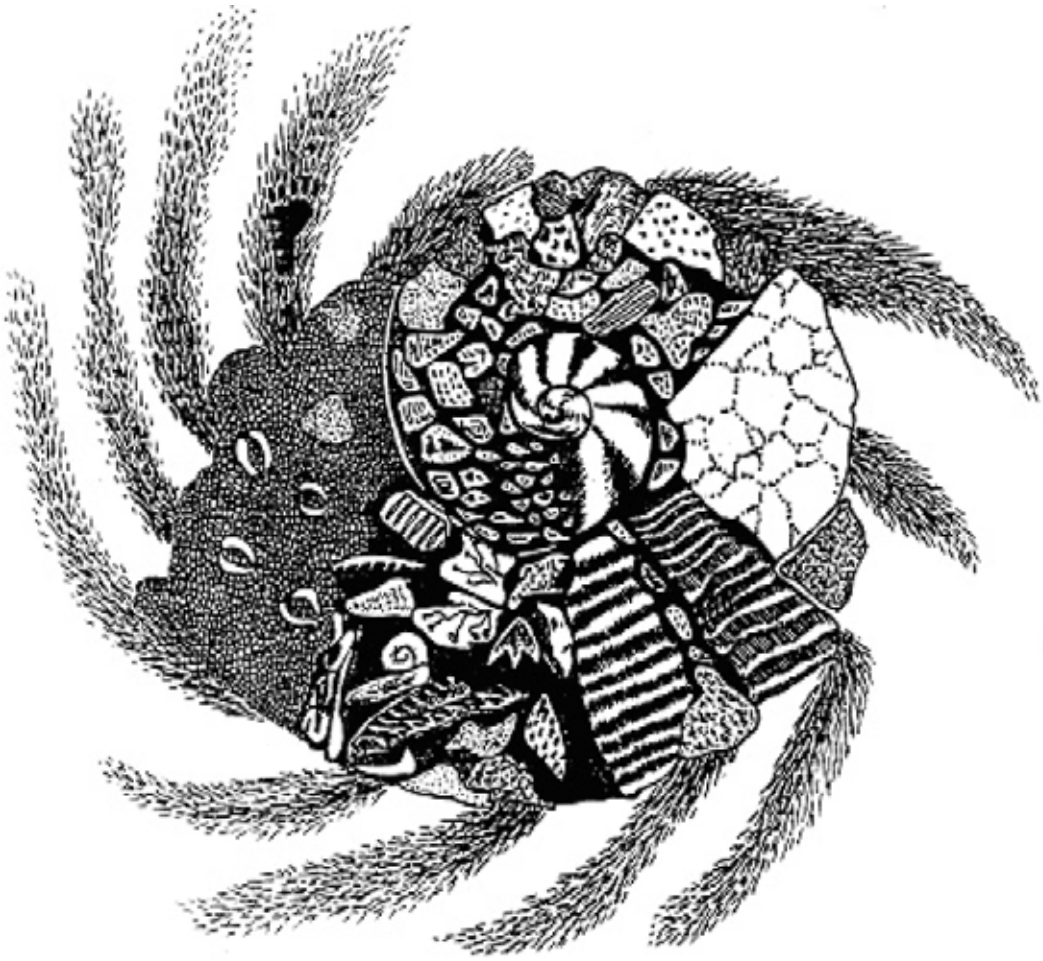
Royal Saskatchewan Museum



Saskatchewan
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The following material provides teachers and students with information about the Ice Age in what is now Saskatchewan (remember, there was no such thing as Saskatchewan in those days!):

- To describe Saskatchewan's climate during the Ice Age.
- To illustrate the geological effects of glaciation.
- To recognize a variety of animals that lived in Saskatchewan during the Ice Age.

Vocabulary

advance	geology	climate
glacier	debris	ice age
deposit	drumlin	esker
meltwater	erratic	moraine
evaporation	fauna	retreat
flora	stagnant	flow
till	fossil	Laurentide Ice Sheet
knob and kettle	Wisconsin Glacial Period	Pleistocene Epoch

BACKGROUND INFORMATION

Ice Ages

The Ice Age or Pleistocene Epoch refers to the last two million years of our geological history when there were at least five periods of glaciation in North America. Gradual climate cooling caused huge continental ice sheets to form. Later, gradual warming caused these to melt during the interglacial periods.

The last glacier began forming approximately 110,000 years ago, building until it covered all but the Cypress Hills and the Wood Mountain Plateau region of the Province. The last interglacial period started about 17,000 years ago. The ice sheet melted completely from our borders about 10,000 years ago. This last period of glaciation is called the Wisconsin Glacial Period. Most of what we know about the Ice Age is from this period because each glacier destroyed evidence of the previous periods.

There are many theories which attempt to explain the cooling climate:

- Sunlight was blocked from reaching the earth when the sun passed through a cosmic dust cloud.
- The atmosphere did not have enough carbon dioxide to insulate the earth.
- The earth "wobbled" on its axis during rotation.
- Mountain building, continental drift, and water evaporation caused cooling of the earth's polar areas.

Glaciation

Glaciers are gigantic masses of ice which form when annual snowfall does not completely melt. Layers of snow build up year after year. Snow may melt, refreeze, and be covered by more snow. The pressure of the weight of succeeding layers turns the lower layers of snow to ice. At the height of the last glaciation, the continental ice sheet, called the Laurentide Ice Sheet, was approximately 3 km high. It almost completely redesigned our province, forming the rivers, valleys, and geological features of our present landscape.

Ice sheets gradually move or slip a few metres a year because of their enormous weight and the effect of melting and freezing. Surface snow melts and refreezes, expanding and contracting, and causing cracks in the glacier. These cracks fill with meltwater. The meltwater may flow under the glacier or between layers of ice within the glacier lubricating the movement of the ice. Surface ice may slip faster than the underlying ice and move off ahead of the main bulk of the glacier, picking up rocks, clay, sand, and organic material in its path. As the main glacier bulldozes forward, it picks up the lighter forward ice as if on a conveyor belt.

It may be worthwhile explaining to students that this continental glacial action affecting our province's topography is different from alpine glaciation, which forms in mountainous terrain. Most of the thousands of glaciers in the world today are alpine glaciers; continental glaciers are rarer, larger, and comprise far more ice. At present, there are two continental glaciers in the world: the Greenland and Antarctic ice sheets.

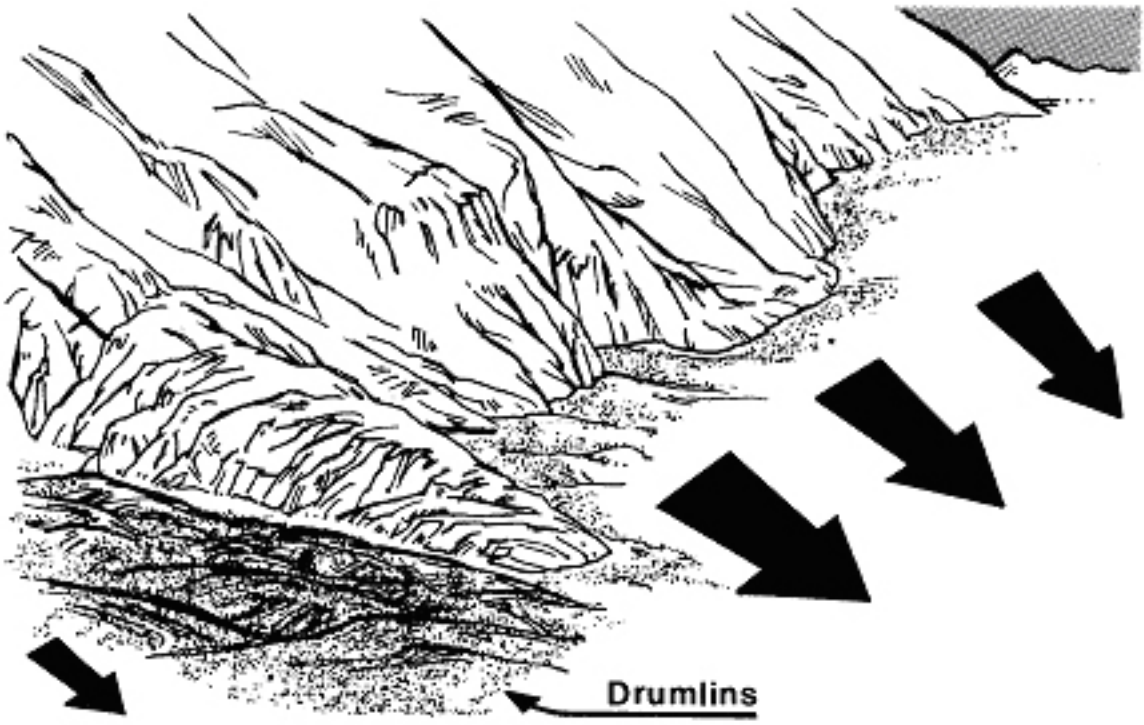
THE EFFECTS OF GLACIAL DEVELOPMENT

Glaciers can change topography as they grow and move.

Fluting Fields and Striations

Large boulders embedded in the ice sometimes scratch the surface of rocks lying under the glacier as it moves. These long scratches in the bedrock are called striations.

If the glacier is moving over areas of soft earth, it can scrape the ground flat. These features are called fluting fields.



Drumlins
Sometimes mounds of glacial debris are dumped and then covered again by advancing ice. The moving ice shapes the deposits into teardrop-shaped hills called drumlins. The narrow end of the drumlin points in the direction of ice movement.

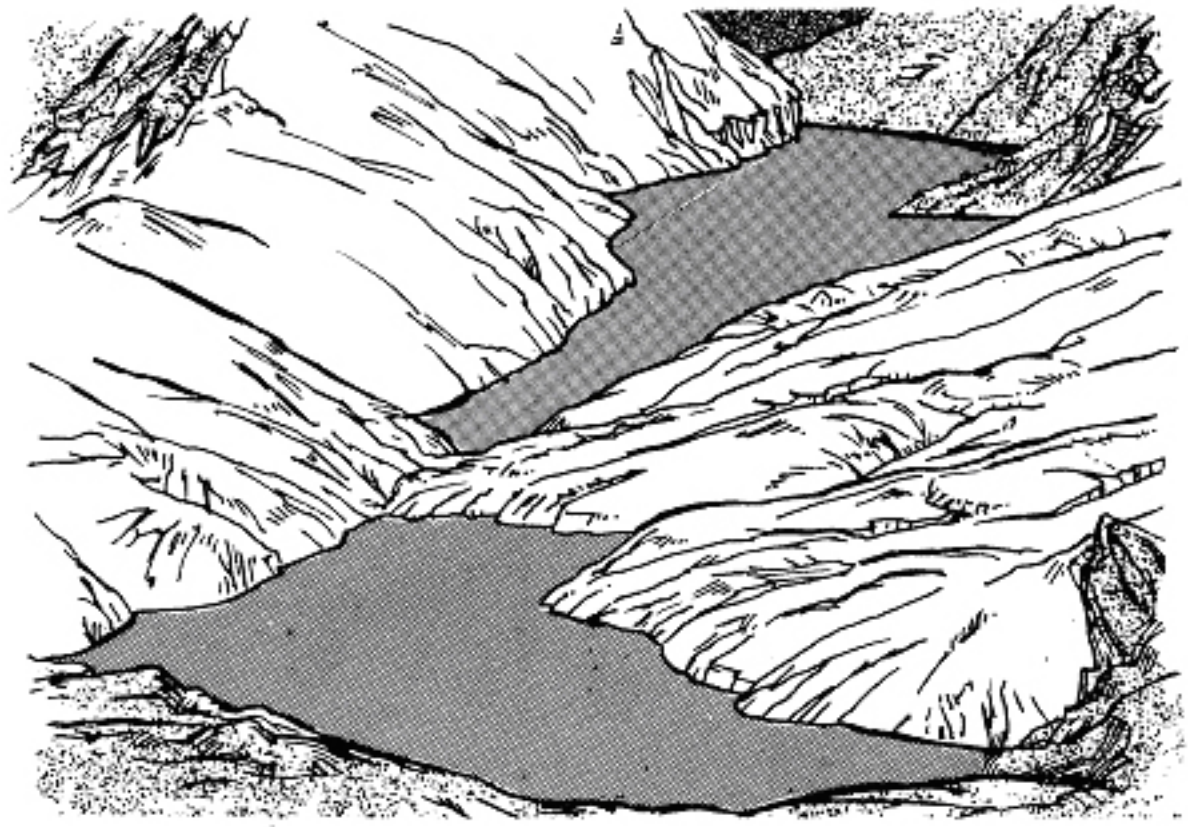
Eskers
Glaciers are never perfectly frozen. Often a growing glacier will have some melting. This water may flow through crevasses, or form a stream under the ice which picks up and deposits sediments as it flows. The formation of these stream beds results in long, low, twisted hills called eskers. Eskers are a prominent feature in Narrow Hills Provincial Park.

THE EFFECTS OF GLACIAL MELTING

Retreat refers to the shrinking of the glaciers. Melting glaciers produced huge amounts of water which accounts for much of Saskatchewan's modern topography.

Glacial Lakes
When glaciers melted, water ponded between the ice sheet and high points of the land to form a huge lake.

Lake Agassiz once covered most of Manitoba and Saskatchewan. As the lake dried up, the bottom became the rich clay plains that make up Saskatchewan's prairie farm land.



Glacial Spillways

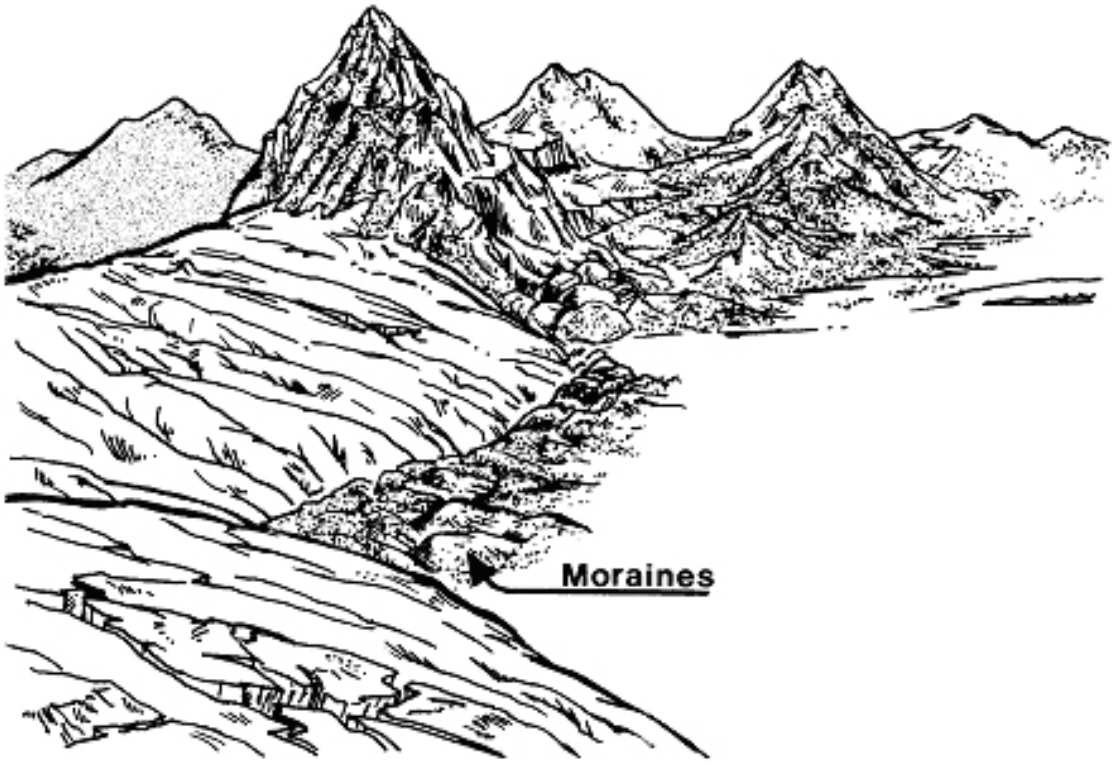
The rivers that emptied glacial lakes could be huge torrents of water capable of carving enormous river valleys called glacial spillways. There are many examples of glacial spillways in Saskatchewan, including the Qu'Appelle, Frenchman, South and North Saskatchewan, Souris, Arm River, Big Muddy, Churchill, and Clearwater river valleys. None of these rivers at their present size could possibly have produced the valleys in which they flow.

Erratics

As glaciers move, they pick up sediments that vary from boulders to fine particles. As long as the glacier is not melting, they are frozen into the ice. Erratics, moraines, and outwash plains are all formed as the melting ice drops its load of sediments.

Erratics are large rock fragments (some may weigh several tons) which have been transported from a distance away by glacial action.

Moraines
Moraines occur when the melting glacier deposits sediment (also called till and consisting of a mixture of clay, silt, sand, as well as gravels and boulders varying widely in size and shape) at the nose of the glacier in a mound or ridge formation. The Moose Mountains are a good example of moraines. Moraines can also occur as pitted terrain (Prairie Potholes described below).

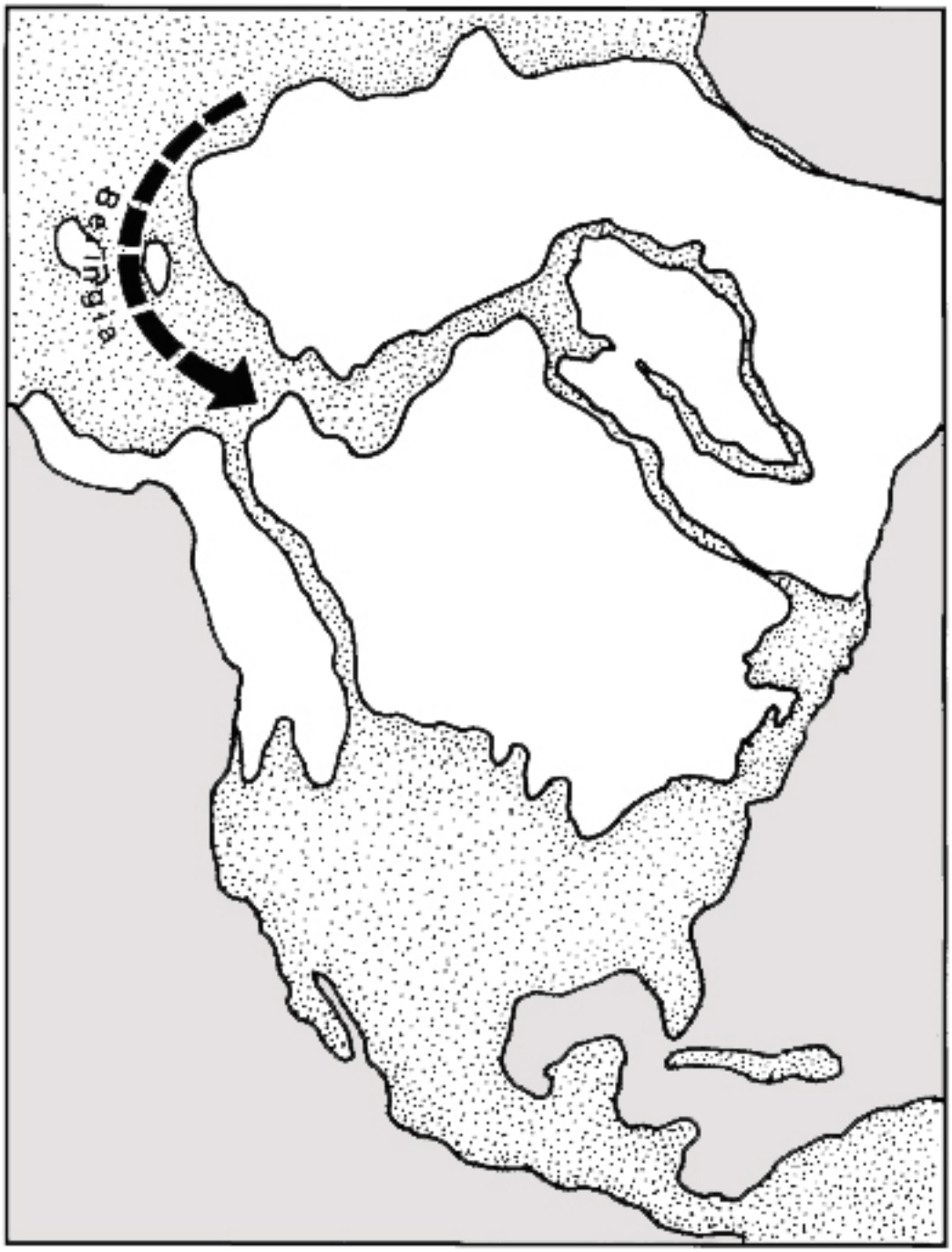


Prairie Potholes (Knob and Kettle Topography)
When blocks of ice calved off the melting glacier, they could be buried in moraines. When the ice later melted, the sediments covering them collapsed, forming a depression or pothole (also known as a Kettle), surrounded by low hills (called Knobs). Today, these prairie potholes or sloughs cover much of southern Saskatchewan. In spring they fill with runoff and provide excellent habitat for nesting waterfowl.

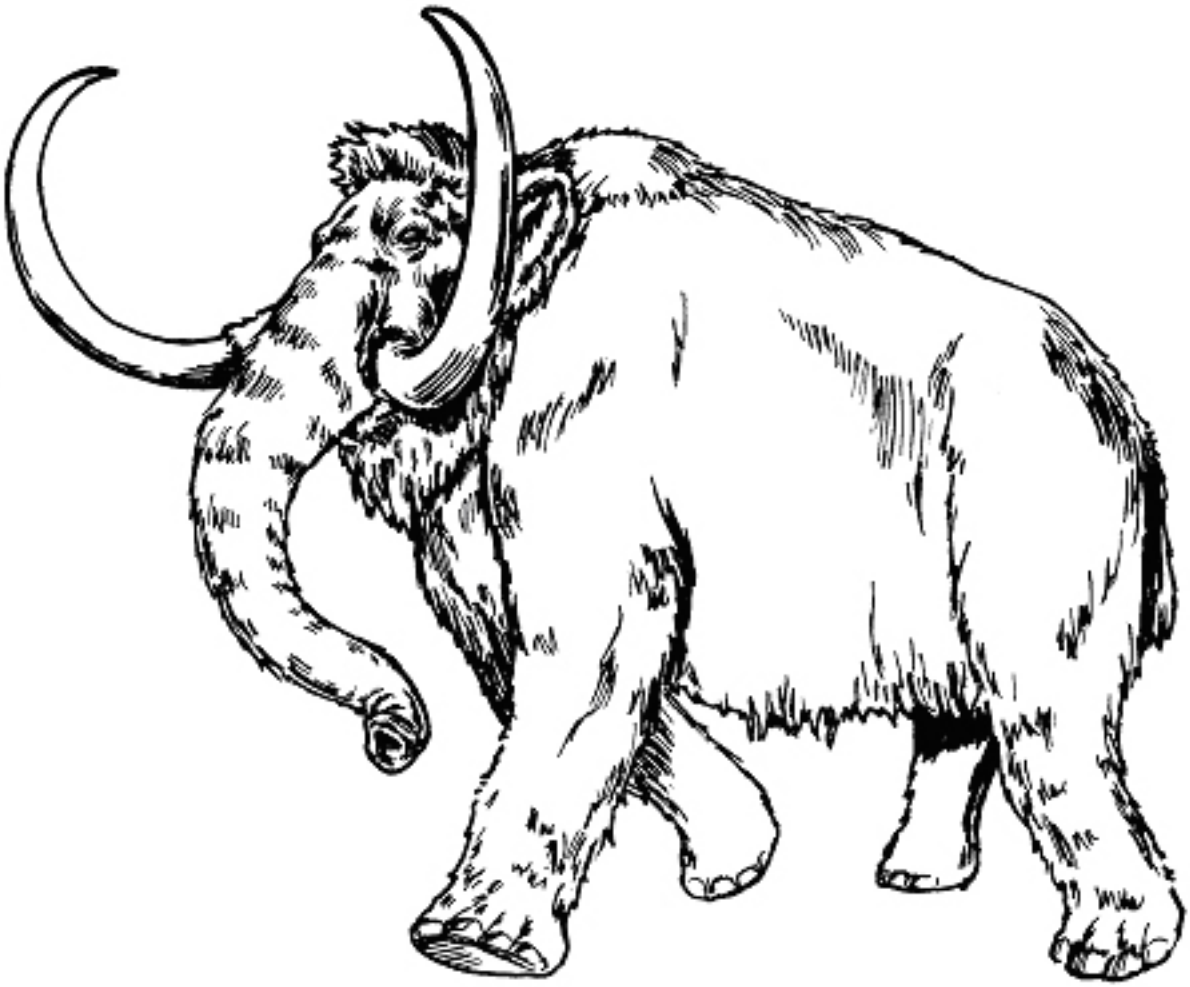
Outwash Plains
Outwash plains occur when sediments that vary from silt to cobble-size are swept rapidly away and deposited by sheets of water.

On the Edge of the Ice
The mineral-rich deposits of soil left behind by the retreat of the last glacier permitted the growth of mixed-wood forest and savannah soon after the withdrawal of ice. These biomes were home to a wide variety of animals particularly well adapted for cold climate conditions. Many of these animals were oversized relatives of our modern wildlife. Some became extinct for reasons we don't yet know.

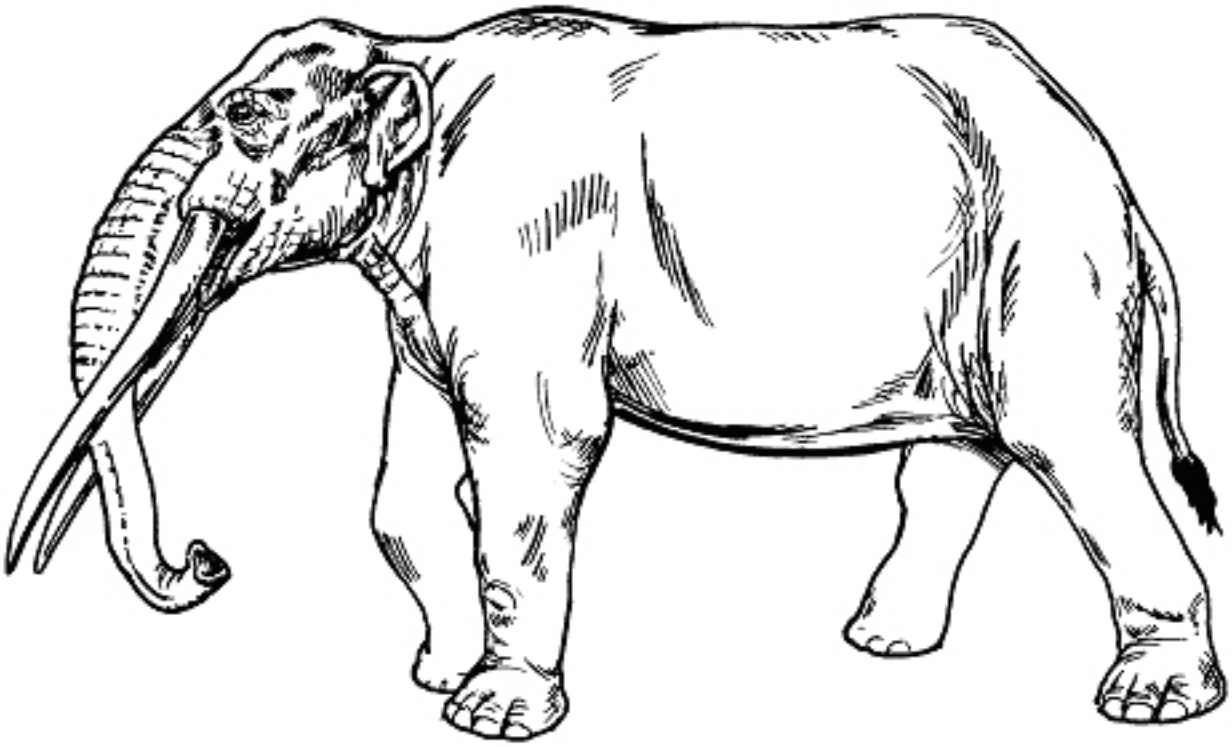
As the glaciers developed, they trapped large quantities of water in the form of ice, sea levels dropped, and a land bridge called **Beringia** was exposed in the area of the Bering Strait. Animals migrated across Beringia into Asia and vice versa.



The **Woolly Mammoth** comes to mind whenever we think of the Ice Age. The Mammoth immigrated from Asia at the beginning of the Pleistocene and did not become extinct until near the end of the Epoch. This mammal was well adapted to cold weather with a heavy, shaggy coat consisting of two layers of hair and a 6 cm thick layer of fat under its tough skin. Its skull had a hollow bulge on top where additional fat may have been stored. Large curved tusks aided foraging through snow cover for grasses, mosses, and shrubs. The Woolly Mammoth was a member of the elephant family. Although not as large as the Imperial Mammoth, it grew to 5 m tall at the shoulder and 8 m long. Mammoth fossils have been found in Saskatchewan near Kyle, Pilot Butte, and Mortlach.

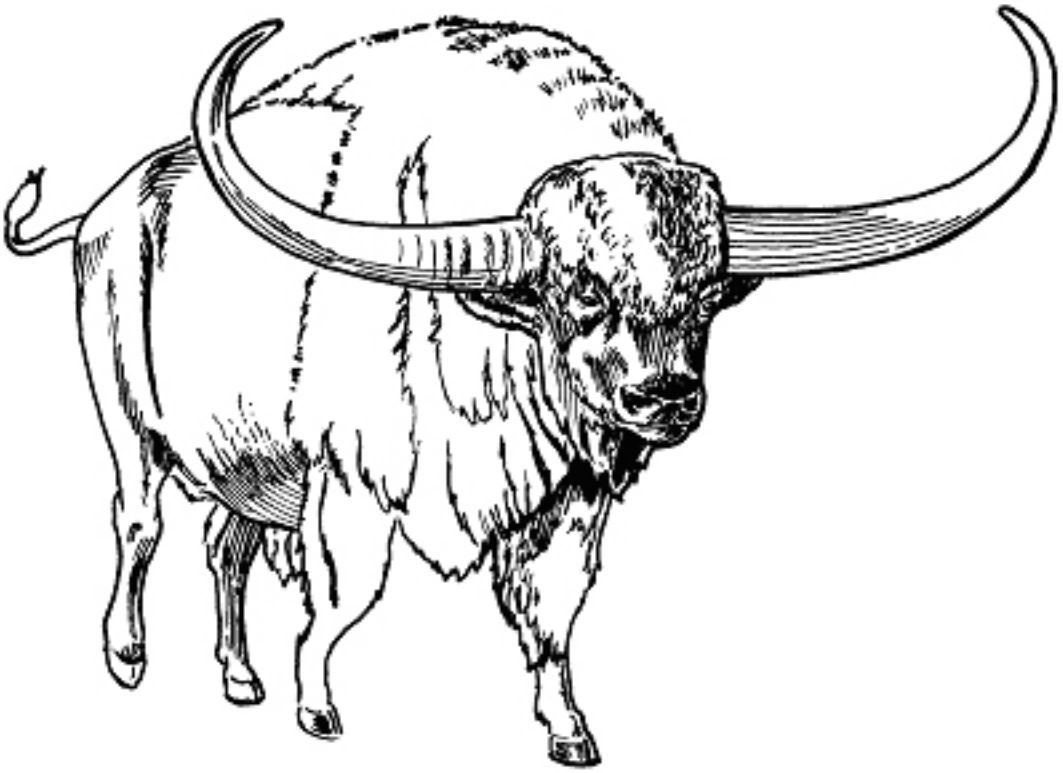


Mastodons were closely related to both mammoths and modern elephants. They fed on twigs and leaves from the forests of the Pleistocene. Mastodons were about the same size as a modern elephant, standing about 3 m tall. Their tusks were not as long nor as curved as the mammoth and the molar teeth were large and cusped – perfect for chewing large quantities of leaves. Mastodon remains have been reported from Prince Albert and Pilot Butte.



Giant Bison were common in the grassland areas south of the glaciers. Ancestor to the modern bison, this beast was much larger and hairier and its horn spread was over 3 m. Like its modern relatives, the Giant Bison grazed in herds, constantly on the move for fresh grasses. Fossils of Giant Bison have been found in the Qu'Appelle Valley.

Alongside the herds of bison roamed other hoofed grazers: primitive horses, camels, and pronghorn. Through fossil evidence, scientists have traced their evolution here for millions of years. They, too, migrated up the edges of the glaciers in search of fresh pastures, over Beringia, and into Asia.



Following the herds of herbivores were carnivores such as the Sabre-tooth and Dire Wolf. Large and vicious, these creatures had long lethal fangs for stabbing as much as biting. Like most Ice Age creatures, they were much larger than their modern relatives.

With the final retreat of the glaciers, another predator of the big game appeared.

Although the theories of how man came to North America may be in dispute, it is certain that no one could live in Saskatchewan until the retreat of the Wisconsin ice sheet freed the land for habitation. The earliest evidence of people in Saskatchewan comes from about 11,000 years ago.

The Legacy of the Ice Age

The glaciers completely obliterated the landscape of other eras, grading the topography, scraping minerals from the Precambrian Shield, grinding down the rocks and mountains, cutting rivers into the plains, dumping hills, flooding the plains with lakes, cutting valleys with rivers, and creating deposits of nutrient-rich sediments on the Plains. The land is what the glaciers left behind, but the current climate has been affected by other elements: the rise of the Rocky Mountains, the winds from the Gulf Stream, and the biology of flora and fauna.

FREQUENTLY ASKED QUESTIONS:

What is the scientific name for the Ice Age? How long did it last?

The scientific name for the Ice Age is the Pleistocene Epoch, which lasted for about 2 million years. The Pleistocene glaciers mark the end of the Tertiary Period and the beginning of the Quaternary Period.

How many glaciers occurred during the Ice Age?

There were five continental ice sheets.

What is a glacier and how does it occur?

A glacier is a build-up of snow that does not melt during the warmest part of the year, creating a snow field. As the snow collects, the increased weight turns the lower layers to ice. When the snow field grows large and heavy enough, ice will flow away from the centre, creating a moving, growing glacier.

What parts of Saskatchewan were covered with ice during the last period of glaciation?

All of Saskatchewan, except for the Cypress Hills and Wood Mountain Plateau, was covered. These two areas were like islands in a vast sea of ice.

How do glaciers change the land when they move?

Advancing glaciers picked up existing sediment off the surface and froze it into the ice. When the glacier melted, it dropped this material in a different location (forming moraines and erratics, for example). Drumlins and eskers also formed under the ice as it moved.

In addition, the grinding, gouging, and scraping action caused by the movement of glacial ice armed with rock fragments frozen into it, created fluting fields and striations.

How does meltwater running off a glacier change the land?

Water is one of the most dynamic forces causing topographical change. As the glaciers melted, huge lakes formed at the nose of the ice. Torrents of meltwater eroded deep valleys and deposited sediments melted out of the glacier.

What was the environment like in what is now southern SK about 1,500,000 years ago?
It was a dry environment. A cold glacial lake not shown in the diorama was located close by. This provided a source of water to support many animals. A similar situation exists today around watering holes in the African savannah.

What animals lived in this region?
Giant Sloth
Imperial Mammoth
Bone-crushing Dog
White-tailed Prairie Dog
Camel
Bobcat
Shrub-ox
Horse
Four-horned Pronghorn

Some animals that lived during the ice age went extinct, others continue to live in other parts of the world but no longer here in SK, and some still live here:? live today?

Extinct: Giant Sloth, Imperial Mammoth, Bone-crushing Dog, Shrub-ox
Camel: SK during ice age, now still live in Africa
Horse: SK during ice age, went extinct and then modern horses were introduced to N. America with arrival of Europeans.

Prairie Dog: still in Saskatchewan/N. America
Bobcat: still in Saskatchewan/N. America
Pronghorn: still in Saskatchewan/N. America

Describe a mammoth.
A mammoth is very similar to an elephant and is related to it. There are differences, however: mammoths had bigger tusks; they had a thick coat of fur; their heads had a hollow dome that could fill with fat; their ears were much smaller than modern elephants, in order to conserve body heat.

Esker, drumlin, valley, moraine, spillway, lake, potholes. Which were formed by ice, which by meltwater?

Esker: Ice
Drumlin: Ice
Valley: In Saskatchewan, the valleys were formed by meltwater.
Moraine: Ice
Spillway: Meltwater
Lake: Meltwater
Potholes: Both ice and meltwater

How was the Giant Bison different from a modern bison? How are they similar?

Differences: Horns much bigger
Animal was bigger

Similarities: Humps
Diet of grasses
Shape of body
Hooves

Why did it become extinct?

The Giant Bison (Bison latifrons) evolved into the familiar form that we know today. It became extinct through evolution.

ACTIVITIES - Geological Time Chart

Put the following phrases under the correct heading:

	Before Ice Age	During Ice Age	After Ice Age
Glacial Lake			
Dire Wolf			
Dinosaurs			
Pronghorn			
Prairie Grass			
Ice sheets			
Giant Bison			
Fertile soil			
First Nations People			
Qu'Appelle Valley			
Tropical			
Moraines			
Woolly Mammoth			
Shallow tropical seas			
Cold weather			
Camel			
Volcanoes			
South Sask. River			
Moraine			
Swamps			
Precambrian Shield			
Lake Agassiz			
Glacial till			
Railroad			
Irrigation			
Lake Diefenbaker			
Tundra			
Meltwater			
Mineral deposits			
Farms			
Beringia			
Regina			
Fossils			
Drumlins			

Meltwater Layering
This experiment illustrates the effect of water on layering of sand and dirt.

Equipment:
a clean jar
sand
dirt
water

Method:
In a clear glass jar put enough dirt to cover the bottom (about 3 cm). Add enough sand to fill another 3 cm. Add water to the jar to a level of 5 to 10 cm above the dirt and sand.

Stir well. Allow to settle. As the water slows down it should deposit the sand, silt, and clay into at least two or more clearly defined layers. Are the heavier particles at the top or the bottom? Why? Under what conditions would the lightest layers be deposited?

Knobs and Kettle Formation
This experiment will illustrate on a small scale the process by which glacial kettles were formed.

Equipment:
a shallow tray (about 6 cm thick)
about 4 to 8 ice cubes
sand or dirt

Method:
Put down a layer of sand or dirt about 2 cm thick in the bottom of the tray. Place ice cubes in different locations on the sand or dirt in the tray. Pour in more sand and dirt in the tray until the ice cubes are barely covered with a layer about .5 cm thick. Level off. Leave the ice cubes to melt. Depending on the temperature and the thickness of the covering, this should take about 4 to 8 hours. When the ice cubes melt, the first covering should cave in, leaving a hollow in the surface.

Glacier Simulation
This experiment will simulate glacier movement.

Equipment:
water
corn starch/icing sugar
mixing bowl
flat board or cookie sheet
small amounts of fine sand, pepper, sugar, etc.

Method:
Mix 1/2 cup (125 ml) of corn starch with water to make a paste about the consistency of cream (corn starch behaves in a peculiar manner and, although it appears and feels lumpy, it will pour easily). Using the board to simulate North America (even draw a representative shape if you wish), pour the mixed corn starch on the board (in the Hudson Bay region if you drew a map).

Scatter bits of sand and pepper on the board. Sprinkle a few grains of pepper on the corn starch. Tilt the board slightly and watch for the following:

1. How the mixture moves.
2. Where does it move fastest?
3. What happens when it meets a particle of sand?
4. What happens to the pepper on top of the corn starch?
5. What happens at the edge of the flowing mixture and what happens to the mixture at the centre?
6. What happens when you add more corn starch?

Not Another Ice Age!

Have students collect articles on the theories of the cause of the Ice Age and on whether the present period is a period of retreat or advance of an Ice Age. Start a bulletin board or resource area to display these articles.

Take a Field Trip

An effective way to study geology is to take a field trip and examine the geological history of your locality. Saskatchewan has a wealth of Ice Age formations. Maps and brochures are available from universities, government departments, and museums.

Student assignments could include:

1. Researching when the last glacier retreated from your area.
2. Determining what local geological formation (valleys, rivers, moraines) resulted from glaciation.
3. Making sketches or photographing local geological features.
4. Analysing field stones to examine how they differ from bedrock and whether they were transported by ice or water.

Ice Age Migrants

Have each student prepare a description and sketch of an animal that lived in Saskatchewan during the Ice Age, i.e. Woolly Mammoth, Imperial Mammoth, Mastodon, Giant Sloth, Shrub-ox, Peccary, Prairie Dog, Pocket Gopher, Horse, Yesterday's Camel, Pronghorn, Lynx, Muskox, Giant Bison, Mexican Ass, Dire Wolf, North American Lion, Giant Beaver, Sabre-tooth, Crane, Stag Moose, Giant Elk, Bone-crushing Dog, Bobcat.

As a class project, prepare an Ice Age map of the world. Place the pictures of the animals on the map with lines of coloured wool to indicate in what part of the world they originated. Be sure to emphasize that the land bridge, Beringia, allowed animals to move between continents