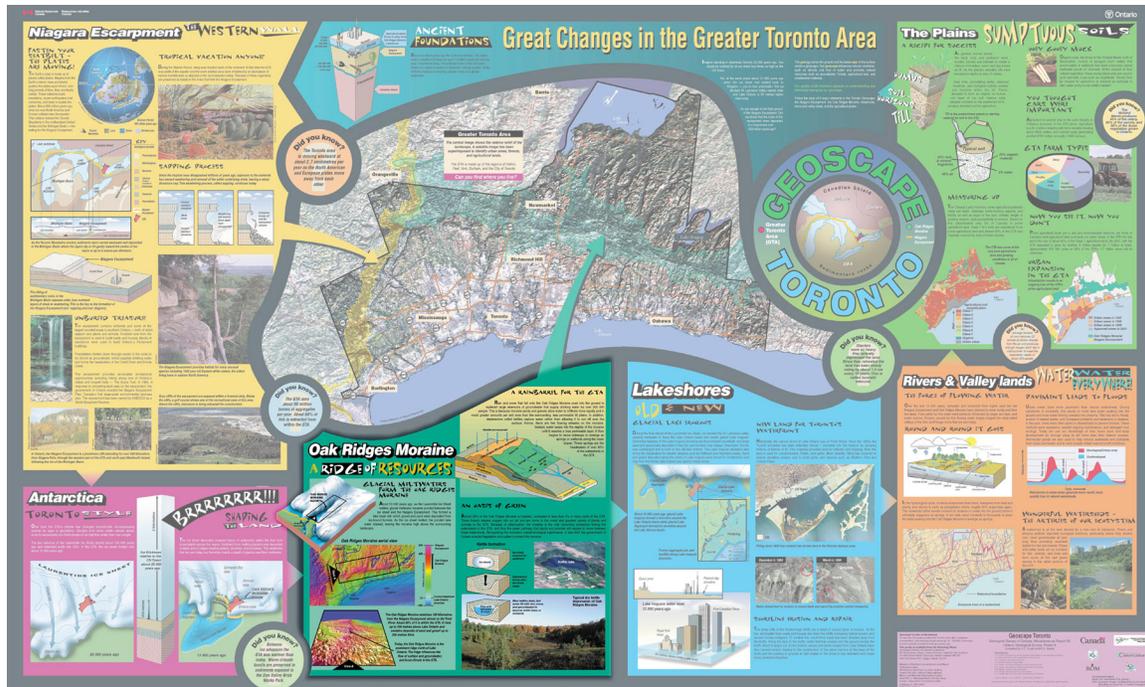


# The Oak Ridges Moraine



## Overview

This Geoscape lesson contains three activities that introduce students to the Oak Ridges Moraine, a prominent sand and gravel ridge north of Lake Ontario that forms the major drainage divide between Lake Ontario and Lake Simcoe–Georgian Bay. Through a teacher-led discussion, students will use visuals to learn about the formation and location of the Oak Ridges Moraine. An on-line animation using a digital elevation model allows students to flyover the region to see its topography. Each student will also read an information bulletin that describes the features of the moraine and land-use issues surrounding the development and preservation of the area. A fictional case study sets up a role-playing activity that addresses land-use controversies in this region. Students will assume the roles of potential interest groups affected by a fictional plan for urban expansion on an area of the Oak Ridges Moraine. Each stakeholder group will present its point of view at a “Town Hall Meeting” using supporting material collected from research. Students will also create a groundwater model to learn how water and contaminants interact with layers of gravel, sand, and clay.

At the end of the lesson, students will be able to:

- Explain how the Oak Ridges Moraine was formed and outline its location
- Identify a variety of land uses on the Oak Ridges Moraine
- Describe varying perspectives of stakeholders who might be affected by urbanization
- Explain the significance of the Oak Ridges Moraine
- Understand how groundwater and contaminants can interact with layers of gravel, sand and clay

## ***Specific Curriculum Expectations***

<b>Grade</b>	<b>Strand</b>	<b>Expectations</b>
7	Geography	<ul style="list-style-type: none"><li>Identify and explain how landforms are used to delineate regions</li></ul>
	Earth and Space Systems	<ul style="list-style-type: none"><li>Describe, using simulations or models, the origin and history of natural features of the local landscape</li></ul>
8	Geography	<ul style="list-style-type: none"><li>Identify and describe types of land use</li></ul>
	Earth and Space Systems	<ul style="list-style-type: none"><li>Identify the various states of water on the Earth's surface and the conditions under which they exist (e.g., glaciers, icecaps, oceans, lakes, rivers, groundwater)</li><li>Explain how changes in the water table relate to the water cycle</li></ul>
9	Geography of Canada	<ul style="list-style-type: none"><li>Demonstrate an understanding of how natural systems influence cultural and economic activities</li><li>Explain how the effects of urban growth alter the natural environment</li></ul>

### ***Duration***

80 minutes

### ***Lesson Instructions***

#### **Activity 1**

- Introduce students to the **Geoscape Toronto Poster** and use the **Overhead Geoscape Toronto Poster - Oak Ridges Moraine Section** to lead a discussion to find out what the students already know about the Oak Ridges Moraine: "What is a moraine? Where would I find the Oak Ridges Moraine? Why is the Oak Ridges Moraine so important? What created that landform? What was the climate like at the time the moraine was created?"
- Use the **Overhead Digital Elevation Model** to illustrate the location and extent of this prominent landform. The Oak Ridges Moraine stretches 160 kilometres from the Niagara Escarpment almost to the Trent River. About 65% of it is within the Greater Toronto Area (GTA). It rises over 300 metres above Lake Ontario and contains deposits of sand and gravel up to 200 metres thick. The digital elevation model is based on a colour ramp optimized for visual identification in 3D the scale provided is not linear and the elevations are approximate.
- Use the **Overhead Formation of the Oak Ridges Moraine** to illustrate how glacial meltwater became ponded between lobes of the last glacial ice sheet and the Niagara Escarpment 13,000 years ago.
- Use the **Overhead A Rain Barrel for the GTA** to illustrate that rain and snow that fall onto the Oak Ridges Moraine soak into the ground to replenish groundwater reservoirs and emerge as springs along the lower slopes to supply water to 60% of the rivers in the GTA. Springs also supply the rivers north of the moraine.
- Ask the students to list features that make the Oak Ridges Moraine a 'rain barrel'.
- Instruct students to view an on-line animation that presents a simulated aircraft flight and oblique view of the Oak Ridges Moraine. The animation can be accessed at:

[http://sts.gsc.nrcan.gc.ca/orm\\_dcp/index\\_e.asp?CaID=6&PgID=14](http://sts.gsc.nrcan.gc.ca/orm_dcp/index_e.asp?CaID=6&PgID=14)

## Activity 1 (continued)

### Background Notes for On-line Animation

The animation was generated from an enhanced Digital Elevation Model. The colours are assigned according to elevation: blue is low elevation and red is high. This animation starts from above the Niagara Escarpment in the west and progresses eastward. The Oak Ridges Moraine forms the ridge running eastward which is defined by the colour red. At the beginning of the animation Lake Ontario appears in blue, in the upper right corner, south of the moraine. At the end of the animation the flat green surface is Rice Lake.

## Activity 2

- Distribute the **Information Bulletin** *The Oak Ridges Moraine* to each student and instruct them to read the document.
- Divide students into six groups.
- Distribute one of each of the **Worksheets** *Case Study*, *Map of Proposed Development on the Oak Ridges Moraine*, and *Role Descriptions (1 to 6)* to each group.
- Instruct students to research and discuss their roles, and to decide their points of view using facts and visual supports.
- Facilitate a debate, allowing each group to present its perspective to the class during a "Town Hall Meeting".
- As a class, have the students vote on whether they are for or against the development plan.
- Instruct students to submit a copy of their research notes, references, and supporting visual data for assessment.

## Activity 3

- Divide students into six groups.
- Distribute the **Worksheet** *Build a Groundwater Model*, which contains instructions for the completion of this hands-on activity.

## ***Materials Required***

Download lesson materials from the Geoscape Toronto Web site at - <a href="http://www.toronto.geoscape.nrcan.gc.ca">www.toronto.geoscape.nrcan.gc.ca</a> (PDF format)	Materials and equipment from the classroom
<b>Activity 1</b>	
<b>Overheads</b> <ul style="list-style-type: none"><li>• <i>Geoscape Toronto Poster - Oak Ridges Moraine Section</i></li><li>• <i>Digital Elevation Model</i></li><li>• <i>Formation of the Oak Ridges Moraine</i></li><li>• <i>A Rain Barrel for the GTA</i></li></ul>	<ul style="list-style-type: none"><li>• overhead projector</li><li>• computer lab</li></ul>
<b>Activity 2</b>	
<b>Information Bulletin</b> (photocopy a class set) <ul style="list-style-type: none"><li>• <i>The Oak Ridges Moraine</i></li></ul> <b>Worksheets</b> (photocopy one per group) <ul style="list-style-type: none"><li>• <i>Case Study</i></li><li>• <i>Map of Proposed Development on the Oak Ridges Moraine</i></li><li>• <i>Role Descriptions (1 to 6)</i><ul style="list-style-type: none"><li>○ <i>Ministry of Municipal Affairs and Housing</i></li><li>○ <i>Housing Developer</i></li><li>○ <i>Environmental Group</i></li><li>○ <i>Ministry of Natural Resources</i></li><li>○ <i>Farmer and Local Land Owners</i></li><li>○ <i>Business Owners</i></li></ul></li></ul>	<ul style="list-style-type: none"><li>• none</li></ul>

## ***Materials Required***

(continued)

<b>Activity 3</b>	
<b>Worksheet</b> (photocopy one per group) <ul style="list-style-type: none"><li>• <i>Build a Groundwater Model</i></li></ul>	(one per group) <ul style="list-style-type: none"><li>• 15 cm x 20 cm clear plastic container that is at least 15 cm deep</li><li>• 0.5 kg of modelling clay</li><li>• 1 kg of white play sand</li><li>• 1 kg of aquarium gravel</li><li>• 1 wide drinking straw or clear plastic tube</li><li>• 1 plastic spray bottle (the stem that extends into the bottle must be clear and fit easily inside the straw)</li><li>• 1 small piece (3 cm x 5 cm) of green felt</li><li>• 30 mL of powered cocoa</li><li>• red food colouring</li><li>• 1 bucket of clean water and small cup to dip water from bucket</li><li>• clear tape</li><li>• 1 small piece (3 cm x 3cm) of cheese cloth to cover one end of the straw/clear plastic tube</li><li>• small elastic band</li></ul>

## ***Glossary of Terms***

The activities in this lesson introduce a number of new geologic terms. Teachers may wish to review the use of a glossary and discuss the meaning of the following terms with the students before commencing the activities. Definitions are provided in the **Glossary of Geologic Terms** found on the Geoscape Toronto Web site at [www.toronto.geoscape.nrcan.gc.ca](http://www.toronto.geoscape.nrcan.gc.ca)

New vocabulary in this lesson falls into a number of broad categories as follows:

**Geological terms:** aquifer, aquitard, glacial, glacier, lake basin, kettle, moraine, till

**Water related terms:** drainage divide, evaporation, groundwater, headwater, inlet, outlet, recharge, reservoir, seeps, spring, transpiration, watershed, well, wetland

**Biological terms:** biodiversity, ecological, habitat

**Other:** organic matter, pollution, topography