



# Geoscape Ottawa-Gatineau

Grade 7 Lesson Plans to accompany the Geoscape Ottawa-Gatineau poster and website  
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## Theme Four: Different Rocks

List of Expectations		
Grade	Strand and Topic	Expectations
7	Science: Earth and Space Systems The Earth's Crust	<ul style="list-style-type: none"> <li>• classify rocks and minerals, based on observations, according to their characteristics and method of formation;</li> <li>• distinguish between rocks and minerals</li> <li>• identify the geological processes involved in rock and mineral formation (e.g., volcanic activity releases lava; the deep cooling of magma produces granite);</li> <li>• explain the rock cycle (e.g., formation, weathering, sedimentation, and reformation)</li> </ul>

### Overview

The Geoscape “Different Rocks” theme involves lessons which will enable students to recognize rocks and minerals and classify them according to their origin and texture. Common rock types found in the Ottawa-Gatineau area will be emphasized.

At the end of these lessons, students will be able to:

- recognize the three main rock ages present in the Ottawa-Gatineau area
- determine where these rocks are situated on a geological map of Canada
- distinguish between igneous, sedimentary and metamorphic rocks
- identify the steps of the rock cycle
- recognize the rock-forming minerals found in Ottawa-Gatineau

Suggested Lessons	Brief Description
Students Take Notes	Different Rocks / Different Landscapes / Different Resources Types of Rocks Igneous Rocks Sedimentary Rocks Metamorphic Rocks Minerals
Key Word Game	Crossword Puzzle
Lesson 1	Geological Map of the Ottawa Area
Lesson 2	Rock Cycle
Lesson 3	WebQuest
List of related web sites and resources	Geological Survey of Canada – fossils <a href="http://gsc.nrcan.gc.ca/paleochron/index_e.php">http://gsc.nrcan.gc.ca/paleochron/index_e.php</a> <a href="http://www.nrcan.gc.ca/mms/scho-ecol/toc_e.htm">http://www.nrcan.gc.ca/mms/scho-ecol/toc_e.htm</a>  <a href="http://www.rocksandminerals.com/finder/H2.HTM">http://www.rocksandminerals.com/finder/H2.HTM</a>  <a href="http://www.ontariominerals.com/">http://www.ontariominerals.com/</a>  Prospectors and Developers Association of Canada Mining Matters is a comprehensive website on rocks, mineral and mining <a href="http://www.pdac.ca/miningmatters/index.html">http://www.pdac.ca/miningmatters/index.html</a>

Students take notes:

## **Different Rocks / Different Landscapes / Different Resources**

Different types of rock result in different types of landscapes and offer different resources.

Three different geological “areas” in the Ottawa-Gatineau region

- Canadian Shield
- Paleozoic Lowlands
- Quaternary Sediments

### 1. Canadian Shield

- Precambrian rocks
- resistant igneous and metamorphic rocks
- rough terrain
- numerous lakes
- abundant outcrops
- Resources: rocks contain metal and mineral resources

### 2. Paleozoic Lowlands

- Paleozoic sedimentary rocks
- flat-lying plains
- low scarps and riverbanks
- low hills
- Resources: limestone and sandstone provide building materials (building stones, cement and concrete products).

### 3. Quaternary Sediments

- glacial and recent deposits
- unconsolidated (loose) sediments
- cover large areas of the Lowlands
- some form gently undulating plains
- some form flat plains (Champlain Sea)
- Resources: sand and gravel are vital for construction  
parent material of soil, important for agriculture

## Generalized Geology / Géologie générale

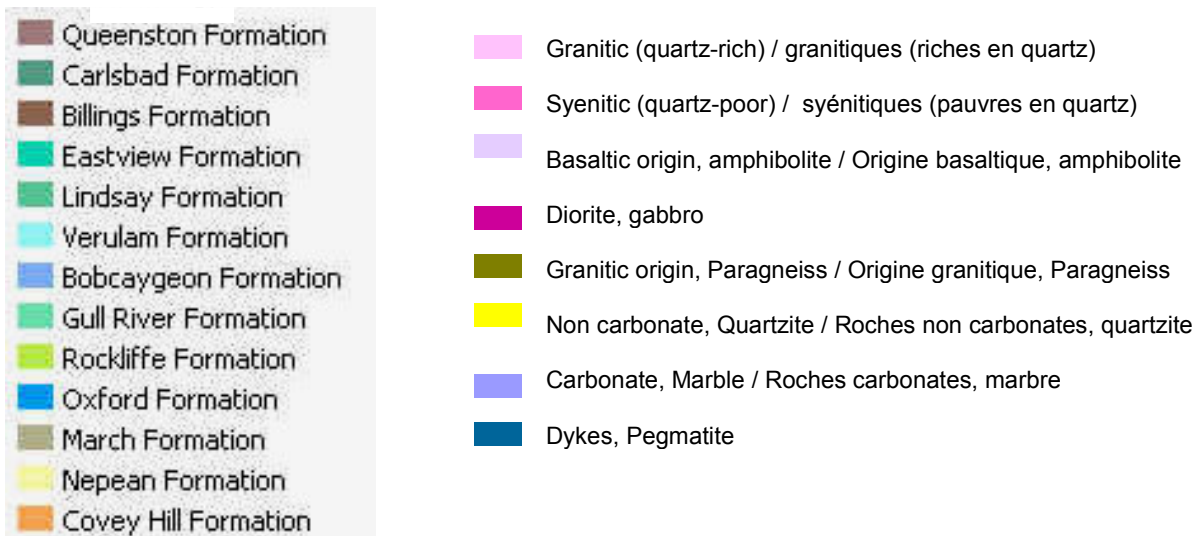
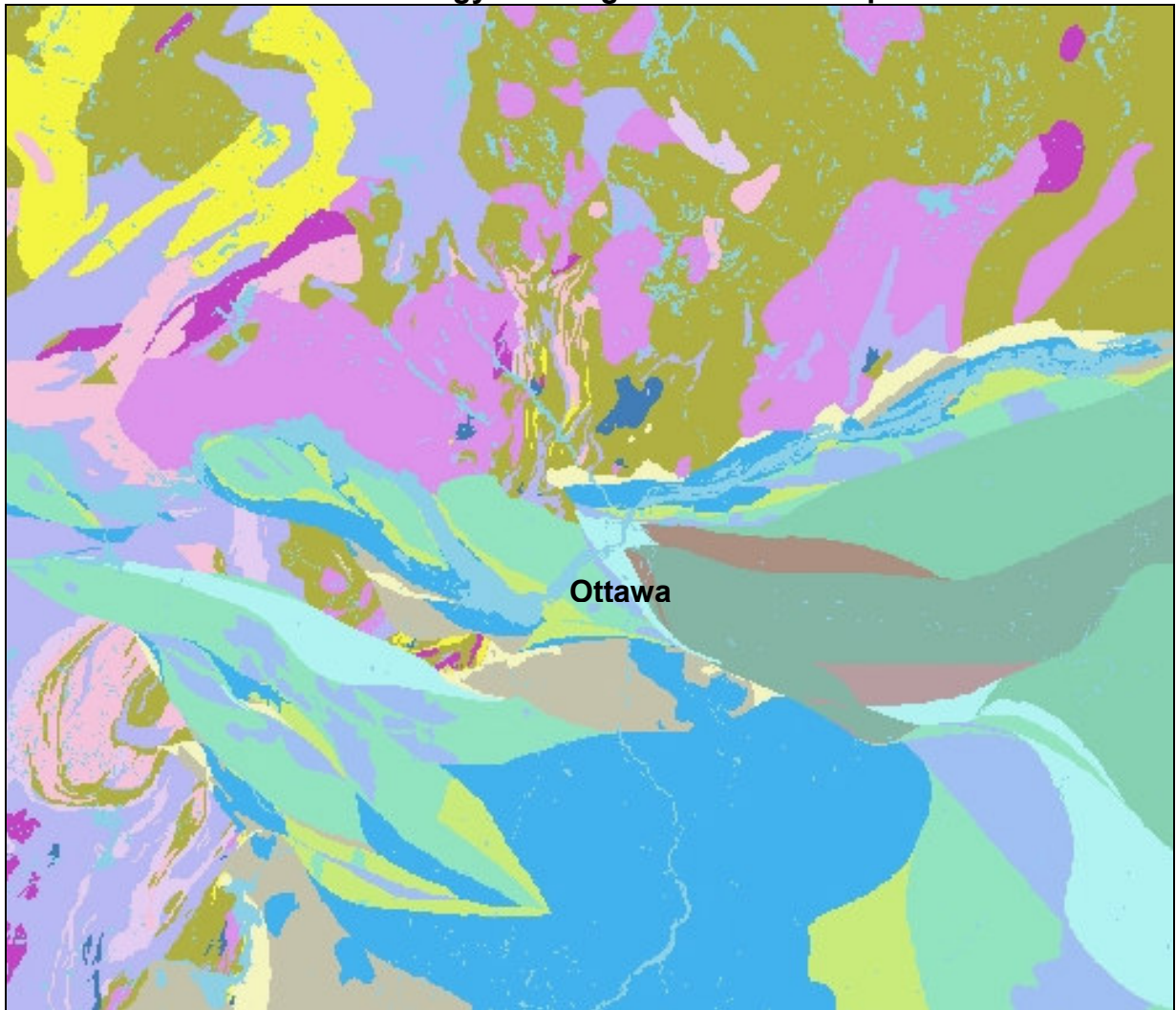


<u>Matériaux a la surface</u>		<u>Surface Material</u>
Roche en place, Paléozoïque		Bedrock, Paleozoic
Roche en place, Précambrienne		Bedrock, Precambrian
Argile et silt		Clay and silt
Dépôts organiques		Organic
Sable		Sand
Sable et gravier, blocs		Sand and gravel, boulders
Sable et silt		Sand and Silt
Till		Till

Urban Geology of the National Capital Area : Online data [http://gsc.nrcan.gc.ca/urbgeo/natcap/index\\_e.php](http://gsc.nrcan.gc.ca/urbgeo/natcap/index_e.php)  
 Géologie urbaine de la région de la capitale nationale : Données en ligne [http://gsc.nrcan.gc.ca/urbgeo/natcap/index\\_f.php](http://gsc.nrcan.gc.ca/urbgeo/natcap/index_f.php)

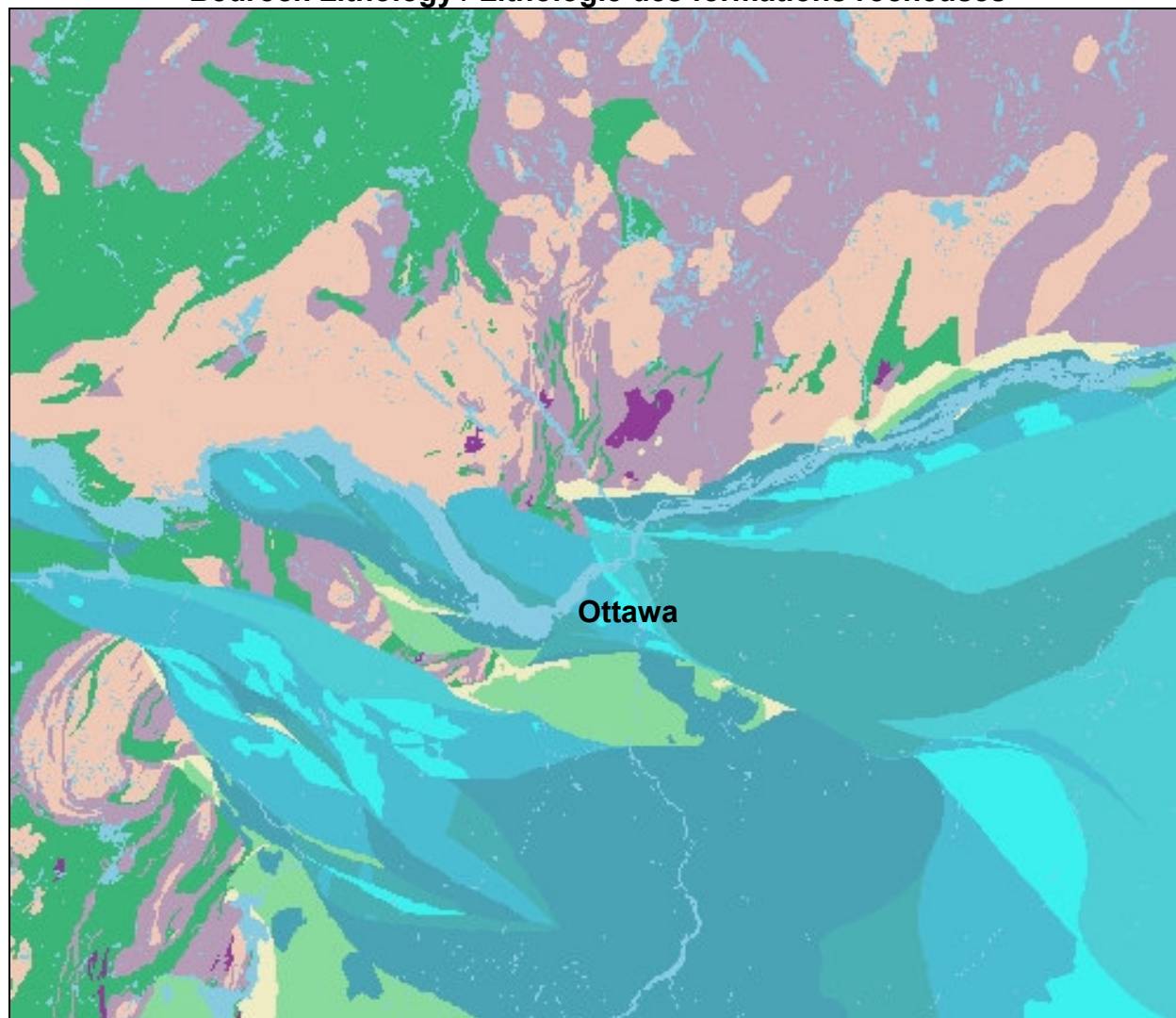


## Bedrock Geology / Géologie de la roche en place



Urban Geology of the National Capital Area : Online data [http://gsc.nrcan.gc.ca/urbgeo/natcap/index\\_e.php](http://gsc.nrcan.gc.ca/urbgeo/natcap/index_e.php)  
 Géologie urbaine de la région de la capitale nationale : Données en ligne [http://gsc.nrcan.gc.ca/urbgeo/natcap/index\\_f.php](http://gsc.nrcan.gc.ca/urbgeo/natcap/index_f.php)

## Bedrock Lithology / Lithologie des formations rocheuses



### Lithologie des formations rocheuses

- Shale
- Calcaire et shale interstratifiés
- Calcaire
- Calcaire et Dolomie interstratifiés
- Dolomie
- Grés et dolomite interstratifiés
- Grés
- Roches intrusives
- Roches migmatiques
- Roches métasédimentaires
- Dykes

### Lithology of formations

- Shale
- Limestone and Shale, interbedded
- Limestone
- Limestone and dolomite, interbedded
- Dolomite
- Sandstone and Dolomite, interbedded
- Sandstone
- Instrusive Rocks
- Migmatic Rocks
- Metasedimentary Rocks
- Dykes

Urban Geology of the National Capital Area : Online data [http://gsc.nrcan.gc.ca/urbgeo/natcap/index\\_e.php](http://gsc.nrcan.gc.ca/urbgeo/natcap/index_e.php)

Géologie urbaine de la région de la capitale nationale : Données en ligne [http://gsc.nrcan.gc.ca/urbgeo/natcap/index\\_f.php](http://gsc.nrcan.gc.ca/urbgeo/natcap/index_f.php)

## Types of Rocks

There are three main types of rocks

Igneous Rocks: (from “fire”)

- formed when molten rock (lava or magma) is cooled and hardens (e.g. Granite)

Sedimentary Rocks: (from sediments)

- formed when pieces of existing rocks break off, are carried away, are deposited and become compressed or cemented together (e.g. Sandstone, Limestone)
- Quaternary and recent unconsolidated sediments are sedimentary rock “in the making”

Metamorphic Rocks: (“changed form”)

- formed when existing rocks are changed due to extremely high temperatures and pressure (e.g. Gneiss, Marble)

Students take notes:

## Igneous Rocks

Underneath the solid crust of the Earth, there is molten material. This material has a different name depending on where it is:

- When it is underneath, it is called **MAGMA**.
- When it comes to the surface, through cracks and volcanoes, it is called **LAVA**.

Igneous rocks are formed when this material cools and hardens.

There are two types of igneous rocks.

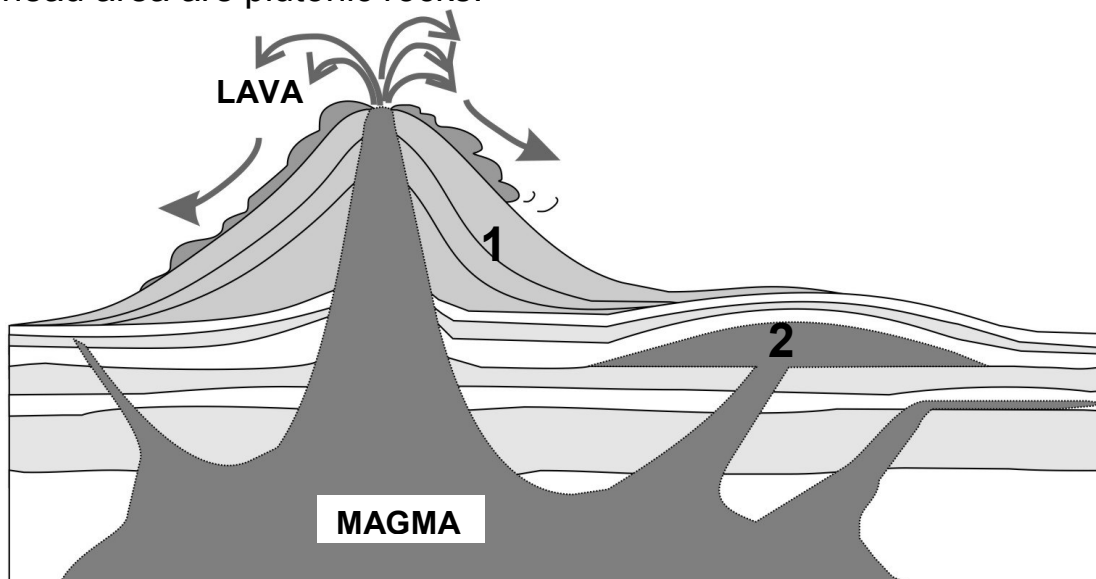
### 1. Volcanic Rocks

- extrusive rocks
- formed when **LAVA** erupts through the surface and hardens
- cooling is rapid
- usually rocks have small mineral grains (basalt)
- some rocks are glassy (obsidian)
- some are full of air spaces and look sponge-like (pumice)

### 2. Plutonic Rocks:

- intrusive rocks
- formed when **MAGMA** is pushed up towards the surface
- cooling is slow and takes place beneath the surface
- rocks have larger mineral grains (granite, rhyolite)

Many of the rocks that make up the rugged Precambrian terrain of the Ottawa-Gatineau area are plutonic rocks.



## Sedimentary Rocks

There are two types of sedimentary rocks based on origin.

### 1. Clastic sedimentary rocks

- formed when existing rocks get eroded by water, ice and wind
- pieces, large and small, break off, are carried away and eventually are deposited.
- if conditions are right, the pieces accumulate and, over time, become compacted.
- if there is enough overlying pressure, they form sedimentary rocks.
- water can carry dissolved minerals through these sediments. If the minerals precipitate from solution, they can cement the particles together.
- classification of clastic sedimentary rocks depends on size and shape of particles:
  - conglomerates: large rounded particles
  - breccias: large angular particles with sharp corners
  - sandstones: small sand sized particles
  - shales: very fine particles
- Many of the rocks in the lowlands of the Ottawa area are sandstones and shales.

### 2. Chemical (Non-clastic) sedimentary rocks

- formed from bio-secretions or remains of marine organisms or from minerals that were dissolved in water
- these materials accumulate on the bottom or they precipitate and settle when water conditions change (temperature, pressure, evaporation)
- resulting rocks are very fine grained (limestone, dolomite)
- Many of the rocks in the lowlands of the Ottawa area are Paleozoic limestones, formed mainly from bio-secretions of marine organisms in a warm sea. Many marine fossils can be found in these rocks.



## **Metamorphic Rocks**

These rocks are formed when existing rocks change composition, texture, or internal structure due to intense heat, pressure and chemical processes below the Earth's surface.

There are two main types of metamorphic rocks depending on their texture.

### 1. Foliated Rocks

- These rocks have parallel, alternating bands of dark and light minerals.
- A common foliated rock in the Precambrian rocks of the Ottawa area is gneiss.
- Gneiss was formed when granite was metamorphosed.

### 2. Nonfoliated Rocks

- These rocks do not have bands.
- Quartzite is a nonfoliated rock found in the Precambrian shield of the Ottawa-Gatineau area.
- Quartzite was formed when sandstone was metamorphosed.
- Marble, a beautiful white rock, was metamorphosed from Precambrian limestone.

Students take notes:

## **Minerals**

Minerals are the basic materials of the Earth's crust; the basic building blocks of Rock.

Minerals:

- are solids
- are inorganic (not living)
- occur naturally in the Earth's crust (not manufactured)
- have a definite chemical composition
- occur as small grains or crystals in rocks

There are thousands of different minerals but less than 20 of them are considered common rock forming minerals.

Only a few minerals are considered gems or precious metals.

Minerals are mainly identified according to colour, lustre, hardness, streak, and crystal shape.

Rock-forming minerals in Ottawa-Gatineau rocks are:

- Granite contains quartz, K-feldspar, plagioclase, and small amounts of dark minerals, either mica or hornblende.
- Limestone contains calcite.
- Sandstone contains mostly grains of quartz.
- Gneiss usually contains the same minerals as granite but the minerals form alternating bands (foliated).
- Shale contains very fine particles of quartz, mica and feldspar.
- Quartzite contains mostly quartz.



Different Rocks



## 4.1 Lesson 1: Geological Map of Ottawa

### **Brief Description**

This lesson consists of an explanation of the different rock formations as indicated on a geological map of the Ottawa area. Students will then have the opportunity to colour and label their own geological map in order to enhance their understanding of the geological locations.

### **Suggested Materials**

Overhead projector

Overheads: "Pictures of typical local rocks" and "Geological Map of the Ottawa-Gatineau Region"

Student worksheet (Map)

Colouring Pencils

Rock samples of Sedimentary rocks (Sandstone, Limestone, Shale), Igneous rocks (Granite, Rhyolite) and Metamorphic rocks (Gneiss, Quartzite, Marble)

**Duration** 30 minutes

### **Lesson Instructions**

1. Discuss and have students copy notes on rocks and minerals overheads.
2. If rock samples are available, distribute these and have students recognize the difference between the sedimentary rocks found in the lowlands (finer texture, duller colour, may be softer, occurs in beds/layers) and the igneous and metamorphic rocks (coarser texture, crystalline, generally more colourful, may be heavier).
3. Use the accompanying overhead "Photos of typical local rocks".
4. Teacher may wish to demonstrate how limestone reacts to acid (fizz). (Shows how limestone neutralizes acid rain.)
5. On the overhead "Map of geological regions of the Ottawa-Gatineau area" indicate the location of the three rivers (Ottawa, Gatineau and Rideau).
6. Explain the legend (geological regions are represented by different colours). Each major geological region has a unique appearance resulting from the type of rock and geo-history of that region. Point out that younger rocks are underlain, at some depth, by older rocks.
7. On their blank map, have students develop a legend and colour the different geological regions accordingly.
8. Ask what they would encounter if they drilled a very deep hole at:
  - Wakefield (just Precambrian bedrock)
  - Casselman (Quaternary sediment over Paleozoic bedrock over Precambrian bedrock)



Overhead:

## Pictures of typical local rocks



**Outcrop:** Paleozoic sedimentary rock



**Outcrop:** Precambrian metamorphic rock



**Sandstone**

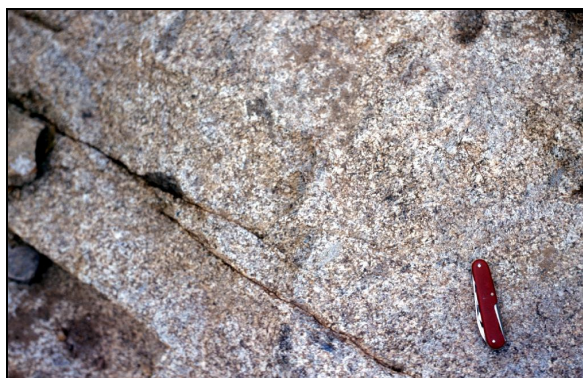


**Limestone with fossil**

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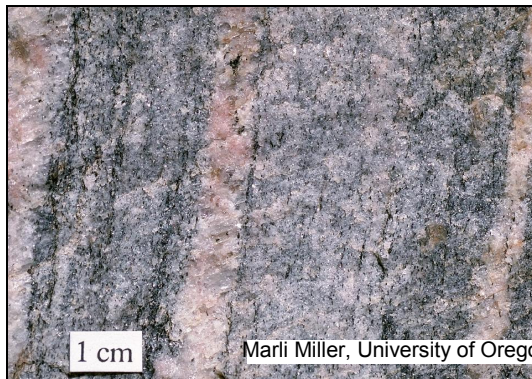
Jerome Wycroft



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Jerome Wycroft

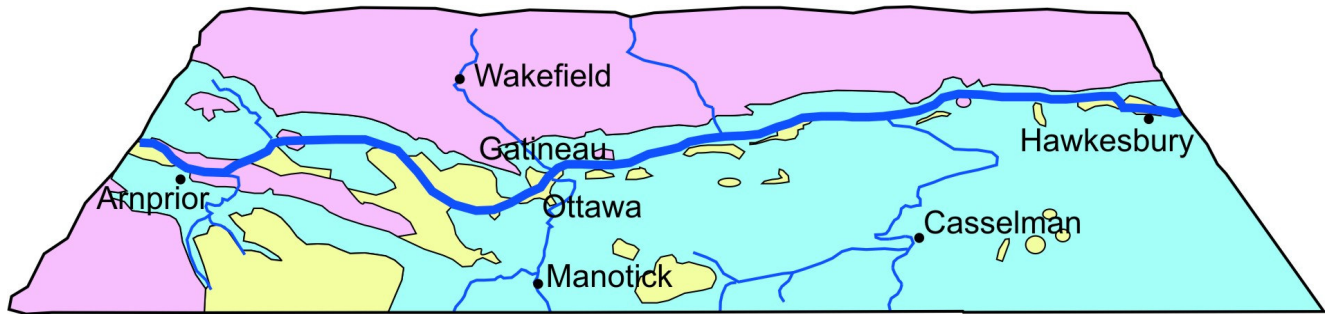



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Marli Miller, University of Oregon


Granite and gneiss photos courtesy of <http://www.earthscienceworld.org/imagebank>

## Geological Map of the Ottawa-Gatineau Region



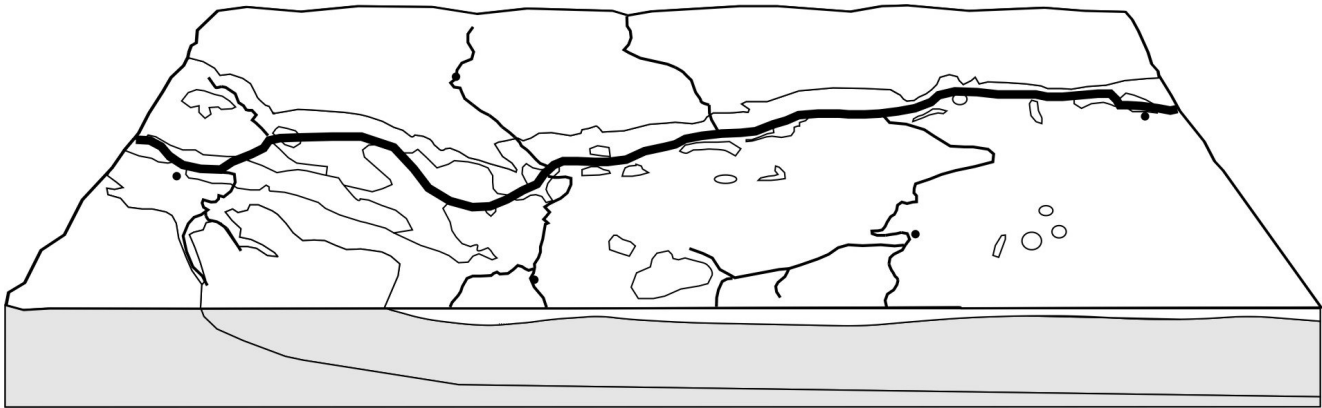
 Precambrian  
marble, quartzite,  
granite, gneiss

 Paleozoic  
limestone, sandstone,  
shale

 Quaternary  
till, gravel, sand,  
silt, clay

## Geological Map of the Ottawa-Gatineau Region

- Colour the geological regions in the Ottawa-Gatineau Area.
- Include a legend with the colours used and associated region.





## 4.2 Lesson 2: Rock Cycle

### **Brief Description**

This lesson briefly explains how the rock cycle works, followed by an activity where students can label a diagram of the rock cycle.

### **Suggested Materials**

Overhead projector  
Overhead of "Rock Cycle"  
Student worksheets

**Duration** 20 - 30 minutes

### **Lesson Instructions**

1. Using the Rock Cycle overhead, explain each step involved in the rock cycle.

#### Cooling

Melted rock (Magma) deep within the earth can be pushed up to or near the surface. Because the temperature is cooler, magma cools and become solid, forming igneous rocks.

#### Weathering and erosion

When rocks are exposed to the elements of nature (wind, rain, ice, water, etc.) they get weathered (worn out) and pieces break off, forming sediment.

#### Pressure and cementation

As sediments accumulate, they push down on each other. The pressure of the weight above compacts the sediment. When water finds its way through these sediments, it may deposit minerals from solution that cement the sediment. Either pressure or cementation causes sediments to form a sedimentary rock.

#### Heat and pressure

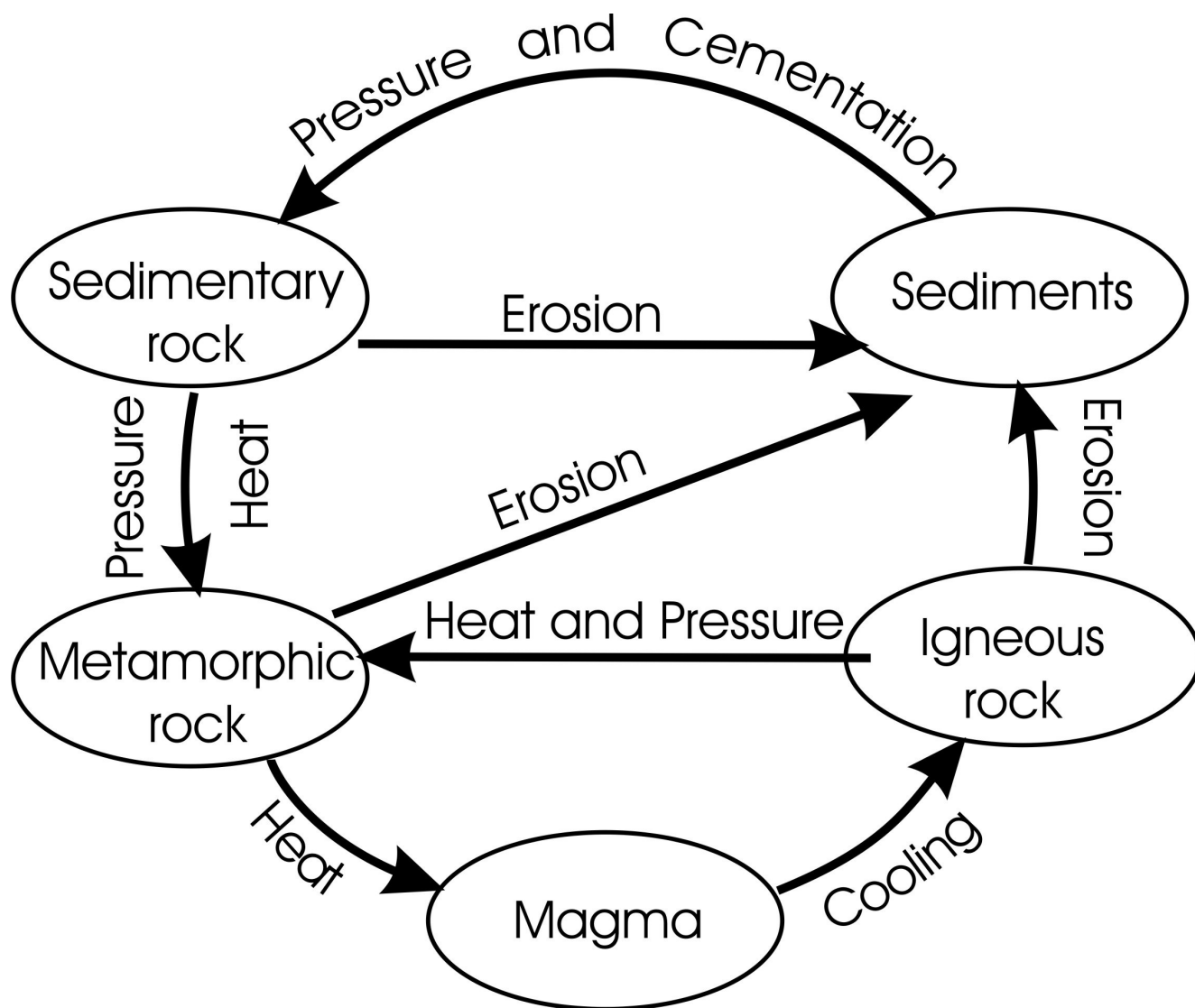
When rocks beneath the surface of the Earth are subjected to intense heat and pressure by the forces of moving continents, they change form, texture, or composition and become metamorphic rocks.

#### Melting

The temperature beneath the Earth's surface is very high. It is hot enough to melt rocks. If solid rocks get pushed beneath the surface by the forces of moving continents, they will get very hot and melt.

2. Distribute the worksheet and have students label the steps represented by the arrows.

# The Rock Cycle

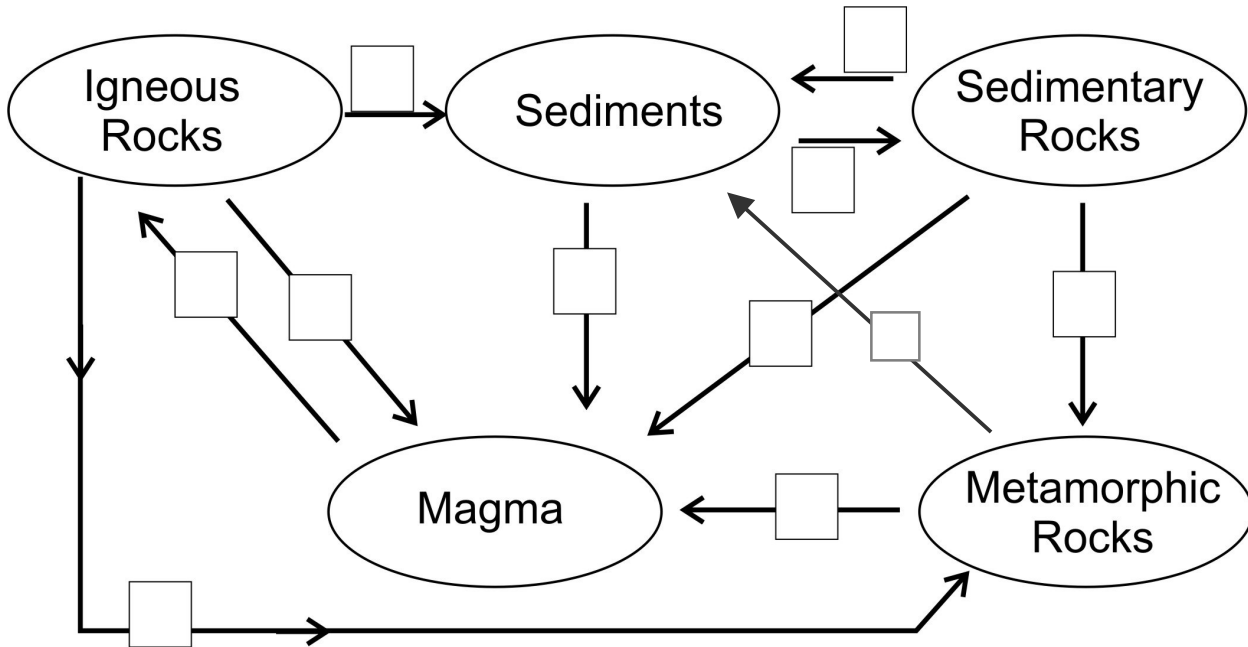




**Label the Rock Cycle**

For each arrow, write, in the box, the number that corresponds to the appropriate process.

1. Pressure and cementation
2. Weathering and erosion
3. Melting
4. Heat and pressure
5. Cooling



## 4.3 Lesson 3: Webquest

### **Brief Description**

This lesson enables students to search the Internet and find information on the properties of rocks and rock-forming minerals in the Ottawa-Gatineau area.

### **Suggested Materials**

Computer Room with at least one computer terminal for every group of two students.  
Worksheet.

**Duration** 40 minutes (or more depending on speed of Internet service)

### **Lesson Instructions**

1. Review the “students take notes” on rocks and minerals provided with lesson 1. If not done previously, have students copy these notes.
2. On the overhead “Minerals”, the most common rock types found in the Ottawa-Gatineau area and their most commonly associated minerals are listed.
3. Have students search the following web sites to find information on the rocks and minerals in the Ottawa area.  
<http://www.rocksandminerals.com/finder/H2.HTM>  
[http://www.nrcan.gc.ca/mms/scho-ecol/toc\\_e.htm](http://www.nrcan.gc.ca/mms/scho-ecol/toc_e.htm)  
<http://www.ontariominerals.com/>
4. With the information derived from the previous notes and the websites listed above, have students fill out the worksheet “Ottawa Rock and Minerals Webquest”.

Part 1: Rocks common in the Ottawa-Gatineau area

Name of Rock	Type of Rock	Description	Rock-forming minerals

Part 2: Rock-forming minerals common in the Ottawa-Gatineau area

Name of Mineral	Colour	Lustre	Hardness	Crystal Form	Streak	Acid Test