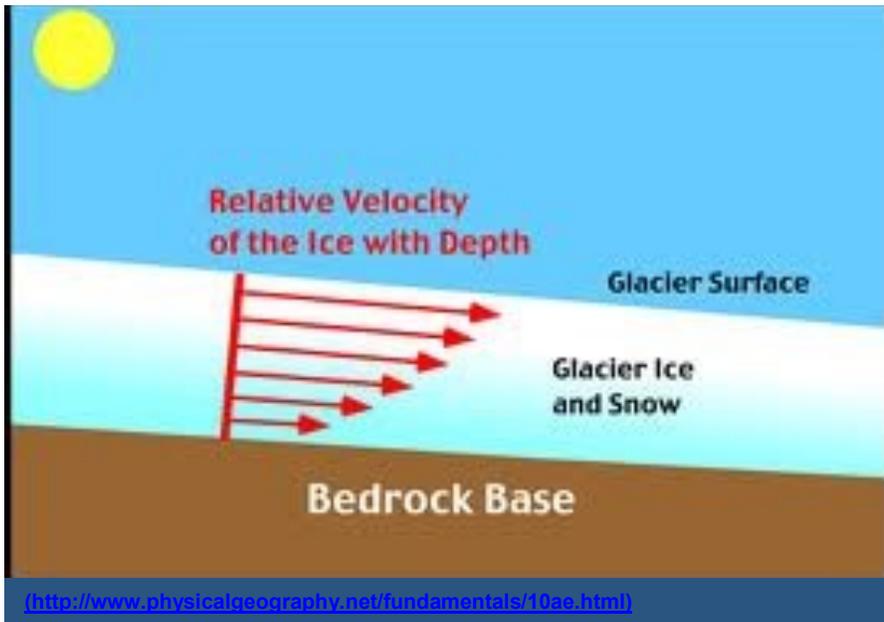


2010 Photo: J. D. Beedle

1993 & 2010 Mendenhall Glacier, Juneau, Alaska

Inside...

- Measuring Movement
- Glacial Zones
- Retreat, Advance & Equilibrium
- Glacial Budget
- Flubber Glacier Model Activity



Measuring Movement

The first experiments designed to measure the movement of glaciers were carried out in the Alps in the 19th century. Markers were placed in a straight line across an alpine glacier and the adjacent valley walls.

Today researchers use time-lapse photography; images taken from the same vantage point over an extended period of time. ([example of time-lapse](#)). Additionally satellite imagery is now being used to track glaciers movements in remote areas where extreme weather conditions have limited research in the past.

Glacial Movement

A glacier is a thick mass of ice that forms over hundreds of years from snow accumulation, compaction, and recrystallization. Although they appear to be motionless they are moving slowly. There are several types of glaciers but the majority are valley or alpine glaciers, so called because they are found in high mountains. There are two basic types of glacial movement: plastic flow, internal deformation within the ice; and basal slip, movement of the entire ice mass slipping along the ground.

Glacial Budget: Retreat, Advance & Equilibrium

The glacial budget is the balance or lack of balance between accumulation and wastage. If accumulation is greater than wastage then the glacial front will be advancing. When wastage is greater than accumulation then the glacier is retreating. If a balance or equilibrium is reached, meaning that the amount of accumulation is equal to the amount of wastage, the front extent of the glacier will remain stationary. ([Video](#))

$$\begin{array}{l}
 \text{Melting} \\
 + \quad > \text{Snowfall} = \text{Retreat} \\
 \text{Ablation} \\
 \\
 \text{Snowfall} > \text{Melting} + \text{Ablation} = \text{Advance} \\
 \\
 \text{Snowfall} = \text{Melting} + \text{Ablation} = \text{Equilibrium}
 \end{array}$$

http://www.geosci.lptw.edu/PhysSys/Unit_11/case_11.html



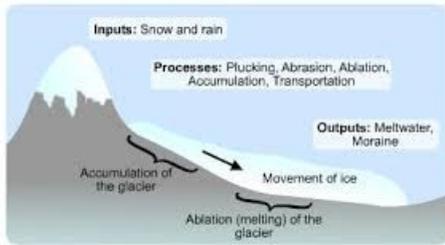
Glacial Zones

Glacial Zones

Zone of Accumulation: the part of the glacier characterized by snow accumulation and ice formation. Its outer limit is the snowline.

Zone of Wastage: the part of the glacier beyond the zone of accumulation where all the snow from the previous winter melts, as does some of the glacial ice.

Zone of Ablation: area of a glacier where losses of ice from melting, evaporation, and sublimation exceed additions of snow annually.



Objective

Students make a model of glacier motion to learn how alpine/valley glaciers move.

Materials

Ingredients to make the glacier model material (known as flubber)

- Two containers for mixing
- $\frac{3}{4}$ cup warm water
- 1 cup white glue
- $\frac{1}{2}$ cup warm water
- 2 teaspoons Borax

Each group will need:

- Large diameter PVC pipes about two feet long, cut in half lengthwise
- Cardboard boxes or books (to prop up PVC / make a slope)
- Ruler
- Permanent marker
- A watch or stopwatch

Engage

The students make a glacier using glue, water and detergent ("flubber") and construct a glacier valley using PVC pipes. They are encouraged to run several tests with different values for valley slope, "flubber" temperature, and basal conditions. The students then calculate the "flubber" velocity for each scenario ([example](#)) ([video of model run](#)).

Explain

This animation shows the basics of Glacial Formation and Movement: <https://www.youtube.com/watch?v=-cBcMfaSxpk>

UAS Video of how the Mendenhall Glacier in Juneau, AK is thinning and moving: <https://www.youtube.com/watch?v=TODfVOBjxqg>

Juneau Icefield Research Program 2012 students and staff show how glacier mass balance is measured on Taku Glacier, Alaska : <https://www.youtube.com/watch?v=ihDPpCm10nU>

Extend

* Students may wish to design an experiment to figure out what effects the speed of a glacier. See part two of the model activity from [Windows to the Universe](#).

* [Flubber glacier model - University of Maine](#): This source contains more in depth explanations and videos of the model activity focused on the Malaspina Glacier near Yakutat, Alaska. Designing the model to reflect this, the largest glacier in Alaska will make this a more place-based learning experience!

* Also see these sources:

[NAGT: Modeling Glacier Dynamics with Flubber](#), by L. Sterns, U. Maine

[Glacial Processes](#)

[Glacial Animation Links](#)

