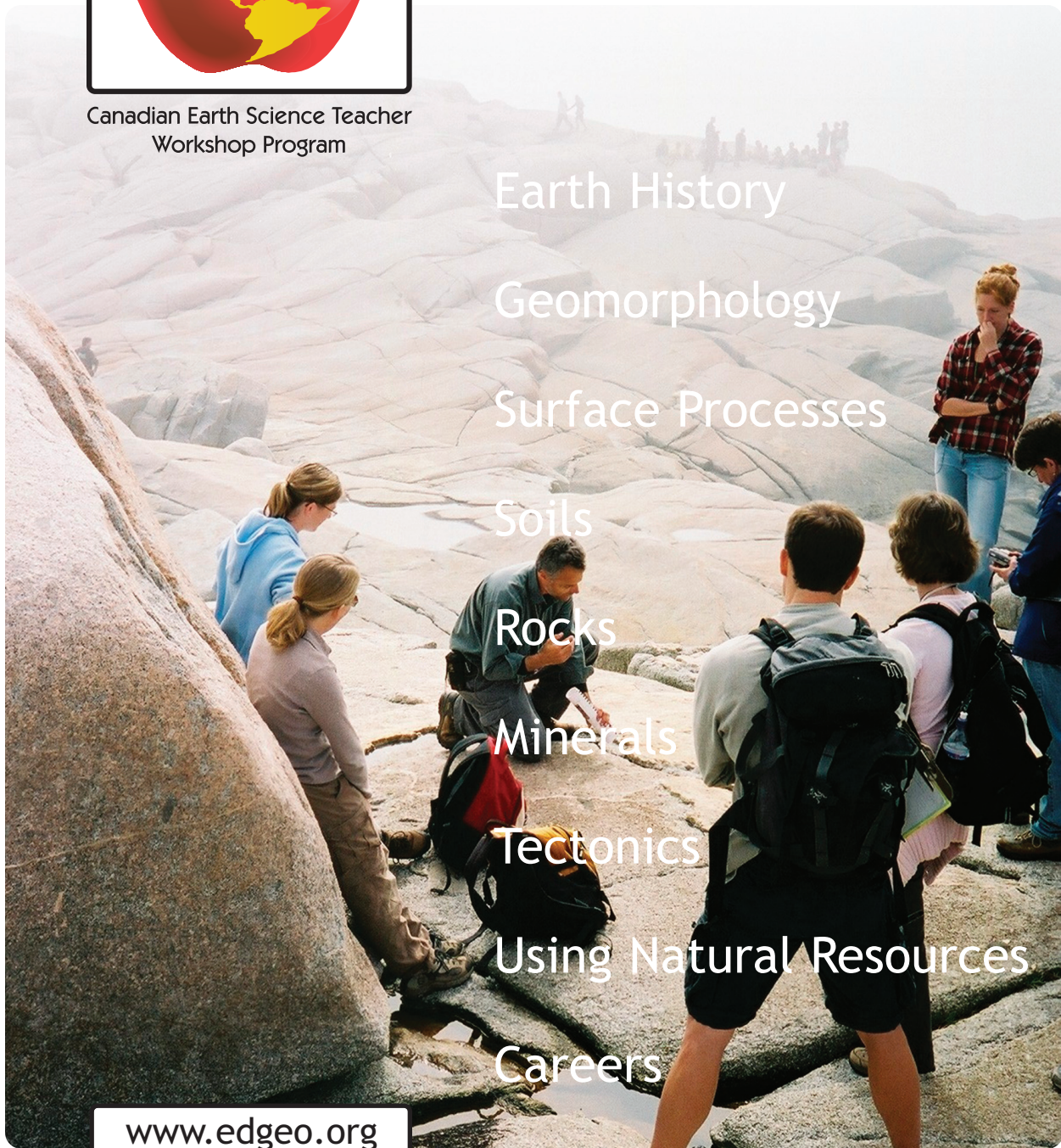




Canadian Earth Science Teacher  
Workshop Program

# Bringing Earth Science to Life



Earth History

Geomorphology

Surface Processes

Soils

Rocks

Minerals

Tectonics

Using Natural Resources

Careers

[www.edgeo.org](http://www.edgeo.org)

In partnership with:



Natural Resources  
Canada

Ressources naturelles  
Canada



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## About Us

### What is EdGEO?

EdGEO is a national program, established in the early 1970s, which supports local workshops designed to give Canadian teachers the knowledge and resources to confidently present Earth science material in the classroom. Local scientists and teachers work together to deliver the workshops. The national EdGEO Program can provide grants of up to \$3000 per workshop.

EdGEO is a core activity of the Canadian Geoscience Education Network (CGEN) <http://www.geoscience.ca/cgen/>, which is part of the Canadian Federation of Earth Sciences.

### Acknowledgements

EdGEO facilitators across Canada have provided all the materials in this resource manual. Their generosity and support is greatly appreciated.

Jennifer Bates, Geological Survey of Canada, Natural Resources Canada, Dartmouth, NS

Laura Clinton, Chair, National EdGEO Committee, Toronto

Jeff Coolican, Saskatchewan Ministry of Energy and Resources

Fran Haidl, Energy and Resources, Government of Saskatchewan, Regina

Stella Heenan, Regional EdGEO Committee, Ontario

Sally Meadows, Office of Outreach and Transition Programs, University of Saskatchewan

Godfrey Nowlan, Geological Survey of Canada, Natural Resources Canada, Calgary

POLARIS Consortium

Prospectors and Developer Association of Canada (PDAC) Mining Matters

Eileen Van der Flier Keller, Earth and Ocean Sciences, University of Victoria

Kim West, Gwenna Moss, Centre for Teaching Effectiveness, University of Saskatchewan

Jane Wynne, Geological Survey of Canada, Natural Resources Canada, Sidney, BC



Credit for parts of the following activities in the tectonics section is due to people and groups outside of EdGEO:

Continental Jigsaw Puzzle: United States Geological Survey

Plate Tectonic Flipbook: Developed by Larry and Sheryl Braile, "Explorations in Earth Science"

<http://web.ics.purdue.edu/~braile/indexlinks/educ.htm>

Time Travel to Past Continents: Lithoprobe, "Dancing Elephants and Floating Continents" <http://lithoprobe.ca>

An Edible Earth: Susan Batson, St. Margaret's School, Saanich BC

First Nations Knowledge of Earthquakes: Ruth Ludwin, University of Washington, [ruth@geophys.washington.edu](mailto:ruth@geophys.washington.edu).

Fault Types: text: IRIS Consortium; images: Richard Harwood

Earthquakes in Canada: Historic earthquake data: Earthquakes Canada, Natural Resources Canada



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## How to use this Resource Manual

### Who should use it?

Anyone interested in delivering an EdGEO workshop for teachers. Most EdGEO facilitators are Earth scientists working in universities, industry or government, and they often team together with education professionals.

### What are its goals?

The classroom-ready activities in this manual have been used successfully and finetuned in EdGEO workshops all over Canada. We hope, by providing them in one online resource manual, to make it easier for new facilitators to put on workshops without having to “reinvent the wheel.” The manual also includes templates and samples of all the supporting materials (from advertising to funding applications) needed to put on a workshop. Facilitators of previous workshops will find this a useful archive of materials for new ideas and to supplement what they have already used. All the materials in this manual support current teaching methodology that values hands-on experiences where students take an active role in learning. The materials can be used as presented or tailored to meet local needs.

### What does it include?

Classroom-ready activities for a wide range of Earth science topics

Information sheets to provide background

Ideas for adapting material to your local region

Templates and supporting materials from successful EdGEO workshops, including outlines, advertisements, manuals, funding applications, etc.



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## Organizing a Workshop

### Fundraising

Funding and in-kind support are available for teacher workshops. The EdGEO national program can provide up to \$3000 per workshop to cover expenses, such as teaching resources, field trip transportation and workshop promotion. Funds are intended to help ensure the workshop breaks even. Salaries and food are not eligible for EdGEO funding.

You can apply using the proposal form available online at <http://www.edgeo.org/funding.html>

Local partnerships can be beneficial in providing support for a workshop. See the partnership section for suggestions.

There are also many grant-giving bodies that support education activities. Some suggestions are:

*Canadian Geological Foundation:*

*<http://www.canadiangeologicalfoundation.org/>*

*Regional divisions of the Geological Association of Canada, for listing see <http://www.gac.ca/chapters/>*

*National professional associations for the Earth sciences: see list on the home page of the Canadian Federation of Earth Sciences  
<http://www.geoscience.ca/>*

*Government agencies in your province/territory with an education or outreach mandate*

*Philanthropic foundations at the municipal and provincial/territorial levels, for example, the Ontario Trillium Foundation, the Winnipeg Foundation*

*Local, provincial/territorial, national corporations with an office in your community and an Earth science connection, for example, mining or oil and gas or environmental companies*

*National corporations with offices in your community, for example, the TD Bank's Friends of the Environment Foundation has a youth and public awareness focus*





## Earth Science Teacher Workshop: FUNDING PROPOSAL

**Proposed Activity:** Teachers' Earth Science Workshop

**Details of event:**

This is a daylong workshop to be held at (location) on (date) which is a local professional development day. The workshop is designed to provide teachers (Grades 7 to 12) with the confidence and skills to teach several Earth science topics. The workshop will cover plate tectonics, volcanoes and earthquakes, and will use hands-on activities that teachers can easily adapt to different grade levels and export to their classrooms. The workshop will be presented by students and staff of the Department of Earth Sciences at the University of \_\_\_\_\_.

This year, the workshop will use the Geoscape\* \_\_\_\_\_ poster to provide local examples in the tectonic and earthquake components of the workshop. The workshop is limited to 20 teachers and will have 3 instructors and up to 5 graduate student assistants.

A \$\_\_\_ fee will be collected from each participant to cover the cost of lunch. Each participant will receive a 50-page manual, which describes both the science and the activities covered in the workshop, as well as several maps and overheads for classroom use. They will also receive a copy of the Geoscape poster.

**Expected Results:**

Teachers who are confident and excited about teaching Earth science to their students

Teachers who know about the educational resources available to them

Teachers will be introduced to Geoscape \_\_\_\_\_ and be able to incorporate it in their classroom activities

**In-kind support:**

20 copies of local geology maps

20 copies of Geoscape \_\_\_\_\_.

Approximately 20 hours of staff time in preparation and delivery of the workshop.

**Funds requested:** Total - \$950.00

\$300 foamies, cardboard, velcro for props to demonstrate plate tectonics

\$500 mail-outs/advertising

\* Geoscape provides Earth science information about many communities across Canada: <http://www.geoscape.nrcan.gc.ca/>



## Partnerships

Many EdGEO workshops are facilitated by teams of people from organizations sharing similar goals. For example, one group may have facilities, another provides presenters, and a third offers materials. Initiating and building on partnerships is a very successful model for delivering excellent programming. Consider making contacts with:

*University and college Earth science departments  
(many have an education outreach mandate)*

*Outreach groups, e.g. Let's Talk Science, Women in Science and Engineering, Canadian Geoscience Education Network*

*Schools*

*School boards or districts*

*Natural Resources Canada*

*Geological surveys (federal, provincial and territorial)*

*Science centres*

*Museums*

*Conservation areas and parks*

*Local industry*

## Workshop advertising

When asked, the majority of teachers respond that workshops are successfully advertised through email. Most school districts have an internal email system for that purpose. One route is to make direct contact with a local teacher who can then distribute advertising internally. Alternatively, approach the school district and request the information be circulated. Search for a superintendent for curriculum, a subject consultant or team leader who should be able to assist.

EdGEO facilitators find that advertising is one aspect enhanced by partnerships with organizations that share similar goals (see the partnership suggestions).



**EdGEO Earth Science Workshop for Teachers**  
**Professional Development Day**

**Date****Location**

**Summary:** A one-day workshop with hands-on activities and demonstrations that may be used to teach about Earth's constantly changing surface (plate tectonics), earthquakes and volcanoes (topics from B.C. Ministry of Education Integrated Resource Package for Science).

**Hosts:** Department of Earth Sciences, \_\_\_\_\_ University, EdGEO

**Outline:****AM** *Plate tectonics - the cause of earthquakes and volcanoes*

Earth Structure

Plate boundaries, earthquakes and volcanoes

Our local plate tectonic setting – features on land and sea floor

*Volcanoes*

Magma and viscosity

Types of eruptions

Products of volcanoes – on land and in the ocean

**PM** *Earthquakes*

Seismic waves – earthquake energy

Recording earthquakes – seismograms

Be a seismologist – locate an earthquake

*Geoscape* \_\_\_\_\_.

Geoscience in the media

**Resources Provided include** Geoscape \_\_\_\_\_ poster

Regional Geology Map

Selected igneous rock samples

Workshop manual and set of colour overheads

**Cost:** \$10

**Place:** \_\_\_\_\_ University (map provided on registration)

*Note: There are only 20 spaces so please register early. Teachers must be registered to attend!*



## Workshop outlines

EdGEO workshops have a great variety of formats, from a few hours to multiple days, for teachers of one specific school course or anyone interested. The workshop can focus on one topic in depth, or serve as an overview to a wide range of Earth science content.

EdGEO encourages workshop facilitators to focus their delivery style on active learning for participants. The emphasis is on having teachers carry out the activities as if they were the students. This hands-on approach maximizes learning and increases the likelihood that teachers will use the material in their own classrooms.

The whole group can do one activity at the same time, or a number of tasks can run simultaneously. Participants can either rotate through each activity station so that everyone completes each task (often called a round-robin or centres approach), or each group can present their activity to the others when completed (referred to as a jigsaw).

Five samples follow of workshop outlines.



## Half-Day Workshops (~2 hours)

### 1. Rocks, Fossils and Earth History

#### Introductions

- Activity 1: Raving Rocks – what stories do rocks tell?
- Activity 2: Earth’s Timeline
- Activity 3: Earth History Clock and Canada Rocks
- Activity 4: Fabulous Fossils – how do they form and what do they tell us?
- Activity 5: Reconstructing ancient geography
- Activity 6: Putting it all together – figuring out relative age with fossils, superposition and cross-cutting relations

### 2. Plate Tectonics Earthquakes and Volcanoes

- Demo 1: Earth as an egg
- Demo 2: Coincidence of volcanoes, earthquakes and plate boundaries
- Activity 1: Foams and plates in the Pacific Northwest
- Activity 2: Cross-section using Juan de Fuca Plate relief map
- Activity 3: Volcanoes and viscosity
- Activity 4: Earthquakes and seismic waves
- Activity 5: Victoria Earthquake Hazard map

### 3. The Earth’s Crust, Rocks, Minerals and More

#### Getting You Enthused About Earth Science

- Let’s Get to Know One Another
- Icebreaker/self-reflective activity

#### Introduction

- What is Earth Science? Why teach Earth Science?
- Think-Pair-Share Role Model Activity

#### Sharing Enthusiasm About Earth Science With Your Students (Hands-on Activities)

- Introduction and Background Materials
- Structure of the Earth



- Demonstration I: What does the Earth look like?
- Sedimentary vs Igneous vs Metamorphic Rocks
  - Demonstration I: Sedimentary Setting (Sedimentary)
  - Demonstration II: Lava Erupting (Igneous)
  - Demonstration III: Squeezing Taffy (Metamorphic)
- The Rock Cycle
- Identifying Rocks and Minerals
  - Activity I: Rock Identification
  - Activity II: The Difference Between Rocks and Minerals; Mineral Identification
  - Activity III: Earth Resources: Scavenger Hunt
- The Earth's Crust
  - Activity I: Pangea Puzzle
- Story Telling and Earth Science
  - Using Stories and Case Histories to Teach Earth Science

Conclusions, Questions and Take-Away Activity



**Full Day Workshop (~5 hours)****Plate Tectonics and Vancouver Island Geology**

9:30 – 9:45 a.m.	Welcome and Introduction, thanks to sponsors, give agenda
9:45 – 10:15 a.m.	Speaker 1: Local Plate Tectonics and Earthquakes
10:15 – 10:30 a.m.	Coffee Break
10:30 – 11:30 a.m.	Demo 1: Earth as an egg (5 min.)
	Activity 1: A look at plate boundaries (5 min)
	Demo 2: Phone books and plate interactions (5 min)
	<i>Objective: To understand and describe types of plate margins</i>
	Activity 2: Plate motion in our backyard (Tectonics and foams)
	Activity 3: Tsunami basin model
	Activity 4: Paper transform challenge
	<i>Objective: To understand the local plate tectonic setting</i>
11:30 - noon	Speaker 2: Episodic tremor and slip
Noon – 1:00 p.m.	Lunch
1:00 – 2:30	Activity 4: GPS exercises
	<i>Objective: To understand how GPS measurements are used to study plate motions</i>
2:30 p.m. - 2:45 p.m.	Activity 5: Seismic relay and P and S wave propagation
2:45 p.m. - 4:15 p.m.	Activity 6: First Nations' Seismology - How earthquakes are described in First Nations' oral tradition on the west coast
	<i>Objective: To explore the seismic history of the Pacific margin within First Nations oral tradition.</i>
4:15 – 4:30 p.m.	Workshop Evaluation and distribution of EdGEO newsletter and resources; wrap-up



**Three Day Workshop (Residential program with field trips)****Day 1**

- 11.30 – 12.00 registration
- 12.00 – 12.30 welcome and opening
- 12.30 – 13.00 brainstorming about geology
- 13.00 – 14.30 rocks, minerals and the rock cycle
- 14.30 – 14.45 break
- 14.45 – 17.00 assessment activities and valuable resources
- 18.30 – 19.15 pizza supper and prizes
- 19.15 – 20.15 lab tours and geology games

**Day 2**

- 8.30 – 9.40 Fossils and time
- 9.40 – 9.55 bathroom break and bus loading
- 9.55 – 10.55 drive to field trip location
- 10.55 – 11.30 tour and activities at field location
- 11.30 – 12.15 lunch
- 12.15 – 12.30 bathroom break and bus loading
- 12.30 – 12.45 drive to beach
- 12.45 – 16.30 become paleontologists on the beach
- 16.30 – 16.40 bus loading
- 16.40 – 17.40 drive back to base

**Day 3**

- 8.30 – 10.00 soil
- 10.00 – 10.15 break
- 10.15 – 12.00 sedimentary geology and how it relates to society
- 12.00 – 13.00 lunch
- 13.00 – 14.30 plate tectonics
- 14.30 – 14.45 break
- 14.45 – 15.30 Earth history and major geological events
- 15.30 – 16.00 feedback, evaluation forms, distribution of resources, thank you





## Workshop manual

Teacher participants in EdGEO workshops rate very highly the materials they take away with them at the end of the workshop. Emphasis is given to content that is directly related to their teaching, e.g. activities and handouts for students, and information that enhances the teachers' knowledge of Earth science, e.g. descriptions of local geology. Workshop manuals can be produced as printed binders or as digital files on disc. Digital versions can be very economic relative to printing costs. A printed index to the digital files, plus one hard copy for viewing in the workshop, ensures participants are aware of the content. A typical EdGEO workshop manual includes the following sections:

- Outline
- Acknowledgements
- Presenters' biographies
- Topics/curriculum covered
- Activities and handouts
- Information sheets
- Presentation slideshows and images
- List of resources

## Additional resources given to attending teachers

The workshop manual is the primary resource that supports teachers using the material post-workshop. In addition, most workshops provide additional resources, either concrete materials that are needed to teach the activities, e.g. rocks and minerals, or supplementary materials that will enhance student learning, e.g. posters, bookmarks, etc.

The following list is intended as inspiration for the types of items available and of interest to teachers. It is by no means prescriptive or exhaustive. Workshop facilitators can use whatever is available to them, as long as it is connected to the content being delivered.



## SUGGESTIONS

### Specimen Kits

Rock kit:	Mineral kit:	Fossil kit:
Granite Basalt Pumice Conglomerate Sandstone Shale Limestone Phyllite Schist Gneiss	Quartz Calcite Gypsum Amethyst Chalcopyrite Magnetite Hematite	Bivalves Sea urchin Petrified wood Dinosaur bone Shark teeth Gastropod Ammonite Belemnite Coral Brachiopod Trilobite

### Equipment:

Slinkies  
Playdough  
Magnets  
Mineral testing kits

### Books:

Dancing Elephants and Floating Continents  
South Vancouver Island Earth Science Fun Guide  
The Last Billion Years: A geological history of the Maritime Provinces of Canada

### Newsletters

EdGEO News (available from [www.edgeo.org](http://www.edgeo.org))  
Minerals Update  
What on Earth (Canadian newsletter for Earth Sciences, available at <http://www.whatonearth.org/>)  
Where on Earth does your stuff come from?  
Provincial Mining Associations  
PDAC Mining Matters

### Maps

Geological highway map  
Geological map  
Natural Resources Canada "Principal Mineral Areas of Canada"  
US Geological Survey "Plate Tectonic Boundaries"

### Posters

PDAC Mining Matters "Mining makes it Happen" posters  
Geoscape  
Natural Resources Canada:  
Climate Change  
Fossils



	<ul style="list-style-type: none"><li>Gemstones</li><li>Meteorites</li><li>Minerals</li><li>Types of Mining</li><li>Minerals of Canada</li><li>Natural Hazards of North America</li><li>Soil: a vital natural resource</li></ul>
DVD	<ul style="list-style-type: none"><li>NickelQuest: An Underground Mine Tour</li><li>Ground Rules</li></ul>
Information Sheets	<ul style="list-style-type: none"><li>A Guide to Rock and Mineral Collecting</li><li>Field Guide to Identification of Pebbles</li><li>Popular Geoscience Fact Sheets</li><li>(<a href="http://www.gac.ca/PopularGeoscience/index.html">http://www.gac.ca/PopularGeoscience/index.html</a>)</li><li>Local museums, science centres, conservation areas, parks</li></ul>
Miscellaneous	<ul style="list-style-type: none"><li>Postcards</li><li>Bookmarks</li><li>Stickers</li><li>Magnets</li></ul>



## EdGEO participant feedback form

For workshops receiving EdGEO financial support, it is required that you collect feedback from participants at the end of the session. A sample form is included below. For any workshop, such feedback is valuable in evaluating the program, designing new workshops, and providing testimonials for future advertising and fundraising.

---

SAMPLE

## EVALUATION FORM

NAME: (optional) \_\_\_\_\_

Grade(s) taught: \_\_\_\_\_

1. **What was right about this workshop?**
  
  
  
  
  
  
  
  
  
  
2. **What was wrong about this workshop?**
  
  
  
  
  
  
  
  
  
  
3. **Overall rating of the workshop**

*Outstanding   Excellent   Very Good   Good   Moderately Good   Fair   Poor*

4. **General Comments**



## Making it Local

### Curriculum links

When providing workshops for teachers, it is important to design content relevant to the teachers' needs, i.e. what they have to teach in their classes as set out in the curriculum that they must follow. All publicly funded schools and most private schools deliver classroom programs that are based on their region's education curricula. Across Canada, school curricula are prescribed at the provincial or territorial government level, and curriculum documents are available online for public access. An internet search using the region name and the terms "education" and "curriculum" usually provides a direct result. Earth science concepts may be included in science and social studies (geography) curricula. When designing a workshop, always choose activities that link to the local curriculum.

Newfoundland and Labrador <http://www.ed.gov.nl.ca/edu/k12/curriculum/index.html>

Nova Scotia [http://www.ednet.ns.ca/index.php?t=sub\\_pages&cat=73](http://www.ednet.ns.ca/index.php?t=sub_pages&cat=73)

Prince Edward Island <http://www.edu.pe.ca/curriculum/default.asp>

New Brunswick <http://www.gnb.ca/0000/anglophone-e.asp>

Ontario <http://www.edu.gov.on.ca/eng/document/curricul/curricul.html>

Manitoba <http://www.edu.gov.mb.ca/k12/cur/index.html>

Saskatchewan <http://www.sasked.gov.sk.ca/branches/curr/evergreen/index.shtml>

Alberta <http://www.education.alberta.ca/teachers/program.aspx>

British Columbia <http://www.bced.gov.bc.ca/irp/>

Northwest Territories

[http://www.ece.gov.nt.ca/Divisions/kindergarten\\_g12/curriculum/curriculum\\_Service/Curriculum%20Services2.htm](http://www.ece.gov.nt.ca/Divisions/kindergarten_g12/curriculum/curriculum_Service/Curriculum%20Services2.htm)

Yukon <http://www.education.gov.yk.ca/psb/curriculum.html>

Nunavut <http://www.gov.nu.ca/education/eng/css/index.htm>



## Modify activities to use local content

The classroom activities provided in this resource are largely generic, but may be customized with data, information and examples from your local area. This is strongly recommended as it will greatly increase the impact for participants and will open up the possibilities for local field trips. The following table lists the activities where local content can be used.

Section/Topic	Activity	Local Content
Earth History: Geological Time	Significant Events in Earth History	Geological formations and events with dates
	Model of Earth History	Geological formations and events with dates
Earth History: Fossil Identification	Fossil Characteristics	Fossil specimens
Earth History: Paleogeography	Mapping Fossil Environments	Fossil specimens
	Stories from the Rocks	Geological strata and ages
Geomorphology	Topographic Cross-Section	Topographic map
Rocks: Observing Rocks	Collecting and Observing Rocks	Field trip to collect rocks
	Classifying Rocks	Rock specimens
Rocks: The Rock Cycle	Story of a Rock	Rock specimens
	Obituary for a Rock	Rock specimens
Rocks: Identifying Rocks	Clues to Rock Type	Rock specimens
	Naming Rocks	Rock specimens
	Looking Closer at Igneous Rocks	Rock specimens
Minerals: Identifying Minerals	Looking at Minerals	Mineral specimens
	Testing Minerals	Mineral specimens
Surface processes: Ice	Mapping Glacial Retreat	Maps of regional ice sheet coverage over time



Soils	Collecting and Observing Soils	Field study to collect soil samples
Tectonics: Tectonic Boundary Processes	Topography of Plate Boundaries	Topographic map of plate boundary
Using Natural Resources: Uses of Rocks and Minerals	Rocks Around Us	Field trip to local structures built from stone
Using Natural Resources: Extracting Natural Resources	Natural Resources in Our Community	Regional map of mineral resources
Careers	People who work in Earth Science	People working in Earth science related careers

### Field trips

Workshops can be wholly or partly based around a local field trip experience. Field trips may present local features of geological interest, or be used to practice Earth science in the field. The goal may be either further education for participants, or concrete examples of experiences they may duplicate for students. Options for destinations include conservation areas, parks, industry sites, research institutions, museums, science centres, tourist areas, etc.

#### Planning Considerations

- Bus transportation
- Food and drink provisions
- Washroom facilities
- Accessibility
- Production of field guide or teaching activities
- Safety



## Safety Procedures

For personal and group safety, all participants are to read and heed the safety related procedures. It is always a good idea to have a trained first aider with you and to carry an adequate first aid kit on any field trip since accidents do happen even with proper precautionary measures.

### Picks and hammers:

Do not indiscriminately hammer and use downward blows. Wear protective glasses or goggles when hammering. Be aware of persons standing around you when hammering. Only rock hammers are suitable for breaking samples. A carpenter's hammer may splinter and send metal chips flying.

### Suitable clothing:

Participants should have adequate footwear and protection against heat, wet and cold, including a hat, gloves and boots.

### Hard hats:

These are compulsory in mines and quarries, and are recommended anywhere you intend to look at rocks where there are cliffs or overhangs.

### Highways:

Road cuts often expose good rock sections and make good field trip stops, but can be very dangerous. You will be paying attention to the rocks and not the traffic. Park as far off the pavement as possible, on the same side of the road as the section you wish to view. Stay off the pavement unless you are crossing the road.

### Cliffs and falling rocks:

Falling rocks are a major hazard. Avoid unstable or overhanging cliffs. Do not climb a cliff when others are below you.

### Abandoned mine shafts and pits:

Many areas contain historic mine sites where deep shafts, open pits or trenches still exist. Some may be flagged with warning signs, but they may also be slumped in or covered with undergrowth. Do not venture close to potential shafts or trenches.

### Hand washing:

Be careful not to place food directly onto rock surfaces, and wash your hands after handling rocks and before eating.





**First Aid:**

Participants with medical expertise or valid first aid certificates are encouraged to identify themselves at the beginning of the trip. Participants with medical conditions (allergies, diabetes, etc) are asked to advise the leader before departure. Medical information will be treated with the strictest confidence.

---

**SAMPLE**

## Field Trip Guide Contents

- Itinerary
- Safety procedures
- Collecting regulations
- Location map
- Regional geology map and description, including tectonic history
- Classification of local stratigraphic units
- Map of field trip with stops marked
- Distance log and identification of each stop
- Descriptions of each stop, with photographs, diagrams, cross section, stratigraphic column as appropriate.
- References and resources for further information



## Activity Index

Section	Topic	Activities		
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		Model of Earth History	7	
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		Fossil Identification	The Button Game	17
			Fossil Characteristics	19
	Paleogeography	Fossil Detectives	Fossil Detectives	25
			Mapping Fossil Environments	29
		Stories from the Rocks	Stories from the Rocks	35
Geomorphology	Geomorphology	Modelling Rock Layers	3	
		Topographic Cross-Section	5	
		Landforms	9	
Surface Processes	Water	Erosion by Water	3	
		Groundwater Systems	7	
		Groundswell	11	
	Ice	The Destructive Power of Ice	17	
		Mapping Glacial Retreat	21	
	Mass Wasting	Investigating Shear Strength	27	
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Soils	Soils	Collecting and Observing Soils	3	
		Making Soils	5	
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## Education Resource List

### Interactive Online Activities

#### Bridge to Classroom

<http://www.eduweb.com/portfolio/bridgetoclassroom/>

Design a bridge to withstand a magnitude 8.2 earthquake with the New Bay Bridge Organization activity “Engineering for Earthquakes.”

#### Cretaceous Crime Scene

<http://www.learnalberta.ca/content/seccs/index.html>

Investigate the mass death of a herd of dinosaurs 70 million years ago with this activity from Learn Alberta. It includes clues, suspects and lots of information about dinosaurs.

#### Groundwork: Exploring for Minerals in Canada

<http://sciencenorth.ca/cool-science/cool-science.html#>

Play a mineral exploration game developed by Science North and the Canadian Institute of Mining, Metallurgy and Petroleum. Available in French and English.

#### IRIS Earthquake Simulator

<http://www.iris.edu/edu/10.5/EQSimulator.html>

Change fault dimensions (length, depth and slip) and discover the magnitude of earthquake that would be produced with this simulator developed by the university consortium IRIS (Incorporated Research Institutions for Seismology).

#### QuakeChasers

<http://www.quakechasers.ca>

Create an earthquake and calculate its magnitude and location from the seismograms. Includes tutorials and background information on earthquakes in Canada. Adaptation for Canada produced by the POLARIS Consortium of “Virtual Earthquake.”

#### Virtual Courseware Project

<http://www.sciencecourseware.org/>

Work on a variety of interactive simulations for the Earth sciences, including:

Virtual Earthquake: Locate an earthquake’s epicentre and determine its magnitude.



Global Warming: Learn about global warming and climate change caused by both natural and human factors.

Virtual Dating: Learn how geologists and archeologists determine the age of rocks and artifacts in two activities: Isochron Dating and Radiocarbon Dating.

Virtual River: Learn about river processes in the River Discharge and River Flooding activities.

## Downloadable Lesson Plans, Resources and Activities

### Burgess Shale Fossils

[http://www.pc.gc.ca/apprendre-learn/prof/sub/burgess/lessonplan3\\_e.asp](http://www.pc.gc.ca/apprendre-learn/prof/sub/burgess/lessonplan3_e.asp)

Parks Canada teachers page for the Burgess Shale fossils in Yoho National Park.

### Climate Change

<http://adaptation.nrcan.gc.ca/posters/>

A series of seven posters in English and French, produced by Natural Resources Canada, depicting the regional impact of climate change in Canada.

### Dancing Elephants and Floating Continents

[http://www.lithoprobe.ca/media/dancing\\_elephants\\_companion\\_material\\_PDF.pdf](http://www.lithoprobe.ca/media/dancing_elephants_companion_material_PDF.pdf)

Free teachers guide, produced by the deep Earth research project Lithoprobe. It contains lesson plans for earthquakes, volcanoes, subduction zones, meteorites, etc.

### Digital Library for Earth System Education

[www.dlese.org](http://www.dlese.org)

Extensive archive of Earth science resources. All the “Teaching Boxes” are excellent for classroom use.  
<http://www.teachingboxes.org>

### Earth Learning Ideas

<http://www.earthlearningidea.com/>

Library of Earth science activities contributed and reviewed by the international Earth science community.

### EQLocate

<http://bingweb.binghamton.edu/~ajones/eqlocate.html>

Program that uses P wave arrivals on real seismograms to locate selected global earthquakes.





**Explorations in Earth Science**

<http://web.ics.purdue.edu/~braile/indexlinks/educ.htm>

Extensive collection of student activities with a geophysics focus.

**Fossil Facts**

<http://www.fossils-facts-and-finds.com>

Source of class handouts for fossils activities (word searches, crossword puzzles, etc.).

**FOSS Earth Material Module (Gr. 3-4)**

<http://www.fossweb.com/modules3-6/EarthMaterials/index.html>

Activities and games based on the observable characteristics of rocks and minerals; includes resources for parents and teachers.

**Geological Society of America**

<http://www.geosociety.org/educate/resources>

A wide range of Earth science lesson plans, activities and resources for teachers.

**GeoRock Garden**

<http://www.geoscapesask.ca/pdfs/geogarden.pdf>

Teachers guide, developed for Regina's GeoRock Garden at Campbell Collegiate, includes lesson material on the rock cycle, mineral and rock identification, and erosion and glaciers.

**Geoscape Canada**

<http://geoscape.nrcan.gc.ca/>

Bilingual resources that explain the landscapes, Earth and water resources, and natural resources of Canadian communities and regions. Includes: Calgary, Fort Francis, Montreal, Nanaimo, northern and southern Saskatchewan, Northwest Territories, Vancouver, Victoria and Whitehorse. An English only site is available for the Grand River Basin Geoscape  
[http://www.geoscapegrandriver.ca/geoscape\\_flash.html](http://www.geoscapegrandriver.ca/geoscape_flash.html)

**Getting into the Fossil Record**

<http://www.ucmp.berkeley.edu/education/explorations/tours/fossil/index.html>

This University of California site provides a basic understanding of fossils and how they are preserved. Includes a teachers guide.



### International Polar Year (IPY)

[http://www.ipy.org/index.php?ipy/detail/ipy\\_2007\\_2008\\_school\\_launch\\_event/](http://www.ipy.org/index.php?ipy/detail/ipy_2007_2008_school_launch_event/)

Classroom activities related to ice and water.

### Let's Do Science

<http://letsdoscience.com/>

A teachers guide to the Alberta elementary science curriculum.

### Ocean Drilling Program

<http://www.joilearning.org/classroom/default.html>

Classroom activities for many Earth science topics, as well as chemistry, geography and math.

### Qu'Appelle Valley

<http://www.cmste.uregina.ca/valley/index2.html>

Biology, geography and geology lessons, virtual tours and activities for Saskatchewan's Fort Qu'Appelle region tailored for middle-year classrooms.

### Science Education Gateway

[http://cse.ssl.berkeley.edu/segway/educators\\_resources.html](http://cse.ssl.berkeley.edu/segway/educators_resources.html)

Indexed portal for education activities that complement various NASA programs.

### Science Net Links

<http://www.sciencenetlinks.com/matrix.cfm>

Comprehensive archive of standards-based activities and information sources developed by the American Association for Advancement of Science. Indexed by topic, grade and benchmark.

### The Science Spot: Earth Science Lessons

<http://sciencespot.net/Pages/classearth.html>

Online and downloadable lesson plans developed by 8<sup>th</sup> grade science teacher, Tracy Trimp.

### Seismic Eruption

<http://bingweb.binghamton.edu/~ajones/eqlocate.html>

Executable program that displays earthquake epicentres and volcanic eruptions.



### Seismic Waves

<http://bingweb.binghamton.edu/~ajones/#Seismic%20Waves>

Executable program that models the propagation of waves through the Earth for selected earthquakes.

### Teach Engineering

<http://www.TeachEngineering.org>

Teacher-tested, standards-based engineering activities for K to 12 teachers to use in science and math classrooms.

### Teach the Earth: Resources for Geoscience Educators

<http://serc.carleton.edu/>

Activities and research for teaching Earth science from the Science Education Resource Center at Carleton College.

### Teachnology

[http://www.teach-nology.com/teachers/lesson\\_plans/science/earth\\_sciences/rocks/](http://www.teach-nology.com/teachers/lesson_plans/science/earth_sciences/rocks/)

Online library of classroom activities, including many for the Earth sciences.

### United States Geological Survey Educational Sites

<http://education.usgs.gov/>

Extensive resource site for information and activities covering all Earth science topics.

### University of California Museum of Paleontology

<http://www.ucmp.berkeley.edu/fosrec/>

Extensive site with many classroom activities and information, of particular note: Learning from the Fossil Record

Evolution <http://evolution.berkeley.edu/>

### Volcano World

<http://volcano.oregonstate.edu/>

Extensive site for student activities and information about volcanoes.

### Waterscapes

<http://geoscape.nrcan.gc.ca/h2o/>

Poster series, some with lesson plans, illustrating water issues in communities across Canada. Available posters include Bow River Basin, Bowen Island, Gulf Islands and Okanagan Basin. The Bow River waterscape has elementary and junior high school teacher's guides:



[http://www.calgary.ca/docgallery/bu/water\\_services/youth\\_education/river\\_basin\\_jr\\_high\\_teachers\\_guide.pdf](http://www.calgary.ca/docgallery/bu/water_services/youth_education/river_basin_jr_high_teachers_guide.pdf)

[http://www.calgary.ca/docgallery/bu/water\\_services/youth\\_education/river\\_basin\\_elementary\\_teachers\\_guide.pdf](http://www.calgary.ca/docgallery/bu/water_services/youth_education/river_basin_elementary_teachers_guide.pdf)

## Online Information Sources

### Canadian Centre for Energy Information

<http://www.centreforenergy.com/Education/>

Education resources and information on energy resources and their usage; this group also publishes the book “Our Petroleum Challenge: Sustainability into the 21st Century.”

### Earth Science World Image Bank

<http://www.earthscienceworld.org/imagebank/>

Source of images that can be used at no charge for educational purposes.

### Earth Sciences Canada

[www.earthsciencescanada.com](http://www.earthsciencescanada.com)

Earth science careers information. It also provides updates on the book in development “Four Billion Years and Counting: Canada’s Geological Heritage” and links to the WHERE Challenge, a contest for Canadians aged 10-14 (includes great video).

### Earthquakes Canada

<http://earthquakescanada.nrcan.gc.ca/>

Real-time, recent and historical information about Canadian earthquakes.

### École des Mines

<http://cri.ensmp.fr/gm/photos.html>

A-Z archive of mineral photographs.

### Geological Association of Canada

[www.gac.ca/populargeoscience](http://www.gac.ca/populargeoscience)

Mineral and energy fact sheets.

Minerals series: Gold, Placer Gold, Klondike Gold, Iron, Metals from Beneath the Crust, Metals from the Sea Floor, Pine Point, Polaris, Diamonds, Emerald and Aquamarine, Sapphire and Ruby, Aggregate, Carving Stone, Dimension Stone, Tyndall Stone, Jade, Labradorite



Energy Series: Petroleum, Oil Sand, Gas Hydrates, Coal, Arctic Oil and Gas, Gas Pipelines, Canol Pipeline, Geothermal Energy, Uranium

### Internet Rock Shop

<http://mineral.galleries.com/>

Compendium of information about minerals.

### IRIS Seismic Monitor

<http://www.iris.edu/seismon/>

Automatic map of the last 2 weeks of earthquakes, scaled for depth and magnitude on a background of epicentres for the last 5 years.

### Natural Resources Canada

Atlas of Canada <http://atlas.gc.ca/>

Downloadable maps for all subjects, usually with one linked to current events, and many education resources.

Canada Centre for Remote Sensing <http://www.ccrs.nrcan.gc.ca/>

“Tour Canada from Space” provides information and images.

Canadian Landscapes [http://gsc.nrcan.gc.ca/landscapes/index\\_e.php](http://gsc.nrcan.gc.ca/landscapes/index_e.php)

Searchable database of images of Canada’s landscape with substantive captions.

Geological Survey of Canada [http://gsc.nrcan.gc.ca/edumat\\_e.php](http://gsc.nrcan.gc.ca/edumat_e.php)

Links to downloadable educational materials and videos. , Some educational posters and brochures are available and free to teachers. Contact the GSC Bookstore (<http://gsc.nrcan.gc.ca/bookstore/> or 1-888-252-4301) for a list of what’s available.

Use of Minerals [http://www.nrcan.gc.ca/mms/stude-etudi/sat\\_e.htm](http://www.nrcan.gc.ca/mms/stude-etudi/sat_e.htm)

### Royal Tyrrell Museum of Palaeontology

<http://www.tyrrellmuseum.com/>

Information on fossils, with an interactive timeline on the home page.

### This Dynamic Earth

<http://pubs.usgs.gov/gip/dynamic/dynamic.html>

Full text and graphics of the book of the same name, published by the United States Geological Survey.



### United States Geological Survey Educational Sites

<http://education.usgs.gov/>

Extensive resource site for information and activities covering all Earth science topics.

### United States Geological Survey Earthquake Center

<http://earthquake.usgs.gov/eqcenter/>

Latest earthquakes (last 7 days automatic map)

Recent earthquakes (last 30 days automatic map)

Earthquake search (create custom maps and lists)

### Water monitoring

<http://www.epa.gov/owow/monitoring/nationswaters/waters2.pdf>

### What on Earth

<http://www.whatonearth.org/>

Online archive of the Canadian newsletter for Earth sciences

## Earth Science Education Organizations

### Canadian Geoscience Education Network (CGEN)

<http://www.geoscience.ca/cgen/>

Promotes K-12 Earth science education nationally and encourages outreach to increase public awareness. Website provides links to core education programs and list of members indexed by region. Membership free, by sending email to [cgen@sympatico.ca](mailto:cgen@sympatico.ca), with "Join CGEN" in subject line.

### EdGEO

<http://www.edgeo.org/>

National teacher workshop program coordinated by the Canadian Geoscience Education Network.

### Geological Association of Canada

<http://www.gac.ca/>

Bookstore provides educational resources along with descriptions of current Earth science research publications.



### Let's Talk Science

<http://letstalkscience.ca/>

National organization providing science outreach to schools, activities and workshops in all areas of science.

### Calgary Science Network

<http://www.calgarysciencenetwork.ca/>

Calgary-area resources and scientists of all disciplines who will visit your classroom.

### Scientists in Schools

[http://www.scientistsinschool.ca/SiS/For\\_Teachers.html](http://www.scientistsinschool.ca/SiS/For_Teachers.html)

Programs, workshops and resources linked to science curriculum.

### Prospectors and Developers Association of Canada Mining Matters

<http://www.pdac.ca/miningmatters>

Workshops for teachers and Earth science educational resources.

### Mineral Resources Education Program of British Columbia

<http://www.bcminerals.ca/>

Newsletter and range of educational resources and opportunities for BC teachers and students.

### Yoho Burgess Shale Foundation

[www.burgess-shale.bc.ca](http://www.burgess-shale.bc.ca)

Information about the discovery and significance of the Burgess Shale fossils in Yoho National Park. Also provides details of annual teachers field trip to visit the site.

### Johnson GeoCentre

<http://www.geocentre.ca/>

Science centre specializing in Earth science, located in St. John's, NL

### Dynamic Earth

<http://dynamicearth.ca/>

Science centre specializing in Earth science and mining, located in Sudbury, ON

### International Geoscience Education Organisation

<http://www.geoscied.org/>

Promotes Earth science education internationally at all levels.



## Books for Teacher Use

- Adventures With Rocks and Minerals (Book II): Geology Experiments for Young People (Barrow, L.H.) Enslow Publishers, 1991.
- Earth Through the Ages (Carona, P.B.) Follett Publishing, 1968.
- Explorations in Science (Level 3) Rock Solid (Campbell, S. et al) Addison-Wesley, 1992.
- Explorations in Science (Level 3) Rock Talk (Campbell, S. et al) Addison-Wesley, 1992.
- Geology (Peacock, G. and Jesson, J.) Thomson Learning, 1995.
- Geology Rocks! 50 Hands-on Activities to Explore the Earth (Blobsaum, C.) Williamson Publishing, 1999.
- Geology Crafts for Kids: 50 Nifty Projects to Explore the Marvels of Planet Earth (Anderson, A., Diehn, G., Krautwurst, T.) Sterling Publishing, 1996.
- Hands-On Minds-On Science Series: Geology (Young, R., Feigen, M.) Teacher Created Resources, 1994.
- Innovations in Science, Process and Inquiry, Level 3 (Peterson, R, McAllister, N.) Harcourt-Brace, 1996.
- In Search of Ancient Alberta (Huck, B., Whiteway, D.) Heartland Publications, 1998.
- Just the Facts: Earth and Space Science (Sinsel, J. L.) Carson-Dellosa Publishing, 2007.
- Overhead and Underfoot (Wiebe, A., Ed.) AIMS Education Foundation, 1996.
- Planet Earth Activity Book and Teachers Guide for Grades 4-6, Milliken Publishing, 1984.
- Rocks and Minerals (Toni, A.) Carson-Dellosa Publishing, 1994.
- Science Is...: A source book of fascinating facts, projects and activities (Bosak, S.) Scholastic Canada, 2000.
- Shake, Rattle and Roll (Christian, S., Felix, A.) John Wiley & Sons, 1997.
- Simple Earth Science Experiments with Everyday Materials (Loeschnig, L.) Sterling Publishing, 1997.

## Books for Teacher and Student Use

- Audubon Society Field Guide to Rocks and Minerals (Chesterton, C.) Chanticleer Press, 1978.
- Dancing Elephants and Floating Continents (Wilson, J.) Key Porter Books, 2003. A free teacher's guide can be downloaded at [www.lithoprobe.ca](http://www.lithoprobe.ca)





- Dr. Art's Guide to Planet Earth (Sussman, A.) Chelsea Green Publishing, 2000.
- A Field Guide to the Identification of Pebbles (Van der Flier-Keller, E.) Harbour Press, 2006.
- Everybody Needs a Rock (Baylor, B.) Aladdin Paperback, 1985.
- Fossils - A Guide to Prehistoric Life (Rhodes, F., Zim, H., Shaffer, P.) Golden Press, reprinted 2001.
- Gemstones (O'Neil, P.) Planet Earth Series, Time-Life Books, 1983.
- Geology (Rhodes, F.) Golden Books Publishing, 1991.
- Guide to Rocks and Minerals (Mottana, A., Crespi, R., Liborio, G.) Simon and Schuster, 1978.
- How the Earth Works (Farndon, J.) Reader's Digest, 1992.
- Reading the Rocks: A Biography of Ancient Alberta (Keiran, M.) Red Deer Press, 2004.
- The Last Billion Years: A Geological History of the Maritime Provinces of Canada (Fensome, R., Williams, G., Eds.) Nimbus Publishing, 2001.
- The Pebble in my Pocket: A History of our Earth (Hooper, M Coady, C) Viking Press, 1996.
- The Quicksand Book (de Paola, T.), Holiday House, 1977.
- Rocks and Minerals - A Guide to Familiar Minerals, Gems, Ores and Rocks (Zim, H., Shaffer, P.) Golden Press, 1957.
- Rocks and Minerals (Podendorf, I.) Scholastic Library Publishing, 1982.
- Rocks and Minerals - Eyewitness Books (Symes, R., Harding, R.) DK Childrens Publishing, 2007.
- Stone Wall Secrets (Thorson, K., Thorson, R.) Tilsbury House, 1998.

## Books: General Interest

These books are not aimed at young audiences, but are wonderful resources to engage readers in Earth science.

A Crack in the Edge of the World: America and the Great California Earthquake of 1906 (Winchester, S.) HarperCollins, 2005. An account of the most devastating North American earthquake of modern times.

A Short History of Nearly Everything (Bryson B.) Doubleday Canada, 2003. Includes the basics of a little bit of everything, including chemistry, physics, paleontology, astronomy and geology.

Canada Rocks: The Geologic Journey (Eyles, N., Miall, A.) Fitzhenry & Whiteside, 2007. A comprehensive look at Canada's geology written for the interested layperson.



Earth Colors (Andrews, S.) St. Martin's Minotaur, 2004. A mystery featuring a forensic geologist. Resources for teachers are included on the author's website: <http://www.sarahandrews.net/foreducators.htm>

Krakatoa. The Day the World Exploded: August 27, 1883 (Winchester, S.) HarperCollins, 2003. An account of one of the greatest volcanic disasters in recent history.

The Map That Changed the World: William Smith and the Birth of Modern Geology (Winchester, S) HarperCollins Publishers, 2001. The story of the first geological map, produced in 1815, and the subsequent development of geology.

The Practical Geologist: The Introductory Guide to the Basics of Geology and to Collecting and Identifying Rocks. (Dixon, D.) Fireside Books, 1992. An introduction to the basics of geology, including rock and mineral identification.

Volcanoes: Fire from the Earth (Krafft, M) Harry N. Abrams, Inc., 1993. A discussion of the connections between history and culture and volcanism.

Wonderful Life (Gould, S.) W.W. Norton, 1989. The fossils of the Burgess Shale in the Canadian Rockies are used to examine the evolution of life on Earth.

## Videos/DVD

Geologic Journey: This 2007 series focuses on the geology of Canadian landscapes. Available from <http://www.cbcshop.ca/>

Geological Survey of Canada [http://gsc.nrcan.gc.ca/edumat\\_e.php](http://gsc.nrcan.gc.ca/edumat_e.php) includes a link to free downloadable videos on various Earth science topics, many of which are available in French and English.

The Day the Earth Shook: Produced by Nova, this video shows footage from two earthquakes: California (1994) and Kobe, Japan (1995).

Way Cool Science: Rockfinders: This 2003 DVD explores rocks and how they form. Available through online vendors such as Amazon.ca.

## Rock and Mineral Kits

School boards often have rock and mineral kits available for teachers. Local rockhound or gem and mineral clubs will often supply kits to teachers at no or low cost. Many Earth science or geology departments at universities and colleges across Canada have people active in education outreach who are able to supply materials, either for loan or permanent use. Sample kits are also available for purchase from scientific supply companies including Wards Natural Science, Northwest Scientific and Boreal Scientific.

