

A glacier is a massive, slow-moving body of ice formed from compacted snow that accumulates over many years. It is not just frozen water sitting still. It is a dynamic, flowing system of ice shaped by gravity.

Glaciers form in places where more snow falls in winter than melts in summer. When snowfall exceeds melting year after year, layers of snow begin to pile up. The weight of new snow compresses the layers below. Over time, loose snow becomes firn (partially compacted snow), and firn becomes dense glacial ice. This transformation can take decades to centuries.

The key ingredient is accumulation. Accumulation means the addition of snow and ice to a glacier. The opposite process is ablation. Ablation refers to the loss of ice through melting, evaporation, or breaking off into water.

When accumulation exceeds ablation over long periods, a glacier grows. When ablation exceeds accumulation, a glacier shrinks.

Glacial ice is different from regular ice cubes in your freezer. Because of extreme pressure from overlying snow, the ice crystals become tightly packed. Air bubbles get squeezed out. The result is dense, blue-tinted ice. The blue color occurs because dense ice absorbs red wavelengths of light and reflects blue.

Gravity causes glaciers to move. Even though they appear solid, glaciers behave like very slow rivers. The immense weight of ice causes internal deformation. Deformation means the ice crystals shift and slide past one another under pressure.

Glaciers move through two main processes: internal flow and basal sliding. Internal flow happens when the ice deforms within itself. Basal sliding happens when meltwater at the base lubricates the glacier, allowing it to slide over rock.

Movement is slow but powerful. Some glaciers move only a few inches per year. Others can move several feet per day. Despite the slow pace, glaciers reshape landscapes dramatically.

There are two main types of glaciers: alpine glaciers and continental glaciers.

Alpine glaciers form in mountainous regions. They flow downhill through valleys, carving them into U-shaped valleys. A U-shaped valley has steep sides and a flat bottom, created by glacial erosion.

Continental glaciers, also called ice sheets, cover vast land areas. Greenland and Antarctica contain the largest ice sheets today. These ice sheets are thousands of feet thick.

Erosion is the wearing away of land. Glaciers erode land through plucking and abrasion. Plucking occurs when ice freezes onto rock and pulls pieces away as it moves. Abrasion happens when rocks embedded in the ice scrape against bedrock like sandpaper.

As glaciers move, they transport rock and debris. This debris is called moraine. When a glacier melts, it leaves behind piles of moraine, forming ridges and hills.

Glaciers also create features called fjords. Fjords are deep, narrow coastal inlets formed when glaciers carve valleys that later fill with seawater.

Climate plays a central role in glacier stability. Temperature determines how much melting occurs. Warmer temperatures increase ablation. Colder temperatures increase preservation of ice.

Glaciers are important indicators of climate change. When global temperatures rise, glaciers retreat. Retreat means the front edge of the glacier moves backward due to melting.

However, retreat does not mean the glacier moves in reverse. It still flows forward; it just melts faster than it advances.

Glaciers store a significant portion of the Earth's freshwater. When they melt, they contribute to sea level rise. Sea level rise refers to the increase in average ocean height due to melting ice and thermal expansion of water.

Thermal expansion means water expands as it warms.

Glaciers also regulate water supply. In many regions, glacial melt provides steady freshwater to rivers during warm seasons. Without glaciers, some rivers would shrink dramatically.

Ice cores drilled from glaciers provide climate history. Ice cores contain trapped air bubbles. These bubbles preserve samples of ancient atmosphere, allowing scientists to measure past carbon dioxide levels.

Carbon dioxide is a greenhouse gas. A greenhouse gas traps heat in the atmosphere.

Glaciers can also produce hazards. When large pieces break off into water, the process is called calving. Calving creates icebergs. Icebergs can be dangerous to ships.

A glacier's front edge is called the terminus. The terminus is where melting, calving, or transition into water occurs.

Glacial cycles have shaped Earth's history. During ice ages, massive ice sheets covered large parts of North America and Europe. Ice ages are long periods of cooler global temperatures when glaciers expand.

We are currently in an interglacial period. An interglacial period is a warmer phase between ice ages.

The weight of glaciers is immense. Ice sheets can press down on the Earth's crust. When glaciers melt, the land slowly rises back up. This process is called isostatic rebound.

Isostatic rebound means the crust adjusts upward after being compressed by ice weight.

Glaciers may seem frozen and static, but they are active geological forces. They carve mountains, shape valleys, transport sediment, influence climate, and store freshwater.

At their core, glaciers are long-term accumulations of compacted snow transformed into flowing ice under gravity.

They are slow, but they are powerful.