



## Giant Gliding Glaciers



Glaciers, like the Traleika Glacier in this photo, are important because they shape the landscape, hold large amounts of frozen water, and record in ice the story of the Earth's climate.

Glaciers are masses of ice on the move. For any place to have glaciers, there must be more snow falling in winter than snow and ice melting in summer.

Denali National Park and Preserve has many glaciers (they cover about 15 percent of the park's area). Some of the park's glaciers are like huge lumps of vanilla ice cream sliding down the scooped-out bowls (*cirques*) of the Alaska Range. Other glaciers are giant rivers of ice that flow and glide slowly downhill in the mountain valleys.

As glaciers move, the sides and bottom

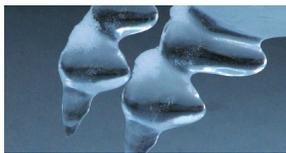
of the ice pluck large boulders, gravel, rocks, and dirt, and drag this material along—in the ice, under the ice, or on the ice. The flowing ice, and rocks frozen into the bottom of the glacier, carve wide U-shaped valleys, scrape grooves in the bedrock, or polish rocks into dust. The glacier surface often breaks forming cracks called *crevasses*.

Read below how glaciers form, then turn the page to explore (1) what glaciologists learn from glaciers, (2) how climate change affects glaciers, and (3) which glaciers and glacial features you might see in Denali.

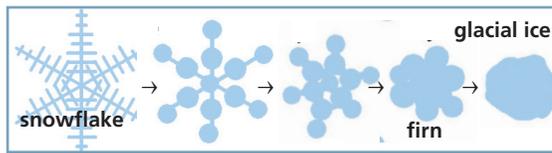
### WHAT IS NEEDED TO MAKE A GLACIER?



**Snow:** Lots of snow falls in a mountain valley and builds up new snow layers each year.



**Cold:** Even summer heat does not melt the new layers, so they bury and compress old layers.



**Time:** Over a few years, the added snow weight melts and refreezes flakes into ice called *firn*.

**Pressure:** As pressure builds with more layers, firn grains fuse to become glacial ice.



**Gravity:** When the ice flows under its own weight, it is a glacier!

## Glaciologists at Work



Photo courtesy Cameron Wake

A glaciologist digs a snow pit on a glacier to measure and collect samples of new snow and firn.



Photo credit: JT Thomas

Glaciologists put stakes in the ice to serve as yardsticks for measuring the depth of snow and ice. They return in spring (to check how much of each stake was covered by winter snow) and in fall (to see how much snow melted during the summer).



Glaciologists use Global Positioning System (GPS) devices to tell how fast the glacier is moving (how fast the stakes move) and to map the outline of the glacier *terminus* (end).

## Climate Change and Glacier Research

Glaciers change when the climate changes. Glaciers have increased in size (length and thickness) during cooler, snowier times and decreased in size during warmer, drier times.

Glaciologists are measuring the surface elevation of Denali's glaciers over time to detect changes in glacier thickness. Denali's glaciers are thinning and losing ice because of a warming climate.

Other scientists have drilled and collected deep ice cores from

## Glacial Features along the Park Road

Look for glaciers or features left by glaciers during a bus ride into the park (or a trip by private vehicle as far as Savage River).

Put an "x" in the white box for each glacier feature you see.

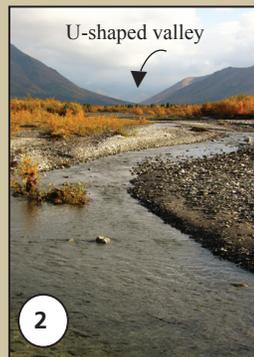
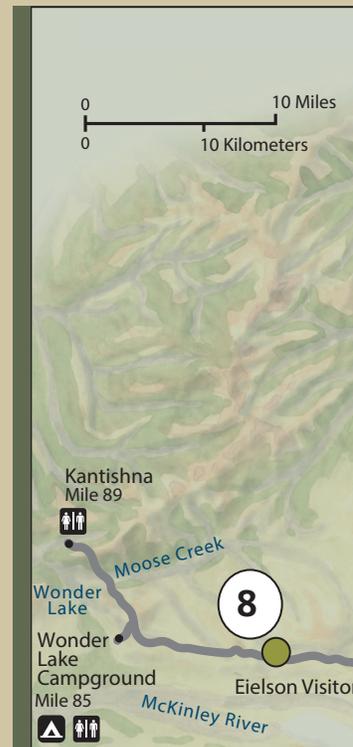


1

### Glacial Erratic (#1)

An erratic is a rock that got a free ride—with a glacier—far away from where it was formed.

**Look:** left (south) going up the hill between the Denali Visitor Center and Park Headquarters



2

### U-Shaped Valley

Glaciers create U-shaped valleys, unlike rivers that cut sharp V's. Look for the valley the glacier carved south of the Savage River bridge.

**Look:** from Savage River Bridge

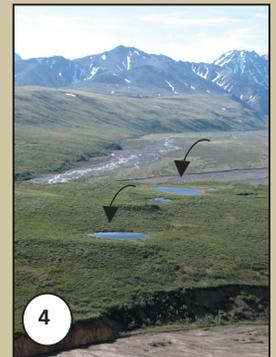


3

### Glacial Silt

Glaciers grind rocks to silt or "flour." Rivers that flow from glaciers are colored by the color of the silt, and flow in many braided channels.

**Look:** between East Fork Bridge and Polychrome



4

### Kettle Ponds

Kettle ponds formed when ice blocks of a melting glacier were buried in gravel. As the ice melted, the depression filled with water.

**Look:** going up Polychrome



5

### Glacial Erratic

This is a large rock that was carried by a glacier from its source area to its current location. How it got there is a mystery. (Hint: hiker)

**Look:** Polychrome

a glacier on Mount Hunter. The deepest layers in the cores may be one thousand years old or older. The glacier holds valuable information about the climate at the time each layer of ice was formed.

## Glaciers and Climbers' Poop

At certain elevations, mountain climbers continue to throw their bagged poop into glacier crevasses. Glaciologists put a magnet into a latrine on the Kahiltna Glacier to keep track of the magnet as it moved with the glacier. Tracking the magnet did not work, but a study of glacier movement helped researchers estimate where and when buried poop will come out of the ice.

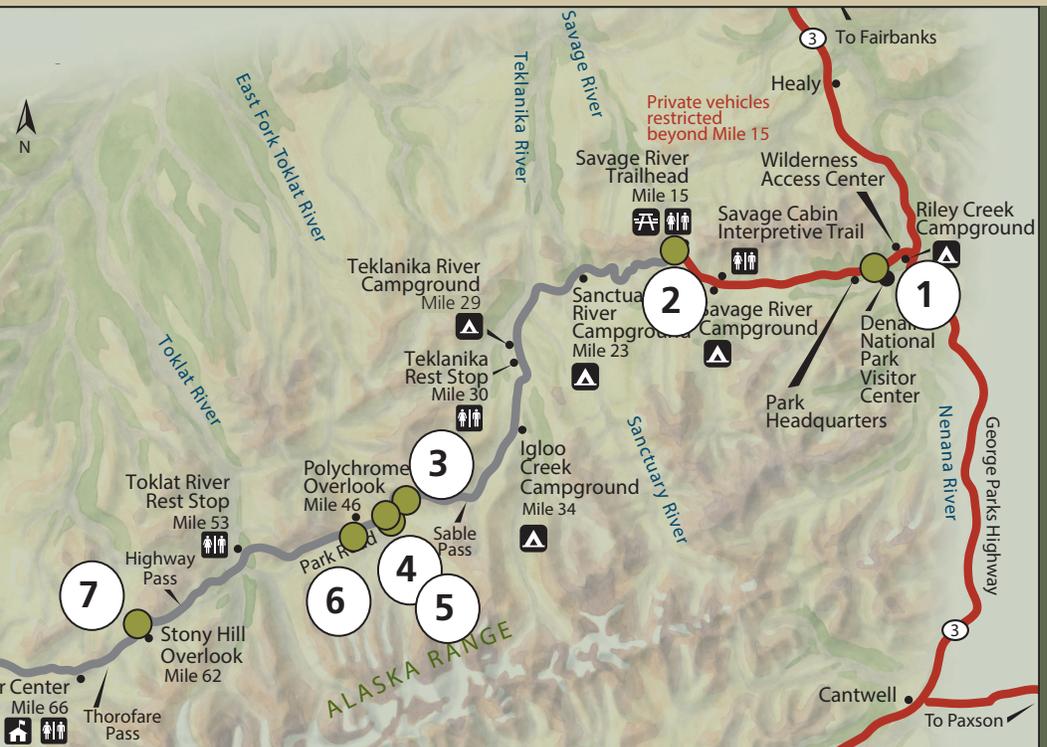
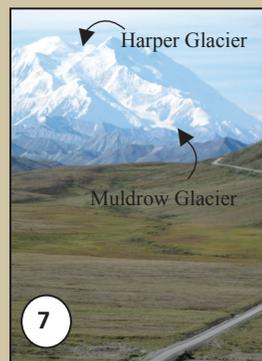


Photo courtesy Philip Hooge

**Glacial Erratic (#2)**  
A limestone erratic sits on basalt rocks. How tall is this erratic? Use the 5-foot person for scale.  
**Going up the chome**



**6 Polychrome Glaciers**  
Find several glaciers, which often look like dirty snow, hidden in the high valleys. Sometimes new snow covers these glaciers!  
**Look: from Polychrome Overlook**



**7 Glaciers on Denali**  
Between the peaks of Denali, look for the Harper Glacier and lower to the right, the Muldrow Glacier.  
**Look: from Stony Hill Overlook**



**8 Muldrow Glacier / Terminal Moraine**  
Is this glacier or terminal moraine? The "lumpy green bedspread" of plants and gravel insulates stagnant ice.  
**Look: south from west of Eielson Visitor Center**

## Explore More!



Inside Eielson Visitor Center, push the buttons to light the routes mountaineers use to climb Denali—do all routes travel on a glacier?



Photo courtesy Heather McKenny

Explore a braided river (Savage, Teklanika, or Toklat). Hold rocks and gravel that a glacier (or former glacier) dropped and a river moved!



Hike to a glacier. Where the glacier ends (glacier terminus), it drops its load of till (rocks and gravel).



Photo courtesy Paula Homan

In other parks or places where there are glaciers to explore (safely) up close, learn about the ice. Touch it!

# Activities

## Portraits of Rock and Ice

Find the best photo to illustrate each feature. Write the letter of the photo beside each term.

- \_\_\_ Cirque (rock bowl carved by glacier)
- \_\_\_ Crevasse (crack in ice)
- \_\_\_ Glacial Erratic (rock moved by a glacier)
- \_\_\_ Glacier Terminus (end of glacier)
- \_\_\_ Lateral Moraine (gravel and rocks carried and deposited at the sides of a glacier)
- \_\_\_ Medial Moraine (stripe of gravel and rocks carried down the middle of a glacier)



A



B



C

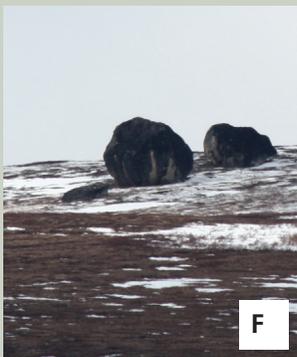


D

Photo Credit: Joe Bickley



E



F

## Then and Now: Glacier Change



summer 1928

Photo Credit: Stephen R. Capps



summer 2011

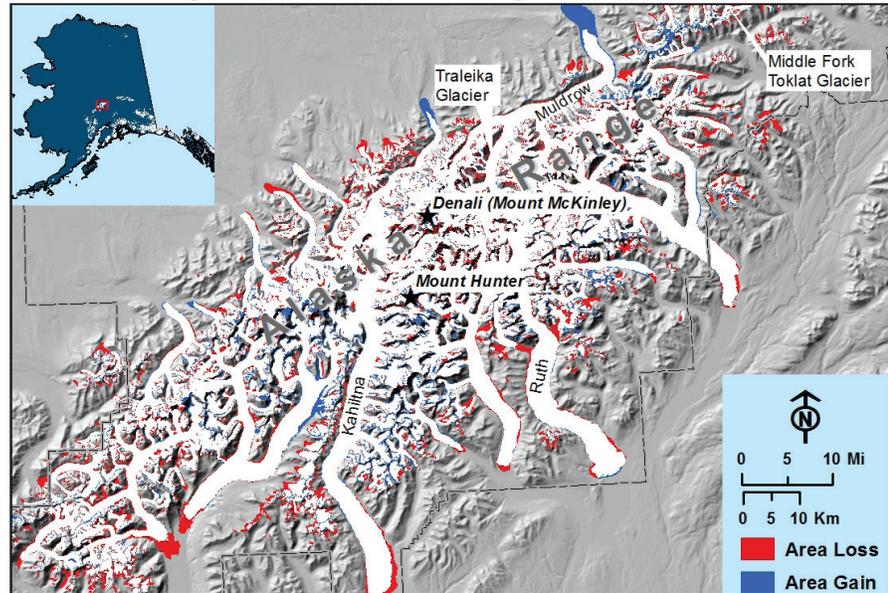
Repeat photography shows how dramatically some glaciers, like the Cantwell Glacier, are shrinking with climate change. How many years apart were these photos taken? What landscape features are in both photos? Where would the glacier terminus (end) have been in 1928?

## Stories in Trash

In 2013, a Denali cleanup crew removed non-historic debris left by climbers on the Muldrow Glacier years ago when leaving trash was a common practice. They found fuel cans, magazines from 1947, wooden skis, and a sleeping bag. Make up a story about climbers who left a boot and a thermos.



## Mapping Glacier Change



This map shows the changes in Denali's glaciers in the 60 years between the 1950s and 2010. During those years, some of Denali's glaciers gained ice (colored blue) and some lost ice (colored red). Were there more gains or losses of glacier ice during the 60 years? *Bonus question:* Are Denali's glaciers longer on the north or south side of the Alaska Range? Why?

Answers for Activities on inside page.

For more information

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