

Living on a Layer Cake: An Investigation of Local Geological History

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Grade level: Grade 12.

Provincial curriculum links: Ontario.

Subject: Science.

Keywords: Geology, mineral resources, natural environment, geological time.

Description

In this activity, students study the local geological history by examining various types of geological evidence.

Curriculum Framework

This lesson is linked directly to the learning expectations described in the Ontario Curriculum for Grade 12 Earth and Space Science (SES 4U).

The learning expectations are also broadly applicable to other Canadian curricula, including the Pan-Canadian Science Curriculum

A: Ontario Curriculum Grade 12 (SES 4U)

Strand: Earth History

Specific Lesson Goals:

- use and interpret information from appropriate sources (e.g. a sequence diagram, geological maps showing major geological regions and associated rock types) in describing the geological history of an area (e.g. Ontario);
- demonstrate the ability to use the geological time scale as an aid in interpreting the history of a sequence of strata;
- investigate and analyze various types of preserved geological evidence of changes that have taken place in Earth history;
- describe the diversity of life in the Proterozoic, Paleozoic, Mesozoic and Cenozoic eras and the range of important groups of fossils that date from each.

B: Pan-Canadian Curriculum

Knowledge:

- 330-12 students will use appropriate evidence to describe the geological history of an area
- 332-4 students will illustrate the geological time scale and compare to human time scales

Preparation

Preparation time: Approximately 60 minutes or more to locate study sites and other evidence of geologi-

cal history, prepare student worksheets, read educator notes (provided) and review references/resources (as noted below).

Length of lesson: Approximately 250 minutes for class discussions, model building and field trip.

Resources required: Paper plates, geological maps showing major geological regions and associated rock types, preserved geological evidence (e.g. fossils, core samples), geologic time scale, geology reference texts, different colours of paint and markers, and student worksheet.

Procedure

1. As a class, brainstorm techniques geologists have used to piece together the continuous layer-by-layer rock record of the earth's history. Build a multi-coloured plasticene model and drill with a straw to show the rock layering.
2. Review the geologic time scale and the correct way to read it (bottom to top).
3. Involve students with reading the song, "Living On A Layer Cake", written by Chris Rawlings. The song features the geology of Southern Ontario, and the lyrics are available at : <http://www.interlog.com/28wrenfolk/>.
4. Discuss examples of local geological features that can be examined to learn further about the local geological history. Display examples of geological evidence such as fossils and rock core drills.
5. Discuss the assignment requirements. Organize students into groups of 2 to 4 members.
6. After the field trip, provide time to complete the research for the paper plate layer cake activity. This activity involves painting paper (or styrofoam) plates to represent the different ages of rock layers beneath the school and community. For example, the rocks under Waterloo, Ontario are Precambrian, Cambrian, Ordovician and Silurian. These rocks are overlain by glacial deposits (Quaternary) and covered by evidence of human activity (use a simple map of the area around the school to provide a visual explanation). Interesting facts and pictures about the deposits, minerals, fossils, etc, are to be included on the plates. The plates are stacked on top of each other from oldest to youngest. The plates could be cut back (i.e. "eroded") to show what a geological map may look like as the layers are weathered away. Overlap the plates to demonstrate this. The ice-age layer covers these older rocks and holes may be cut in this plate to allow

the rocks to be seen below.

Discussion and Questions

- Conduct a whole-class discussion around the field trip observations and research findings on the pre-existing environments below the school and community.
- Discuss the following questions. Why was your community built where it is? Was it built there because of access to water, trade routes, mineral deposits or quality soils? What were the first industries in your area? Over time, have they changed for better or worse? What would the view of the top plate community be 500 years into the future?

Student Evaluation

- Paper plate layer cake project
- Completion of worksheets and quality of observations
- Observation
- Peer and self-evaluation

Enrichment and Extension Activities

- Modify the words of “Living On A Layer Cake” to suit your area’s geology. Alternatively, write a new song to include the human history.
- Research how radioactivity is used to determine the age of rocks.
- Compare the geological history of the school area to other regions of the country.
- Research how the geological history of your school ground has set the stage for its current ecology. How has the geological history of your town or region affected the industries that developed there and the suitability of the area for agriculture?

Educator Notes

- Geologists used radioactive dating, correlation by rock type from all over the world, and the fossils they contain to develop a geologic time scale by piecing together a continuous column of rock representing the history of the earth, layer by layer.
- Continuous changes on the earth’s surface from mountain building, volcanic eruptions and the deposition and erosion of material have prevented the deposition of a complete succession of all rock layers.
- The Law of Superposition applies to the sequencing of the earth’s rock layers; the youngest lie on top and the oldest lie on the bottom. More recent geological events are recorded in the top rocks while the older events can be seen in the rocks underneath. Geological periods are therefore, always “written” with the oldest at the bottom, and are read upward - oldest to newest.

- Collect geological maps, geological surveys and other library resources to assist students in researching the geological history of the area.
- If available, collect fossil records, drilled core samples and rock specimens as geological evidence.
- Scout the local area for potential field trip sites that illustrate the earth’s preserved geological history (e.g. outcrops, escarpments, cliff faces, shorelines, boulders, road rock cuts, canyons, rock columns, gorges, mountains and valleys, bedrock waterfalls and quarries).
- Students should have prior knowledge of reading geological maps, naming the categories and distinctive plants and animals in the geologic time scale and identifying representative fossils.
- **Safety Note:** Consult your school board’s policy regarding safety precautions for outdoor excursions and plan your trip accordingly. Be aware of any students with allergies to insect bites and plants and ensure they carry the required medications. Students should wash their hands after handling soil, plants and equipment. Encourage students to wear sunscreen and appropriate clothing (e.g. hat, long-sleeved shirt) to minimize the damaging effects of sun exposure.

References

- For the song: “Living on a Layer Cake”, visit: <http://www.interlog.com/29wrenfolk/>
- For information on Geology for Beginners, visit: <http://www.science.uwaterloo.ca/earth/waton/watonf00.html>
- For information on Canadian landscapes, visit: <http://sts.gsc.nrcan.gc.ca/landscapes.asp>
- For information on the geological timescale, visit: <http://www.canadianrockhound.com/junior/time scale.gif>
- For the article “Geological Time” in the Summer 2004 issue of What on Earth, visit: <http://www.whatonearth.org>
- Eyles, Nick. Ontario Rocks: three billion years of environmental change. Markam: Fitzhenry & Whiteside Limited. 2002.
- Ontario Mines and Minerals Information Centre offers excellent teaching resources (e.g. books, posters, kits, Geology of Ontario maps). Contact: 1-800-665-4480.

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Student Worksheet

Date: _____

Group Members: _____

In this activity, you will research and map the geological history of your school area and community.

Part A: Outdoor Study

1. Are there any areas in your community where the original pre-human geological environment can be seen (e.g. road rock cuts, escarpments, cliff faces, boulders, gorges, mountains, canyons, bedrock, rock columns, etc.)? List these examples.
2. Visit the sites you listed. For each site, note the name and location of the rock structures, and record your observations and interpretations of the physical features (e.g. rock type, colour, width of rock layers, evidence of fossils, etc.).

Part B: Model Building Project

1. Research the geological history underneath your school and community. Make reference to geological maps, geological surveys, library resources and the internet. Identify the era, period, epoch and approximate age of each rock layer, from oldest to youngest. Include interesting facts about the rock types, mineral resources, fossils, distinctive plants and animals and the climate of each period. Design a poster to summarize your research.
2. Assemble a layer cake model to illustrate the complete sequence of rock layers in your area. Follow these instructions:
 - a) For each layer, take a paper plate and paint with a different bright colour.
 - b) Record the period name and approximate age of each layer.
 - c) Draw or paint on representative fossils, minerals and rock or magma intrusions (e.g. mammoths and mastodons may represent the fossils of the ice-age on the Quaternary plate).
 - d) On the top layer, draw a simple map of the area around the school.
 - e) Stack the plates on top of each other from oldest to youngest. Cut back or “erode” the plates to show what a geological map may look like as the layers are weathered away. This can be done by partially overlapping the plates.
 - f) Cut holes in the ice-age layer plate to allow the rocks to be seen below.
 - g) Attach the labeled layer cake model to your poster.