



Teacher's Corner Lesson Plans

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I Want a Gravestone That Lasts!

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Grade level: Grade 12.

Provincial curriculum links: Ontario and Pan-Canadian.

Subject: Science.

Keywords: Erosion, weathering, climate zones, climate, lichens, wind, monuments, dimension, stone, .

Description

In this activity, students will investigate the effects of weathering on gravestones.

Curriculum Framework

A: Ontario Grade 12 Earth and Space Science, University Preparation (SES 4U)

Strand: Internal and Surficial Earth Processes

Specific Lesson Goals:

- distinguish between erosion and weathering, and describe the processes and effects of physical, chemical and biological weathering.

B: Pan-Canadian Curriculum

Knowledge:

- 330-4 analyze the interactions between the atmosphere and human activities.

Preparation

Preparation time: Approximately 20 minutes to collect materials, prepare student worksheets, read educator notes (provided) and review references/resources (as noted below), plus time to explore a local cemetery in advance.

Length of lesson: Approximately 120 minutes for class discussions and field trip.

Resources required: Digital cameras, map of the cemetery, identification guides for lichens and rocks and minerals and lesson worksheets.

Procedure

1. Review the rock cycle. Distinguish between weathering and erosion.
2. Discuss factors that influence weathering. Explain Rahn's Index of Weathering for gravestones. Cite examples of common rock material used for gravestone construction and why these materials were used.
3. Discuss the assignment requirements. Organize students into groups of 2 to 4 members.
4. Back in the classroom, provide time to complete the follow-up discussion questions.

Discussion and Questions

Conduct a whole-class discussion around the results and the following questions:

1. Which rock type showed the greatest resistance to weathering? Why?
2. Which rock type showed the least resistance to weathering? Why?
3. What are the effects of weathering on rocks?
4. What types of weathering have affected the tombstones (e.g. physical)? Support your answer.
5. Which rock type would you choose for a gravestone? Why?
6. Why is the cemetery placed where it is? Consider the geology of the area.

Student Evaluation

- Completion of worksheets and quality of observations
- Observation
- Peer and self-evaluation

Enrichment and Extension Activities

- Visit a local monument maker. Watch carving in action. Find out the cost of a monument/tombstone for a rock of your choice. Which country is the rock from? Why did you select this type of rock?

- Contact the local Genealogical Society and invite a representative to join the field trip. These groups are experienced in the preservation of historical information and monuments, and may have insight or stories about the history of the cemetery and source of the stones.
- If some students have ancestors or family buried at the cemetery, encourage an independent study that takes this human factor into account. Why would the family have decided to use a particular type of stone? How much would they have had to pay for it? What is the oldest monument in the cemetery? What could students find out about the first families that settled in your area?
- Research why the cemetery is placed where it is. Is there a geological reason? Consider interviewing a gravedigger to obtain this information.
- Find out if the coffin requires a concrete cover to protect the groundwater from pollution (embalming fluid).
- Design an experiment to show how weathering occurs in the most weathered material seen during the study.

Educator Notes

- Weathering is a slow process. Some rocks erode faster than others. The conditions causing the deterioration may be chemical, physical (temperature change) and biological activity.
- The durability of rocks varies with climate, composition, and exposure to weather.
- Rocks that are rich in quartz, such as granite, are highly resistant to chemical weathering. On the other hand, marble, which consists of soluble calcite, is more easily weathered by acidified precipitation. Medium-grained quartz sandstone containing feldspar and micas are much less soluble than marble. Fine-grained sandstone consisting almost entirely of quartz is very insoluble and hence, more resistant to chemical weathering.
- Both moisture and heat promote chemical reactions. Weathering generally goes deeper into rock materials in a moist warm climate than in a dry, cold one.
- Rocks provide an environment for lichens to grow.
- Weathering is an intrinsic part of erosion and so participates in the rock cycle.
- Rahn's Index for Weathering can be used to measure the extent to which gravestones have been weathered. This is dependent on lithology (the rock cycle), exposure and the time that the stones have been standing.
 1. Unweathered.
 2. Slightly Weathered - faint rounding of corner of letters.
 3. Moderately Weathered - rough surfaces, letters still legible.
 4. Badly Weathered - letters and difficult to read.

5. Very Badly Weathered - letters almost indistinguishable.
 6. Extremely Weathered - no letters left, scaling.
- Visit the cemetery ahead of time to identify the study areas containing tombstones that exhibit a range of weathering and different rock types. Permission must be obtained to study the graveyard.
 - Contact local monument maker. Consider inviting him or her as a guest on the field trip or to give a classroom presentation.
 - Collect identification references for lichens, rocks and minerals.
 - 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 information on weathering, visit: <http://www.geographypages.co.uk/weathering.htm>
- For information on gravestone weathering, visit: <http://www.envf.port.ac.uk/geo/inkpenr/graveweb/gravestone.htm>
- For information on Dimension Stone Suppliers (Ontario), visit: http://www.mndm.gov.on.ca/mndm/mines/mg/dimstone/alphprod_e.asp
- For information on Nova Scotia Dimension Stone, visit: <http://www.gov.ns.ca/natr/meb/is/is19.htm>
- For information on "Dead in the Water", visit: <http://www.motherjones.com/news/outfront/1999/01/cook.html>
- For information on chemical and mechanical weathering, visit: <http://www.ux1.eiu.edu/~cfjps//1300/weathering.html>
- For information on weathering of gravestones, visit: <http://www.tiscali.co.uk/reference/encyclopaedia/hutchinson/m0007806.html>
- For information on weathering of various stones in a churchyard in England, visit: <http://www.linslademiddle.beds.sch.uk/geography1.html>

Worksheets

Student Worksheet

Date: _____

Group Members: _____

Cemetery Location: _____

In this activity, you will investigate the effects of weathering on tombstones.

1. Walk through the assigned study area of the cemetery and observe the extent of weathering on the gravestones.
2. Choose 4 tombstones that vary in condition from unweathered to extremely weathered. For each tombstone, record the following information in the provided chart:
 - (a) Identify the extent of weathering based on Rahn's Index of Weathering:
 - i. Unweathered
 - ii. Slightly Weathered - faint rounding of corner of letters.
 - iii. Moderately Weathered - rough surfaces, letters still legible.
 - iv. Badly Weathered - letters are difficult to read.
 - v. Very Badly Weathered - letters almost indistinguishable.
 - vi. Extremely Weathered - no letters left, scaling.
 - (b) Note which areas are weathered. Sketch a few representative letters to illustrate the extent of weathering (if a digital camera is not available).
 - (c) Identify the rock type and colour.
 - (d) Note the presence (or absence) of lichens.
 - (e) If lichens are present, examine them closely. What type are they? Do they grow on the sheltered sides of the tombstone or on all sides? What is the effect of biological weathering?
 - (f) Calculate the age of the tombstone.
 - (g) Mark each of your four tombstone locations on the cemetery map.
3. Are there areas in the cemetery where "micro-environments" allow easily weathered stones to survive better or to be eroded quicker? Support your answer. Mark these stones on your cemetery map.
4. Does stone orientation to prevailing wind also have an impact on the extent of weathering? Explain.
5. Find the oldest gravestone in the cemetery. Describe the extent of weathering and the type of rock used.

TOMBSTONE #...:

Tombstone Age:	
Rahn's Index:	
Rock type and colour:	
Lichens: Present or Absent?	
Lichen description (if present)	
Description of weathering	Sketch or digital photograph of tombstone