

Student Guide to Glacier National Park

Located in northwestern Montana, Glacier National Park contains a spectacular stretch of the Rocky Mountains and preserves one of the outstanding wild areas in the National Park System.

The park's 1,600 square miles of U-shaped valleys, sharp ridges, and horn-shaped peaks provide evidence of the huge Ice Age glaciers that shaped this land. Today, 30 to 40 small glaciers still cling to the mountains and remind us of a time when winters were long and summers short.

History

Before the Park

Recent archaeological surveys have found evidence of human use dating back over 10,000 years. These people may have been the ancestors of tribes that live in the area today. By the time the first European explorers came to this region, several different tribes inhabited the area. The Blackfoot Indians controlled the vast prairies east of the mountains. The Salish and Kootenai Indians lived and hunted in the western valleys. They also traveled east of the mountains to hunt buffalo.

In the early 1800's, French, English, and Spanish trappers came in search of beaver. In 1806, the Lewis and Clark Expedition came within 50 miles of the area that is now the park.

As the number of people moving west steadily increased, the Blackfoot, Salish, and Kootenai were forced onto reservations. The Blackfoot Reservation adjoins the east side of the park. The Salish and Kootenai reservation is southwest of Glacier. This entire area holds great spiritual importance to the Blackfoot, Salish, and Kootenai people.

The railroad over Marias Pass was completed in 1891. The completion of the Great Northern Railway allowed more people to enter the area. Homesteaders settled in the valleys west of Marias Pass and soon small towns developed.

Under pressure from miners, the mountains east of the Continental Divide were acquired in 1895 from the Blackfoot. Miners came searching for copper and gold. They hoped to strike it rich, but no large copper or gold deposits were ever located. Although the mining boom lasted only a few years, abandoned mine shafts are still found in several places in the park.

Glacier's high, rocky peaks straddle the Continental Divide and form the headwaters of three major river systems. From this land known as "The Crown of the Continent," rivers flow west to the Pacific, east to the Gulf of Mexico, and north to Hudson Bay.

The park's geologic history, geographic location, and undisturbed wildlife populations allow both visitors and scientists the opportunity to see and study a land almost unchanged for centuries.

Establishing the Park

Around the turn of the century, people started to look at the land differently. Rather than just seeing the minerals they could mine or land to settle on, they started to recognize the value of its spectacular scenic beauty. Facilities for tourists started to spring up. In the late 1890's, visitors arriving at Belton (now called West Glacier) could get off the train, take a stagecoach ride a few miles to Lake McDonald, and then board a boat for an eight mile trip to the Snyder Hotel. No roads existed in the mountains, but the lakes allowed boat travel into the wilderness.

Soon people, like George Bird Grinnell, pushed for the creation of a national park. Grinnell was an early explorer to this part of Montana and spent many years working to get the park established. The area was made a Forest Preserve in 1900, but was open to mining and homesteading. Grinnell and others sought the added protection a national park would provide. Grinnell saw his efforts rewarded in 1910 when President Taft signed the bill establishing Glacier as the country's 10th national park.

After the creation of the park, the growing staff of park rangers needed housing and offices to help protect the new park. The increasing number of park visitors made the need for roads, trails, and hotels urgent. The Great Northern Railway built a series of hotels and small backcountry lodges, called chalets, throughout the park. A typical visit to Glacier involved a train ride to the park, followed by a multi-day journey on horseback. Each day after a long ride in the mountains, guests would stay at a different hotel or chalet. The lack of roads meant that, to see the interior of the park, visitors had to hike or ride a horse. Eventually, the demand for a road across the mountains led to the building of the Going-to-the-Sun Road.

A Heritage for the Future

The construction of the Going-to-the-Sun Road was a huge undertaking. Even today, visitors to the park marvel at how such a road could have been built. The final section of the Going-to-the-Sun Road, over Logan Pass, was completed in 1932 after 11 years of work. The road is considered an engineering feat and is a National Historic Landmark. It is one of the most scenic roads in North America. The construction of the road forever changed the way visitors would experience Glacier National Park. Future visitors would drive over sections of the park that previously had taken days of horseback riding to see.

Just across the border, in Canada, is Waterton Lakes National Park. In 1931, members of the Rotary Clubs of Alberta and Montana suggested joining the two parks as a symbol of the peace and friendship between our two countries. In 1932, the United States and Canadian governments voted to designate the parks as Waterton-Glacier International Peace Park, the world's first. More recently the parks have received two other international honors. The parks are both Biosphere Reserves, and were named as a World Heritage Site in 1995. This international recognition highlights the importance of this area, not just to the United States and Canada, but to the entire world.

While much has changed since the first visitors came to Glacier, it is possible to relive some of Glacier's early history. You can take a horseback ride like an early visitor. Miles of hiking trails follow routes first used by trappers in the early 1800's. Several hotels and chalets, built by the Great Northern Railway in the early 1900's, house summer guests to the park. A visit to Glacier National Park is still a great adventure!



Trail to Iceberg Lake



Additional information on Glacier National Park can be found online at the Glacier Website:

<http://www.nps.gov/glac>







or you may write or call:
Superintendent
Glacier National Park
West Glacier, Montana 59936
406-888-7800

Park Facts

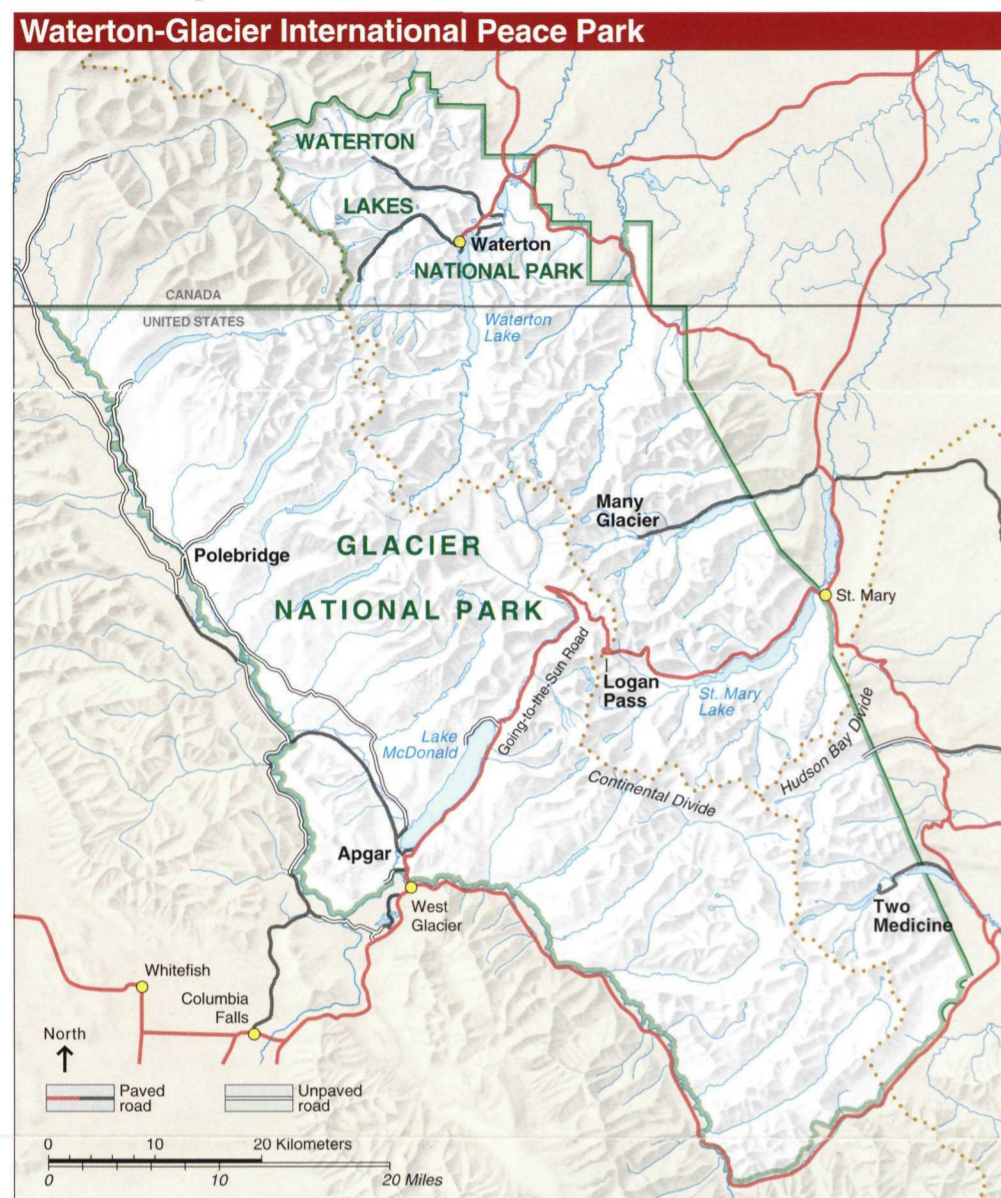
Glacier at a Glance

- **Park established** - May 11, 1910
- **Acreage** - 1,013,572.42 acres
- **Highest elevation** - Mt. Cleveland, 10,466 ft.
- **Lowest elevation** - junction of the Middle and North Forks of the Flathead River, 3150 ft.
- **Average annual precipitation** - 30.56 inches
- **Average annual snowfall** - 138.45 inches (both at Park Headquarters, West Glacier)
- **Number of glaciers** - 30 to 40
- **Largest glacier** - Blackfoot Glacier (less than 1,000 acres)
- **Number of mountains** - 185 (named peaks); 6 mountains are over 10,000 feet; 43 mountains are over 9,000 feet.
- **Visitation** - 1,830,944 (1998)
- **Going-to-the-Sun Road** - 52 miles long
Earliest Opening - May 16, 1987
Latest Opening - June 23, 1991 & 1995
Earliest Closing - Oct. 4, 1990
Latest Closing - Nov. 21, 1992
- **Approximately 1800 species of plants**
- **272 species of birds**
Endangered Species - peregrine falcon
Threatened Species - bald eagle
- **63 species of mammals**
Endangered Species - gray wolf
Threatened Species - grizzly bear (lynx to be listed in summer of 1999)
- **23 species of fish** (6 non-native)
Endangered Species - bull trout
- **5 species of amphibians**
- **3 species of reptiles**
- **Over 350 historic structures** (buildings, roads, bridges, and trails listed on the National Register of Historic Places)
- **6 National Historic Landmarks** (includes hotels, chalets, and the Going-to-the-Sun Road)

Glacier National Park Historical Timeline

1890	1900	1910	1920	1930	1940	1950	1960	1970	1980	1990	2000	
1891 George Bird Grinnell calls for the creation of a national park to protect area	1900 Area becomes a Forest Preserve	1910 - 1912 Park Superintendent Logan proposes road across park	August 25, 1916 Congress passes <i>The National Park Service Organic Act</i> establishing the National Park Service	Fall 1932 Going-to-the-Sun Road completed	July 1934 President Franklin D. Roosevelt broadcasts address to the nation from Glacier National Park		1960 50th Anniversary of the park		1977 Granite Park and Sperry Chalets are listed on the National Register of Historic Places		1997 Going-to-the-Sun Road designated a National Historic Landmark	2010 100th Anniversary of the park
 George Bird Grinnell			 Train Depot at East Glacier, Montana, in the 1930's		 President Franklin D. Roosevelt at Two Medicine Chalet		 Going-to-the-Sun Road		 Granite Park Chalet		 December 1995 Waterton-Glacier International Peace Park is designated a World Heritage Site	

Park Map



Geology

The Rocks of Glacier

Most rocks in Glacier are about 1.2 billion years old. They were formed when this area was repeatedly covered and uncovered by the sea. During this time, thousands of feet of mud and sand deposited and compressed into rock. These rocks were lifted upwards around 70 million years ago and formed the park's mountains.

One of the oldest layers is a band of limestone called the Altny (*all' tin*) Formation. Limestone is usually formed from shells and skeletons of dead sea animals that settle to the ocean bottom. The Altny Formation formed about 1.2 billion years ago, long before such life forms existed. It is layer after layer of mud and sand held together by calcium carbonate, the same chemical as chalk.

Lying on top of the Altny Formation is a broad band of red and greenish-gray rock, 2500 to 3500 feet thick, called the Appekunny (*ap a koon' e*) Formation. It consists of deposits of silts and mud hardened into a rock known as mudstone, as well as thick sand layers that became a hard rock called quartzite.

Atop the Appekunny lies another layer of thick, red mudstone called the Grinnell (*grin el'*) Formation. The red and green colors are caused by small amounts of iron. The difference in color depends on whether the rocks were formed in the presence of oxygen or not. Without oxygen, the rocks turned a greenish color. In the presence of oxygen, the rocks turned red. The Grinnell Formation has well-preserved mud cracks and ripple marks indicating shallow water at the time of deposition.

The Siyeh (*sy ee'*) Formation forms many of the bold cliffs and mountaintops seen in the park. Fossilized blue-green algae colonies, known as stromatolites (*stro mat' il ites*), are found in this layer. This indicates the area was covered by shallow warm waters when this layer was deposited slightly less than a billion years ago.

Forming the Mountains

The youngest rocks in Glacier are found along the eastern edge of the park. Some of these sedimentary rocks are only 70 million years old, just yesterday in geologic terms.

Usually the younger layers lie on top of the older layers. Along the east and south sides of Glacier National Park, very old Altny limestone are found on top of the youngest rocks. How can this be?

About 70 million years ago, pressures in the Earth's crust built up along the western edge of the North American continent. These pressures pushed the land up and created the Rocky Mountains. Locally, a large section of rock broke under this pressure and slid over the layers to the east. This movement, known as the Lewis Overthrust Fault, pushed rocks in some places as much as 50 to 60 miles from west to east. The old rocks ended up on top of much younger rocks.

Over millions of years, running water and the passage of large Ice Age glaciers carved the rugged peaks and deep valleys of Glacier National Park. This is one of the most spectacular landscapes in the world.

Cross Section of Major Rock Layers

Siyeh	Limestone with numerous fossilized algae colonies
Grinnell	Red argillite (mudstone) with quartzite banding
Appekunny	Green argillite with quartzite banding
Altny	Limestone

Carving the Mountains

A glacier forms when more snow falls each winter than melts the next summer. The weight of snow above presses down on the layers below and compacts them into ice. The ice needs to be about 100 feet thick for a glacier to form.

Ice near the surface of the glacier is often hard and brittle. Due to the pressure of ice above, the ice near the bottom of the glacier becomes flexible. This flexible layer allows the ice to move. Depending on the amount of ice, the angle of the mountainside, and the pull of gravity, the ice may start to move downhill. Once the ice begins to move, it is called a glacier.

As the ice moves, it plucks rock from the sides and bottom of the valleys. Rocks falling on the glacier from above mix with the glacial ice as well. Over long periods of time the sandpaper-like quality of the moving ice scours and reshapes the land into broad U-shaped valleys, sharp peaks, and lake-filled basins.

At the start of the Ice Age, about 2 million years ago, the climate became cooler and/or wetter. Huge glaciers formed and filled the valleys with

thousands of feet of ice. Imagine the valleys of the park filled with ice and just the tops of the highest peaks sticking out. These giant rivers of ice carved the mountains and valleys into their present appearance. (see illustrations below)

Today, there are 30 to 40 small glaciers scattered throughout the park. They are not the remains of Ice Age glaciers. The glaciers in Glacier National Park are all geologically new, having formed in the last 6,000 to 7,000 years. However, they work in the same way as the larger glaciers of the past and teach us about the park's geologic history.

Presently, all the glaciers in the park are shrinking. More snow melts each summer than accumulates each winter. Research in Glacier National Park, and worldwide, strongly suggests that the Earth is warming. If present climate trends continue, the glaciers and snowfields that embrace Glacier's lofty peaks may once again melt away completely, possibly by the year 2030. Many species of the park's plants, animals, and fish may be particularly sensitive to this climate change. Thus, the park will likely continue to be an important site for global climate change research in the future.

Biology

An Abundance of Plants and Animals

Glacier National Park is rich with plants and animals. Approximately 1800 species of plants, 272 species of birds, and 63 different types of mammals live here. Scientists refer to an area with large numbers of different plants and animals as a biologically diverse place. One of the things that is special about Glacier is its biodiversity.

Glacier is located at the crossroads of several different biological communities. Plants and animals more often associated with parts of northern Canada, the Pacific Coast, and the prairies to the east, mingle here with alpine and Rocky Mountain plants and animals. The result is a mixture of plants and animals that do not usually live together.

What is it about Glacier that allows for such a rich biologic population? Take a look at the park's location on the map below. Glacier is close to Canada, the Great Plains, and the Pacific Coast. The Rocky Mountains are at their narrowest point here, allowing a much easier mixing of species from these very different communities.



Weather, wind, and elevation combine to influence Glacier's plant and animal species. Glacier National Park straddles the Continental Divide. Moist Pacific air masses encounter this wall of mountains and drop most of their rain on the west side. The lighter, drier air can then rise over the mountains and continue east. This difference in rainfall between the east and west sides of the park creates different living conditions.

Glacier National Park is dominated by dense forests. Thick forests of evergreens carpet nearly two-thirds of the park. On the wetter west side of the park, in the McDonald Valley, huge western red cedars grow. These cedars are more typical of plants found on the Pacific Coast. They do not grow any further east than Glacier.

Just a few miles away on the drier east side of the mountains, lodgepole pine are the main species of tree. Lodgepole pine trees prefer the drier, sunnier conditions found there. Their small cones are somewhat fire resistant. After a fire has passed through the forest, the cones that did not burn release their seeds to the wind.

Because of the differences in rainfall, climate, and soil type, 25 different species of trees live within the boundaries of Glacier National Park.

Forests, meadows, streams, lakes, and mountaintops combine to provide almost unlimited varieties of wildlife habitat. Forests in the valleys provide food and cover for bears and mountain lions, while a few thousand feet above, rocky cliffs supply habitat for mountain goats, marmots, and ptarmigan (*tar' mi gan*). The streams and lakes are home to fish, beaver, muskrat, and hundreds of ducks. Meadows bursting with wildflowers support elk, coyotes, hawks, and a variety of rodents.

This variety of habitats presents different survival challenges to animals and plants. Some species, like the western tanager, nest in the United States in summer and migrate to South America in the fall, where food sources are more abundant.

The hoary marmot has a different method of surviving the winter. They spend the summer eating vegetation to gain weight for hibernation. They hibernate for up to eight months to survive winter, when there is no food.

The most common survival method is adaptation. Plants and animals have developed special ways to survive. The bright pink douglasia has a low, compact growth to reduce wind damage, and has thick, fuzzy, water conserving leaves. Both help it to survive in dry, rocky, and windy conditions.

The mountain goat's thick coat and specially developed hooves, for traction, are good examples of adaptations specifically useful to an animal that lives on the high, rocky cliffs of the park.



Mountain Goat

Some animal adaptations are designed to help avoid predators. If an animal blends into the environment, it is much less likely to be seen by another animal looking for food. One expert at camouflage (blending into the surroundings) is the ptarmigan. These birds live in the high, rocky subalpine areas of the park. In summer, the subalpine areas are mostly brown in color. In winter, a thick blanket of snow turns the land a brilliant white. Ptarmigan molt (replace) their feathers from brown in summer to white in winter, making them difficult to see.



Ptarmigan

Bears are one of the most adaptable of the park animals. They are found in all areas of the park, from the low valleys to the high, rocky slopes. Grizzly bears have long claws and a powerful hump of muscle on their shoulders to aid in digging. Many people are surprised to learn that the majority of a bear's diet is roots and berries. They do eat meat, but only a small portion of their diet is from other animals. In Glacier National Park, berries are one of the most important foods for bears.



Grizzly Bear

List of Common Species

Mammals

Gray Wolf
Mountain Lion
Bobcat
Mountain Goat
Bighorn Sheep
White-tailed Deer
Mule Deer
Moose
American Elk
Grizzly Bear
Black Bear
Muskrat
Coyote
Hoary Marmot
Ground Squirrel
Red Squirrel
Snowshoe Hare
Pika
Beaver

Birds

Golden Eagle
Pileated Woodpecker
Ptarmigan
Water Ouzel (Dipper)
Clark's Nutcracker
Osprey
Bald Eagle
Common Goldeneye
Varied Thrush
Mountain Bluebird
Canada Goose
Yellow Warbler
Chipping Sparrow
Peregrine Falcon
Mountain Chickadee
Rosy Finch
Red-tailed Hawk
Ruffed Grouse
Raven
Hairy Woodpecker
Common Merganser

Fish

Cutthroat Trout
Bull Trout
Whitefish
Rainbow Trout
Brook Trout
Grayling
Lake Trout

Trees

Lodgepole Pine
Western Red Cedar
Western Larch
Ponderosa Pine
Whitebark Pine
Subalpine Fir
Western Hemlock
Englemann Spruce
Black Cottonwood
Quaking Aspen
Alder
Chokecherry
Rocky Mountain Maple

Wildflowers

Beargrass
Glacier Lily
Indian Paintbrush
Brown-eyed Susan
Thimbleberry
Cow Parsnip
Trillium
Red Baneberry
Kinnikinnick
Fireweed
Columbine
Alpine Aster
Huckleberry
Bearberry Honeysuckle
Devil's Club
Pearly Everlasting
Twinflower
Lupine

Endangered Species

Glacier is a refuge for several endangered and threatened species. Fifty-two of the plant species found within the park are rare in Montana, and sixteen species are not found anywhere else in the United States. Both the gray wolf and the peregrine falcon are listed as endangered by the federal government, while the grizzly bear and bald eagle are listed as threatened.

Glacier's plants and animals do not rely solely on the park to survive. Glacier National Park forms the core of a large area of wild lands that are vital to their survival. Many species of birds live within the park only part of the year. Wolves and other large mammals travel and use areas outside the park. For Glacier's diverse plant and animal species to survive, it will take the cooperation of many different landowners and agencies.



Gray Wolf