Our Diverse Prairie Landscape: Saskatchewan is Not Just Flat! Glacial Terminology

Subject/Grade: Science/12, 8 & 7.
Lesson Title: Our Diverse Prairie Landscape: Glacial Terminology

Stage 1: Identify Desired Results

Outcome(s)/Indicator(s)

Earth Science 30 Lithosphere

Analyze surface geography as a product of deposition, weathering, erosion and mass wasting processes. [SI, CP]

a) Observe, describe and locate common landforms (e.g., moraines, potholes, drumlins, buttes, coulees, dunes, oxbow lakes and river valleys. (K)

c) Explain how surficial geological features of Saskatchewan such as Qu' Appelle Valley are characterized by specific depositional and erosional processes. (K)

d) Describe the effects of mechanical weathering and erosion, including glaciation, on the surface geography of Saskatchewan as shown by landforms such as drumlins, moraines, eskers, kettles, and outwash. (K)

Grade 8 Water Systems

WS8.2 Examine how wind, water, and ice have shaped and continue to shape the Canadian landscape. [DM, SI]

g) Relate factors that affect glacier formation and reduction and their effects on the environment to the formation of glacial landforms in Saskatchewan (e.g., drumlins, moraines, eskers, and kettle lakes).

Grade 7 Earth's Crust and Resources

EC7.3 Investigate the characteristics and formation of the surface geology of Saskatchewan, including soil, and identify correlations between surface geology and past, present, and possible future land uses. [DM, SI]

f) Differentiate between weathering and erosion, and explain the role of water in each process.

g) Document the natural surface geological features of the local environment and provide explanations for the origin of those features.

Key Understandings: ('I Can' statements)	**Essential Questions:**
I can… describe and locate glacial landforms in Saskatchewan (e.g., drumlins, moraines, eskers, and kettle lakes). I can… explain how surficial geological features of Saskatchewan such as Qu' Appelle Valley were formed. I can... describe the effects of weathering and erosion in relation to glaciation, on the surficial geology of Saskatchewan.	● How have past glaciation events affected the geography of Saskatchewan today? ● What are some glacial features that we see in Saskatchewan and how were they formed? ● What does weathering and erosion have to do with glaciation?

Teacher Background

This lesson is an introduction to the terminology and landforms associated with glaciation; particular attention is paid to the effects of the Laurentide Ice Sheet that covered much of Saskatchewan 12,000 years ago. This lesson is the first in a series of lessons dealing with glaciation; topics are explored in more detail throughout the series.

The Laurentide Ice Sheet was the last glacier to advance over Saskatchewan; it reached its maximum thickness and extent approximately 18,000 years ago. The retreat of the Laurentide Ice Sheet went on for the next 10,000 years; through the movement of the ice sheet the landscape of Saskatchewan was created. In this lesson students will be introduced to the vocabulary of glaciation. A slide show is provided with a corresponding student activity sheet. If students are able to work with less guidance the student activity sheet need not be used, students can create their own notes.

Stage 3: Build Learning Plan

Preparation:

1. A PowerPoint Presentation will help guide the lesson on Glacial Terminology. Become familiar with the PowerPoint Presentation and either print off the notes about the PowerPoint Slides or Presenter View where it allows you to see the notes as you are presenting.
2. Setup projector and ensure the PowerPoint Presentation loads correctly with all the photos.
3. Discuss the concepts of parallel and perpendicular detailing the short notations that may be used for each. Parallel //
   Perpendicular $\perp$

Set (Warm-up, Focusing the Learning): Time: 5-10 min

Get students engaged in the topic by saying a series of statements. Have students give a thumbs up if they think it the statement is true or thumbs down if they think it is false. You can ask some students to explain their thought process as you go through the statements.

Possible statements that you could use…

- Today glacial ice covers more than 20% of the Earth's land surface. False - less than 10%
- Glacial ice is the largest reservoir of freshwater on Earth.
  True - 75% of Earth's freshwater
- The colour of glacial ice is white. False - blue
- A glacier moves under the influence of its own weight and gravity. True
- Saskatchewan has been covered by at least three glaciations. True
- Glaciers can tell us important information about climate change. True

Development: **Time:** 34-40 min

Present the slideshow allowing time for students to make any notes that they feel is necessary. The student activity sheet can be used to guide these notes or students can create their own.

Learning Closure: **Time:** 15min

- On the second last slide there is a drawing of a diagram. Ask students to help you label and name the features in the diagram. Have students label their own diagrams on their worksheets.
- Ask students to reflect and speculate on the question in the final slide. This question is repeated as a summary activity at the closure of this lesson series.

Materials/Equipment:

- Projector
- Google Slides with the notes for presentation
- Student Activity Sheet (if desired)

Possible Adaptations/ Differentiation

If students are able to work with less guidance the student activity sheet need not be used, students can create their own notes.
You can change the engage questions or the activity sheet to fit the lesson that you want to teach.

Stage 4: Determine Evidence for Assessing Learning

- Future activities in this series rely on the knowledge gained from this slide show.
- Informal - class questions and discussions as you present the slide show.
- Have students hand in the worksheet for grades or to check for understanding.

Extensions
Challenge students to a photo hunt; ask them to find photographs of the effects of glaciation either in their own personal collections, travel brochures, in science magazines or online. --- Look at the Digital Geological Highway Map of Saskatchewan (*GeoExplore Saskatchewan*) website for further information and a deeper understanding of the local context: Main Website https://skgeolhighwaymap.maps.arcgis.com/apps/MapSeries/index.html?appid=a845cbb370f7401597806887318e2676 For more background information related to this lesson check out ● Main tab “Landforms” ● Main tab “Ice Age”

Name:_____

Student Activity Sheet
Glacial Terminology

The province of Saskatchewan was covered by at least five continental ice sheets over the past 2 million years. The action of these ice sheets carved much of the landscape we see today. The final ice sheet is known as the Laurentide Ice Sheet and retreated for the last time between _____ and _____ years ago.

Continental Ice Sheet -_____
_____

Ice Age -_____
_____

_____ - all process that remove snow or ice from a glacier.

_____ - all process that add snow or ice to a glacier.

Advance -_____

Retreat -_____

How does a glacier or ice sheet form? _____

_____

_____

Till - _____

_____ - a rock that has been moved a distance to an area where the lithology (or rock type) is different.

Striae -_____
Are straie parallel (//) to ice flow or perpendicular ($\perp$)? _____

Roche Moutonnees - _____

Drumlin - _____

_____ - lakes and sloughs formed when a block of ice becomes isolated and melts.

Melt water channel - _____
_____

Geoscape Southern Saskatchewan: Geoscience for Prairie Communities.

Glacial Lake: _____
_____

Esker: _____

Make notes on the types of moraines discussed:
_____

_____

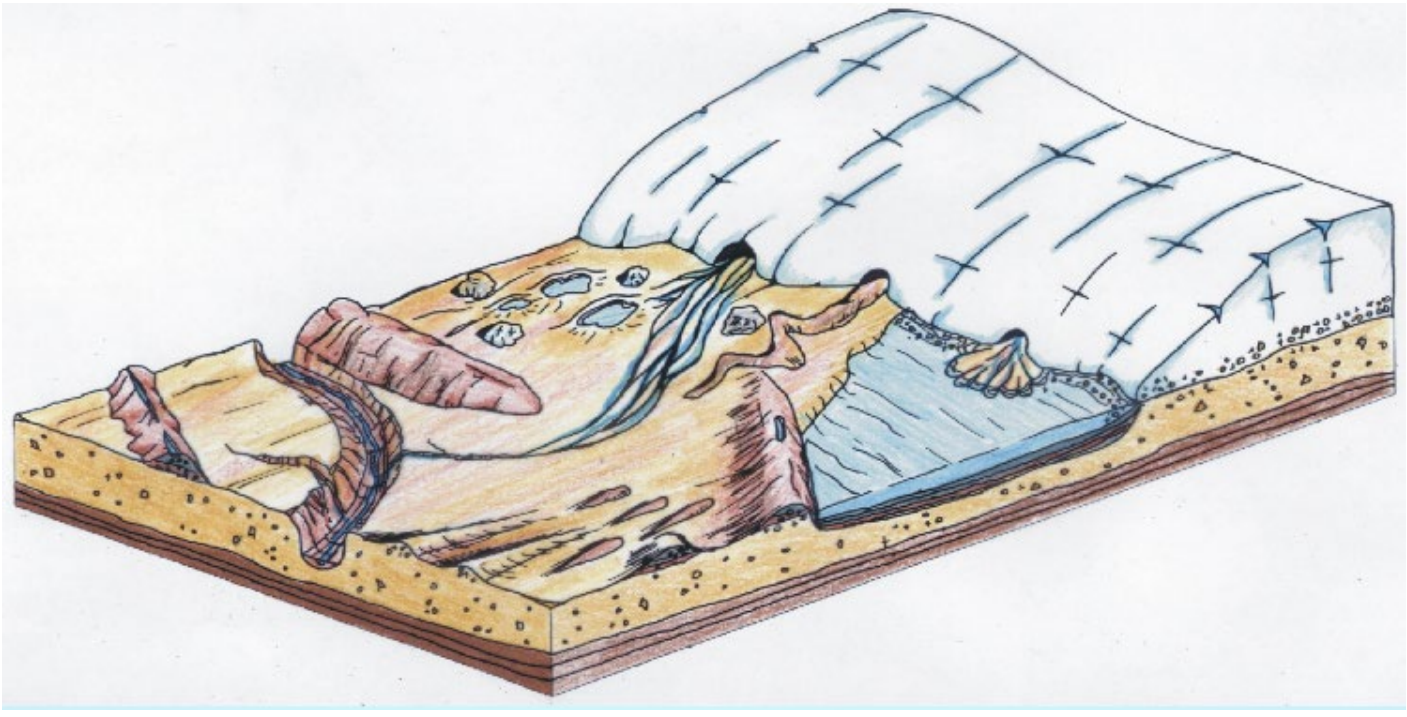
_____

_____

_____

_____

Label the diagram with the following terms: Moraine, Kettle, Drumlin, Glacial Lake, Erratic & Esker.



Glacial Terminology
Answers

The province of Saskatchewan was covered by at least five continental ice sheets over the past 2 million years. The action of these ice sheets carved the much of landscape, as we know it today. The final ice sheet is known as the Laurentian Ice Sheet and retreated for the last time between 12,000 and 8,000 years ago.

Continental Ice Sheet – a large mass of ice that covers almost all land features.

Ice Age – a period of extensive glaciation.

Ablation - all process that remove snow or ice from a glacier.

Accumulation - all process that add snow or ice to a glacier.

Advance – movement of a glacier that coincides with growth of the glacier.

Retreat –movement of a glacier that results from a decrease in mass.

How does a glacier or ice sheet form? Snow must accumulate and firn must be formed. The snow that accumulates becomes compacted and air spaces between the crystals shrink. The snow will become pure ice.

Till – glacial debris: sand, silt, clay, and rocks.

Erratic - a rock that has been moved a distance to an area where the lithology (or rock type) is different.

Striae – scratch marks caused by rocks and debris in the ice moving over the rock bed.
Are striae parallel (//) to ice flow or perpendicular (⊥)? //

Roche Moutonnees – rock outcrops that have been modified by glacial ice. The upstream side is smooth and rounded, while the downstream side is rough and angular.
Drumlin – a hill formed from build up of glacial debris.
Kettles - lakes and sloughs formed when a block of ice becomes isolated and melts.
Melt water channel – a river or stream created by glacial runoff

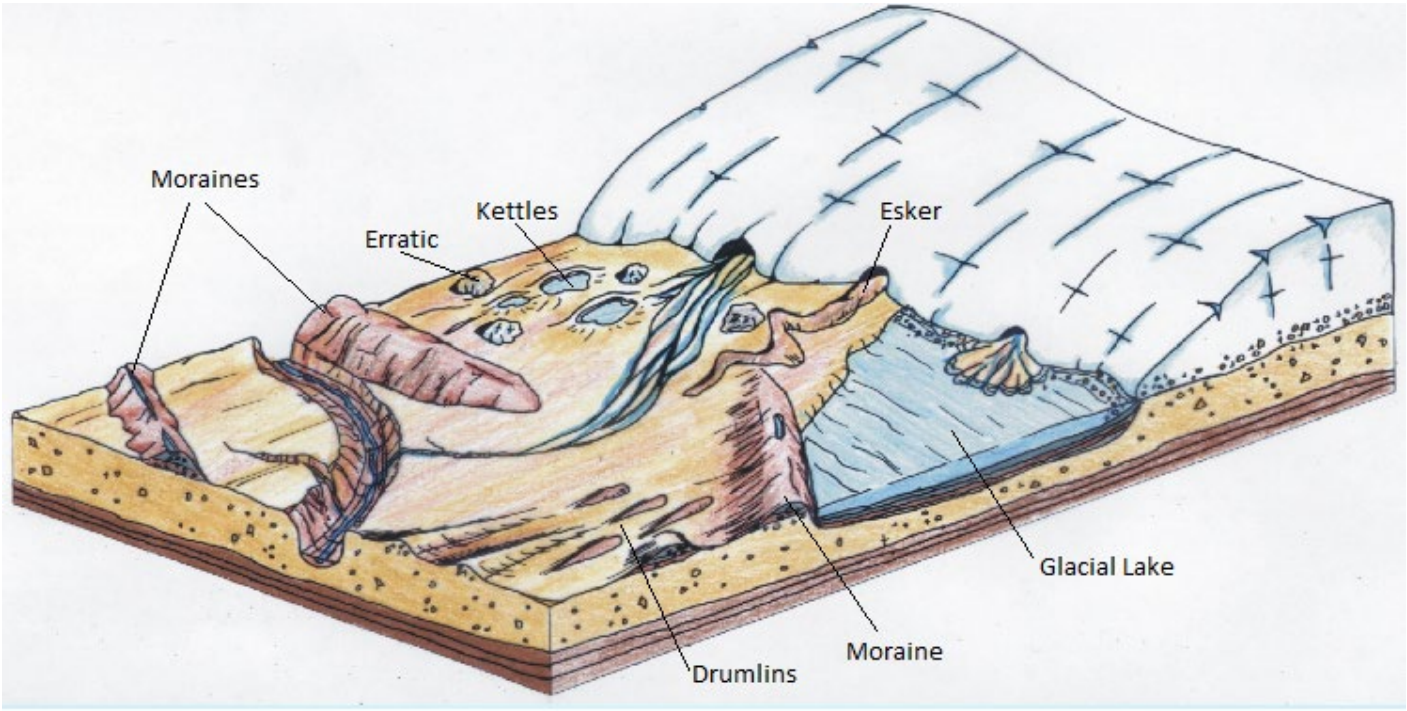
Glacial Lake: a lake formed from glacial meltwater trapped in a low-lying area.
Esker: a long winding hill or ridge that used to be the bed of a glacial stream that ran under or on top of the glacier, the ridge formed from the build up of the glacial stream bed.

Make notes on the types of moraines discussed:
Moraines are mound, ridges or accumulations of till.
End Moraine - the ridge formed at the outer edge (or nose) of the glacier, similar to a yard line in relation to the movement of the football team.

Geoscape Southern Saskatchewan: Geoscience for Prairie Communities.

Lateral Moraine – the ridge or mound accumulated at the outer edges of the glacier parallel to ice flow.
Medial Moraine – the ridge formed when two lateral moraines come together as two glaciers meet to become one glacier.

Label the diagram with the following terms: Moraine, Kettle, Drumlin, Glacial Lake, Erratic & Esker.



Our Diverse Prairie Landscape
Presentation Notes

Slide 1: Our Diverse Prairie Landscape

Notes: This slide show is meant to introduce students to the vocabulary of glaciation. After viewing the slide show students can further investigate the topics through the remaining lessons in this series.

Slide 2: Ice Age: Architect of Our Landscape

The province of Saskatchewan was covered by at least five continental ice sheets over the past 2 million years.The action of these ice sheets carved much of the landscape, as we know it today. The final ice sheet is known as the Laurentide Ice Sheet and retreated for the last time between 12,000 and 8,000 years ago.

Notes: The Quaternary Period began 2.58 million years ago and is the current phase of geologic time. Events during the Quaternary Period include the Ice Age and the arrival of human beings to North America. The province of Saskatchewan owes much of its current geography to the actions of the Laurentide Ice Sheet.

Slide 3: Ice Age: Architect of Our Landscape: A few terms

Continental Ice Sheet - a large mass of ice that covers almost all land features. Today there are continental ice sheets in Antarctica and Greenland.

Ice Age - a extended period of time when large areas of the earth were covered by glaciers. The last ice age took place during the Quaternary Period, which began 2.58 million years ago.

Notes: To begin a few terms need to be clarified. A continental ice sheet is a large mass of ice that covers almost all land features that begins at high latitudes and flows to low latitudes, an alpine glacier is an ice mass that begins in high altitudes and travels between mountains to lower altitudes. The last ice age ended 8,000 years ago with the retreat of continental ice sheets in North America, Europe and Asia.

Slide 4: Ice Age: Architect of Our Landscape: A few terms

Ablation - ice mass lost when the build up of ice is less than the melt.

Accumulation – the ice mass increases when the build up of ice is more than the loss.

Slide 5: Ice Age: Architect of Our Landscape: A few terms

Advance - as ice is added to the glacier it grows in mass, the increase causes the glacier to slide slowly. A moving glacier is like a bulldozer, pushing some obstacles out of its way and moving over others.

Retreat - ice at the front of a glacier melts causing the glacier to decrease in size. This melt leaves behind a variety of sediments and landforms.

Notes: It is important to understand the difference between advance and retreat and accumulation and ablation. Advance and retreat describe the **action** of the glacier or ice sheet whereas accumulation and ablation refer to the **mass** of the ice sheet.

Slide 6: Ice Age: Architect of Our Landscape: How does a glacier form?
A snowfield is critical in the formation of a glacier. When the snow that accumulates during the winter is unable to melt completely during the summer thick ice accumulates. If the ice thickens enough it will begin to slide away from the snowfield. As more ice builds the glacier thickens and advances.

Slide 7: Ice Age: Architect of Our Landscape: How does a glacier form?
Firn or neve is a type of ice that is critical in the formation of glaciers. Snow crystals that have survived a summer become compacted and turn into small globules. They then form a mass of ice crystals with interconnected air spaces, this is firn. As the firn is compacted the air spaces become less and less until pure ice is formed.
Notes: Think of a snow crystal, typically light and fluffy. As pressure increases the crystal becomes crushed and melted together. What was once light and fluffy becomes rigid; making a good snowball is a similar analogy.When you pick up snow in your hands, it is light and fluffy. Once you squeeze it and shape it in your hands it becomes hard and forms a solid snowball Pressure compacts the snow into ice through pressure melting and refreezing.

Slide 8: Ice Age: Architect of Our Landscape
Notes: This slide shows the extent of ice coverage of the Laurentian Ice Sheet and it's retreat over 10,000 years. Notice that there are unglaciated areas, why might this be?

Slide 9: Ice Age: Architect of Our Landscape: How does a glacier move?
Glaciers and ice sheets can move slowly or quickly. Creep happens when the mass of the ice combined with the force of gravity cause the glacier to slowly move. This generally happens in a down slope direction. There may be water under the ice; this allows the glacier to flow. The glacier may also crack or deform to allow for movement over or around it's surroundings.
Notes: Creep also happens to rock and soil and is actually a type of landslide. Think of a fence that is slowly getting bent over because the soil the fence is grounded in is slowly moving downhill.

Slide 10: Ice Age: Architect of Our Landscape: Glacial Effects
This diagram shows the province of Saskatchewan 11,500 years ago.
Notes: What features are recognizable? What types of landforms would you expect to see as a result of glacial ice?

Slide 11: Ice Age: Architect of Our Landscape: Glacial Effects
As glaciers move they pick up sediments, rocks and other debris. As the glacier travels, till (glacial debris) is left behind creating some beautiful and interesting landforms.
Notes: Till is the building block of many of the geographic landforms we see in Saskatchewan. The glacial till left behind after the last ice age is more than 10 metres thick in some locations throughout Southern

Saskatchewan. This makes up a very small percentage of the rock layers in Saskatchewan; the deposits from the Age of Mammals (57-65 million years ago) make up 225 metres of the geologic column at some locations.

Slide 12: Ice Age: Architect of Our Landscape: Glacial Effects
This is a granitic erratic that was carried by glacial ice over 400 km from northern Saskatchewan to Rockhaven.
Notes: An erratic is a rock that has been moved a distance from its outcrop to an area where the lithology (rock type) is different. This erratic is located at Big Rock Heritage Site near Cutknife, Saskatchewan. It weighs over 2500 tonnes and was once over 10 m by 10m by 10m but has been broken apart.

Slide 13: Ice Age: Architect of Our Landscape: Glacial Effects
Striae are scratch marks caused by the rocks and sediments frozen in the glacial ice as they travel over the landscape.
Notes: Striae are always parallel to the direction of ice flow. The camera lens cover is included on the photo to show scale.

Slide 14: Ice Age: Architect of Our Landscape: Glacial Effects
Roche Moutonnees are rock outcrops that have been modified by glacial ice.
Notes: The steep side of the roche moutonnee points in the direction of ice flow. As the ice moved over the outcrop the pressure caused a little melting that allowed the ice to slide over the rock, which made it smooth and rounded and left striations. On the other side of the outcrop, lower pressure allowed the water to freeze the ice to the rock. As the glacier continued to move this part of the outcrop was plucked away, making it steep and angular. Think about gluing a piece of wood to a piece of paper and pulling them apart. Chunks of paper are pulled away – Just like chunks of rock frozen to the ice are pulled away by the glacier.

Slide 15: Ice Age: Architect of Our Landscape: Glacial Effects
This is a drumlin near Kamsack, Saskatchewan.
Notes: A drumlin is a hill formed from build up of glacial debris. A drumlin is not symmetrical; the gently sloped slide is parallel to the direction of ice flow. The drumlin is built under the margin of the ice that is it is built while the glacier is moving.

Slide 16: Ice Age: Architect of Our Landscape: Glacial Effects
Notes: An aerial view of drumlins in the Athabasca Basin, northern Saskatchewan

Slide 17: Ice Age: Architect of Our Landscape: Glacial Effects
Kettles are lakes and sloughs formed when a block of ice becomes isolated then melts.
Notes: Think of an ice cube melting in a pan of sand. If the ice cube is buried in the sand it will have a water filled depression upon melting.

Slide 18: Ice Age: Architect of Our Landscape: Glacial Effects

Outwash plains are formed from the melt water that flows from the glacial ice margin. This allows for many layers of sand, silt and clay to build up in a smooth, gently sloping manner.

Notes: What type of activity occurs on outwash plains?

Slide 19: Ice Age: Architect of Our Landscape: Glacial Effects

Melt water channels are created by the movement of glacial melt water and are generally steep sided with wide valley floors.

Notes: The Qu'appelle valley is considered one of Canada's most spectacular melt water channels. After the creation of the valley it acted as a spillway for melt water from the glacial lakes.

Slide 20: Ice Age: Architect of Our Landscape: Glacial Effects

Glacial lakes are formed when glacial meltwater is trapped in low-lying areas. The melt water contains fine sediments that settle on the bottom of the lake bed.

Notes: Glacial lake beds are the sites of many towns and cities. How many can you remember from the diagram of Saskatchewan 11,500 years ago?

Slide 21: Ice Age: Architect of Our Landscape: Glacial Effects

Notes: The sediments have now formed the fertile plains that cover much of southern Saskatchewan.

Slide 22: Ice Age: Architect of Our Landscape: Glacial Effects

Notes: The glacial ice was not entirely a solid mass. Under the ice sheet glacial streams flowed. The beds of these streams formed ridges called eskers. Eskers are parallel to the direction of ice flow.

Slide 23: Ice Age: Architect of Our Landscape: Glacial Effects

Moraines are mounds, ridges or accumulations of till. Moraines are deposited by the glacier and can take a variety of forms.

Notes: Moraines can be parallel to ice flow or perpendicular to ice flow depending on the type of moraine.

Slide 24: Ice Age: Architect of Our Landscape: Glacial Effects

An end moraine is the ridge formed at the outer end of a glacier. This type of moraine is perpendicular to ice flow.

Notes: An end moraine is like the yard line of a football field. It is the distance the 'team' of ice traveled, the distance is marked with a deposition of till. The glacier is moving perpendicular to the till.

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Slide 25: Ice Age: Architect of Our Landscape: Glacial Effects

A lateral moraine is a ridge or mound accumulated on the outer edges of the glacier.

Notes: A lateral moraine is like the sidelines of a football field. As the glacier moves towards to goalposts the sidelines maintain the outer boundaries. Unlike a football field a lateral moraine is transient and is always being redefined.

Slide 26: Ice Age: Architect of Our Landscape: Glacial Effects

A medial moraine is formed when two glaciers come together as one. The medial moraine is formed when two lateral moraines combine, this creates a striped appearance within the glacier.

Notes: Medial moraines are parallel to the direction of ice flow.

Slide 27: Ice Age: Architect of Our Landscape: Glacial Effects

Hummocky moraines can also be referred to as hummocky terrain. This type of terrain is formed when an area is marked by many hills (hummocks) and kettles.

Slide 28: Ice Age: Architect of Our Landscape: Glacial Effects

Notes: Can you locate the following features on this diagram:

Moraine
Kettle
Drumlin
Glacial Lake
Erratic (hint: it is near the kettles)
Esker (hint: how are eskers formed?)

Slide 29: Ice Age: Architect of Our Landscape

How would the province of Saskatchewan be changed without the effects of glaciation?