Studies of Canada for Geography 7–10

Canada: Beautiful, liveable, but vulnerable





Spirit Island in Maligne Lake, Jasper National Park, Alberta, Canada (Part of the Canada Parks World Heritage Area). Image: L. Chaffer

PART 2: SELECTED LANDSCAPES and LANDFORMS, VALUES and PROTECTION

SYLLABUS LINKS

CONTENT (http://syllabus.bos.nsw.edu.au/hsie/geography-k10/content/1185/)

Landscapes and landforms

- Landscapes and the geomorphic processes that create distinctive landforms
- The values of landscape and landforms
- Ways people manage and protect landscapes

GLOSSARY (http://syllabus.bos.nsw.edu.au/hsie/geography-k10/glossary/)

Glaciated landscape: shaped by the action of icesheets and glaciers **Fluvial landscape**: shaped by the action of a stream or river **Volcanic landscape**: shaped by tectonic forces in Earth's crust that cause volcanic eruptions

The geomorphic processes of weathering, erosion and deposition by water and ice are responsible for the development iconic landscapes and their distinctive landforms in Canada, including the Columbia Icefields, the Great Lakes and Niagara Falls, Lake Louise and the Maligne and Fraser Canyons. These landscapes and landforms, along with the volcanic mountains, created by tectonic plate movements, hold important aesthetic, spiritual, cultural and economic value.

GLACIATED LANDSCAPES AND LANDFORMS

During the Pleistocene era the Laurentide Ice Sheet (Source A) covered most of Canada and northern USA. In parts of Central Canada the ice sheet was up to 3 km thick. Over time, the actions of the ice sheet and mountain glaciers left behind rugged mountain ranges, spectacular glaciated valleys and waterfalls, extensive plains and lake systems that making Canada the most glaciated country in the world. The last remains of the Laurentide Ice Sheet are the Barns Ice Cap and glaciers on Baffin Island in Canada's far north. Along the continental divide, where the Rock Mountains separate Canada's western coast from the interior plains and eastern thousands of glaciers and icefields characterise the mountain landscape and feed major river systems that cross the country and empty into oceans to the north, east and west. These rivers erode through mountains, plateaus and glacial sediments to create their own distinctive landform features. Canada's rivers and water resources will be examined in Part C

Source A: The extent of the ice sheet covering North America in the Pleistocene Era



Source: http://serc.carleton.edu/eslabs/climatedetectives/3.html

Different landscapes and the geomorphic processes that create distinctive landforms

Canada's spectacular glaciated landscapes and landforms attract millions of visitors each year for their aesthetic and spiritual value and are an economic asset because of the income they generate in states such and Alberta and British Columbia. Glaciers also have environmental value as indicators of environmental change and as water sources for many river systems. National Geographic ranks the Icefields Parkway and its landscapes among the top scenic drives in the world.

The Columbian Icefield in Jasper National Park is one of Canada's most famous landscapes, covering an area of 325 square kilometres with ice to a depth of 100 to 365 metres. Up to 7 meters of snow falls here each year enhancing its aesthetic value. Millions of tourists visit the icefield and the spectacular landforms it contains including

- Glaciers fed by the icefield such as the highly accessible Athabasca Glacier
- Ice carved mountains, U shaped valleys, waterfalls, lakes and rivers fed by snow and glacial melt.
- Braided rivers formed where rivers break into many channels as they erode through tonnes of glacial debris

The boreal forests that cover the lower mountain slopes are an important feature of this mountain landscape.

Lake Louise in Banff National Park was created when a natural dam of glacial debris caused snow and glacial meltwater water to back up and form a lake. The lake feeds into the Bow River an important east flowing

 river and source of water on Canada's interior plains.
Other glacial lakes are formed high in mountains where glaciers carved hollows, which later fill with water. These

The aesthetic, cultural, spiritual and economic value of landscapes and landforms



The Athabasca Glacier can be seen from the Icefields Parkway and Icefields Visitors Centre. Image: L Chaffer

are known as cirque lakes. Landslides also dammed rivers creating lakes such as Maligne Lake in Jasper National Park and Moraine Lake in Banff National Park. The turquoise coloured water in Canada's mountain lakes and rivers is caused the presence of moraine flour deposited by snow and glacial melt. Over time glacial lakes will fill with debris currently being weathered and eroded by glaciers and water high in the mountains above. Tourists flock to Lake Louise for the landscape and the adventure activities the landscape offers such as hiking, skiing, kayaking and photography.



Visitors transported onto the Athabasca Glacier in specialised vehicles. Image: L Chaffer



A glaciated landscape: The valley of the Athabasca River (that originates in the Columbia Icefield) seen from the Icefields Parkway showing a U shaped valley, mountain peaks of the Columbian Icefield, glacial moraine, a braided river channel, glacial deposits and taiga biome. Image: L Chaffer



Lake Louise is an iconic Canadian landform of glacial origin . Image: L Chaffer

The Great Lakes and Niagara Falls

The Great Lakes, a series of five interconnected lakes (Superior, Michigan, Huron, Erie and Ontario) on the border of Canada and the USA were formed by retreating ice sheets that carved large basins into the land that filled with glacial meltwater. Water from the lakes then eroded a passage through the Niagara escarpment where a resistant layer of rock created the three waterfalls (Horseshoe, American and Bridal Veil Falls) that combined form Niagara Falls. The lakes are the largest freshwater basin in the world with a fifth of its freshwater, and two thirds of this water flows over Niagara Falls each year. From the falls, water travels to the Atlantic Ocean via Lake Ontario and the St Lawrence River. Water erosion continues to sculpt the falls causing them to change shape and move upstream. In 12,000 years the falls migrated approximately 11km upstream leaving a deep gorge below. Snow and ice remain an important influence on Great Lakes landscapes and landforms. (Source B)

Niagara Falls provides inspiration for travelers, creatives (artists, authors and filmmakers) and residents and it was the aesthetic and social values of the falls that led to preservation efforts to reduce threats from industrial and commercial exploitation like withdrawal of water for hydroelectric generation. Legislation has been used in the past to restrict the amount of water diverted from the falls and erosion control strategies such as strengthening the rocks at the top of the falls have been implemented **to** reduce the rate of erosion and ensure the safety of visitors.

The value of landscapes and landforms

Ways people manage and protect landscapes



Source: http://nyfalls.com/niagara-falls/faq/

NASA satellite image of the great lakes in summer and winter



Source: http://visibleearth.nasa.gov/view.php?id=54379



Horseshoe Falls



Source: http://www.lonelyplanet.com/north-america/activities/small-grouptours/niagara-falls-canadian-side-tour-maid-mist-boat-ride





VOLCANIC MOUNTAINS

Mountain landscapes in Canada been shaped by volcanism. Western Canada is on the Ring of Fire zone of earthquake and volcanic activity circling the Pacific Ocean. Over 100 volcanoes are located in western and northern Canada, mostly in remote locations, and are less active than those in other Pacific countries. Some volcanic mountains formed beneath glaciers and were exposed when ice retreated. Mount Garibaldi (2,678 m), just 66km north of Vancouver, is the youngest volcano in Canada and most likely to become active in the future. (Sources C and D)

Source C: The location and type of volcanic mountains in British Columbia



Source: http://plate-tectonic.narod.ru/volcanoam10bphotoalbum.html

Hoodoo Mountain (1,850 m) in British Columbia (left) is a subglacial volcano that formed beneath a glacier but since exposed by retreating ice. It causes some seismic activity.

Source: http://www.bcmag.ca/British_Columbias_18_Sleeping_Volcanoes

AVALANCHE VULNERABILITY

An avalanche occurs when thousands of tonnes of snow suddenly move down a mountain slope at very high speed (up to 320 km/hr.). The steep snow covered slopes of Canada's glaciated and volcanic mountains are high-risk sites for avalanches. To prevent unpredictable avalanches the Canadian Avalanche Centre sets off controlled slides in areas where snow has accumulated (Source C).

Source D: Sites at high risk of avalanches in western Canada



Source: http://www.canadiangeographic.ca/magazine/so01/avalanche.asp

FLUVIAL AND KARST LANDSCAPES AND LANDFORMS

Water is the main agent of erosion and deposition responsible for the formation of landforms across much of modern day Canada including valleys, canyons, caves, waterfalls, lakes, floodplains and deltas. In places the erosion is influenced by past glaciation and tectonic activity as well as the type of rock present. Most of Canada's canyons are recent additions to the landscape

> Different landscapes and the geomorphic processes that create distinctive landforms

formed since the departure of glaciers. As ice melted, large amounts of water with high erosive power was released creating deep narrow canyons. Karst landscapes and landforms resulted where carbonate rock such as limestone is easily dissolved in water to leave caves, underground rivers and deep canyons (Source E).

The Fraser Canyon is an 84 km canyon formed by the Fraser River as it cut through the interior plateau and Coast Mountains on its journey from the Rocky Mountains to the sea. The past volcanic history of the landscape can be seen in lava flows present in cliffs along the Fraser Canyon. After descending through rapids the Fraser River emerges from the canyon only slightly above sea level but over 100 km inland after which it winds its way to the Pacific coast near Vancouver its sediment load is deposited on a large floodplain and delta.

Maligne River, Maligne Canyon and Medicine Lake

Maligne Canyon formed from a hanging glacial valley, when a smaller glacier melted to leave a valley high above the main floor of the retreating Athabasca Glacier. The Maligne River carved quickly downwards to reach the lower level of the main valley leaving a deep narrow canyon.

Fraser Canyon in British Columbia cuts through a dry intermontane plateau.





Source E Karst landscapes and landform

The Maligne River, which formed from meltwater from the surrounding mountains, flows into and out of Maligne Lake (a large glacial lake created by a natural moraine dam), enters *Medicine Lake* and then disappears to flow underground for 14 km before reappearing in a 55 metre deep canyon the river has eroded. The underlying limestone rock is easily dissolved in the rapidly flowing and swirling water creating caves,

Maligne Canyon is an example of a Karst landscape.





Maligne Canyon

underground channels and large potholes. Marine fossils in the limestone provide evidence that these rocks formed when covered by ocean water before being lifted by tectonic activity. Medicine lake fills with snow melt every year and gradually drains like a bathtub into the karst below before refilling with water in the following spring. To determine the extent of the karst system researchers used dye, which later appeared in many lakes and rivers in the area and led to the conclusion that it was one of the most extensive underground river systems in the world. Karst and cave experiences, such as caving, attract an increasing number of visitors to Canada each year. Vancouver Island attracts more than 55 000 visitors annually to its Horne Lakes Caves Provincial Park.

The Badlands, on the interior plains to the east of Calgary in Alberta, is one of the most interesting depositional and erosional landscapes in Canada. Unusual rock formations, known as Hoodoos, were created by river erosion and wind over 70,000 years ago. The layers of sedimentary rock formed millions of years before the hoodoos were created contain dinosaur fossils that still being uncovered by archeologists today. Specimens of every group of cretaceous dinosaurs have been found here including those of 35 species dating more than 75 Million years ago. The site is now a part of Dinosaur Provincial Park World Heritage Area.

Examples of hoodoos found in Canada's Badlands landscape



Source: http://interiorplains.weebly.com/location-and-landscape.html

Below: The Cheltenham Badlands, a geological feature just north of Mississauga in Caledon, Ontario.

Source: https://commons.wikimedia.org/wiki/File:Cheltenham_Badlands_(10661024274).jpg





LANDSCAPE VALUES AND PROTECTION

The aesthetic, spiritual, cultural and economic values of Canada's landscapes, landforms and biomes are evident in the images and example contained in this article. These values are managed and protected in a system of protected forty-four national parks and park reserves. Parks Canada's first priority is the protection the natural and cultural heritage. The parks system includes representative areas for key landscapes and biomes.

• National Parks are a system of 44 representative natural areas of significance in every province and territory, managed for public enjoyment without compromising the area for future generations, including the management of wildlife and their habitats eg. Banff National Park. Park management recognises and incorporates indigenous knowledge and the unique relationship of First Nations people with the land in park management.

> The aesthetic, cultural, spiritual and economic value of landscapes and landforms

Ways people manage and protect landscapes

- World Heritage Listing recognises sites of natural and cultural significance. For example the national parks of Banff, Jasper, Kootenay and Yoho and three provincial parks are listed as the *Canadian Rocky Mountain Parks World Heritage Site* for the following reasons.
 - Natural Beauty and biological diversity including landscape features such as mountain peaks, glaciers, lakes, waterfalls, canyons and limestone caves

 Representation of significant and on-going glacial processes along the continental divide on highly faulted, folded and uplifted sedimentary rocks.

The *Dinosaur Provincial Park* is listed for its natural qualities including the unique badlands landscape and landforms and fossil site. The park also protects the prairie grasslands on the site.

The *Head Smashed In Buffalo Jump* cultural listing recognises the cultural significance of a site where, for hundreds of years, Blackfoot hunters drove stampeding bison off the edge of a cliff and into the rocks below. This cultural listing is one of the world's oldest, largest, and best-preserved buffalo jumps where the foothills of Canada's Rocky Mountains meet interior plains. The site contains the cliff, the remains of butchering camps, buffalo trails and an accumulation of bones that recognises the understanding of topography and bison behaviour that enabled native people to hunt bison (buffalo).

The unique *Waterton-Glacier International Peace Park* includes the *Waterton Lakes National Park* in Canada and the Glacier National Park in the United States. Both parks are declared Biosphere Reserves by UNESCO and their union as a World Heritage Site to preserve the unique mountains, prairie, lakes and freshwater wetlands where the "prairies meet the mountains". Landscapes and biomes (and their habitats) protected in the two biosphere reserves include prairie grasslands, alpine tundra, subalpine forests, and deciduous and coniferous forests.

- Wildlife protected areas fall into two categories:
 - National Wildlife areas (46 Marine and terrestrial sites) to protect wildlife and wildlife habitat
 - *Migratory Bird Sanctuaries* (92 sites) to protect and conserve migratory birds and their nests.

There are146 sites protecting many of Canada's important wildlife habitats. Since 1990, the overall protected area in Canada has nearly doubled to nearly 10% of land.



Source: http://www.cbc.ca/news2/interactives/map-canada-parks/

The *Head Smashed in Buffalo Jump* World Heritage Listing recognises and protects the cultural values of this cliff landform, prairie landscape and cultural heritage





Source: http://www.pc.gc.ca/eng/progs/spm-whs/sec02.aspx

The Canadian Rocky Mountain Parks World Heritage Site and National Park Status recognise the aesthetic, spiritual and environmental values of this mountain landscape above Lake Louise.

The aesthetic, spiritual and economic value of Canada's landscapes, landforms and biomes is reflected in the thousands tourists travelling Canada in RV's every year.





Waterton Lakes National Park, Peace Park and Biosphere reserve is an region of stunning beauty and diversity.

Source: https://en.wikipedia.org/wiki/Waterton_Lakes_National_Park#/media/File:Pano14.jpg

STUDENT ACTIVITIES

- 1. Select ONE landform featured in this article for geographical inquiry.
 - Examine the geomorphic processes that created the landform
 - Identify the value of the landform to people and / or the environment
 - Explain how the landform is managed and / or protected.
 - Present as a written report incorporating diagrams, maps and photographs.
- 2. Describe the spatial distribution of Canada's National Parks and World Heritage sites.
- 3. Investigate one of Canada's protected areas (National Park, World Heritage Site or Wildlife Protected Area).
 - Identify the landscape, landform or biome being protected
 - Outline the reasons for protection.
 - Identify issues associated with human interactions with the protected area.
 - Present as a photo story or webpage.

Weblinks

Head Smashed In Buffalo Jump video clips – http://www.history.alberta.ca/headsmashedin/ photovideo/photovideo.aspx

360 degree interactive panorama – http://www.seevirtual360.com/themes/50/noTabs. aspx?listingID=5027

Canada's 44 National Parks – http://www.cbc.ca/news2/interactives/map-canadaparks/

Canadian Geographic: Avalanches – http://www.canadiangeographic.ca/magazine/so01/ avalanche.asp

Canada's sleeping volcanoes – http://www.bcmag.ca/British_Columbias_18_Sleeping_ Volcanoes