



Teacher's Corner Lesson Plans

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My School is Eroding and Corroding

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Grade level: Grade 12.

Provincial curriculum links: Ontario.

Subject: Science.

Keywords: Erosion, weathering, climate, climate zones, wind, earth materials.

Description

In this activity, students will evaluate the extent of natural and human-caused weathering of school building materials.

Curriculum Framework

This lesson is linked directly to the learning expectations described in the Ontario Curriculum for Grade 12 science.

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

A: Ontario Curriculum Grade 12 Earth and Space Science (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 40 minutes tour school grounds to identify examples of weathering of building materials, prepare student worksheets, read educator notes (provided) and review references/resources (as noted below).

Length of lesson: Approximately 140 minutes for class discussions and field trip.

Resources required: Digital camera(s) and lesson worksheets.

Procedure

1. As a class, brainstorm a list of building materials used to construct the school and adjacent walkways, driveways, fences and signs. Classify the source of these materials as grown (e.g. wood), mined (e.g. stone or glass), synthetic (e.g. plastic) or mixed.
2. Brainstorm examples of evidence of chemical, physical and biological weathering of building materials.
3. Discuss the objectives and procedures for the investigation.
4. Organize students into groups of two to four members. Assign special tasks (e.g. group leader, data collector, photographer, etc.).
5. Take the students outside to conduct the activity, as outlined in the student worksheets.
6. Back in the classroom, provide time to complete the discussion questions.

Discussion and Questions

Conduct a whole-class discussion around the results and the following questions. Emphasize the importance of having an understanding of how building materials react to natural and human generated factors when designing and constructing buildings.

1. Which type of school building materials show the least erosion? Explain why.
2. Which type of school building materials show the greatest erosion? Explain why.
3. What type of weathering had the greatest overall impact on the school building materials? Explain why.
4. If you were hired to build a new school, what exterior materials would you recommend be used for the exterior walls? Steps? Walkways and paths? Driveway? Fence? Signs? Windows? Monuments? Storage sheds? Support your answers.
5. What recommendations would you make to your school principal to limit further effects of erosion on affected building structures?
6. Research the following information on the building material assigned to you:

- (a) Composition
- (b) Source (local/national/international)
- (c) Approximate cost
- (d) What would cause it to erode/weather?
- (e) Relative abundance of the resource(s)
- (f) Construction use
- (g) Any other interesting facts

Student Evaluation

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

Enrichment and Extension Activities

- Visit another building, or several buildings, in your community. If your school is a heritage building, try visiting a newer structure to compare weathering effects. If your school is new, take a look at an older building to see how it has weathered the years.
- Look for salt damage to building materials and plantings on school property. Salt damage does not stop at the school door. Follow it inside! Check carpets for staining. Sand may also be tracked in and abrade the floor tile, terrazzo etc.
- Research the benefits and drawbacks of using interlocking bricks instead of asphalt to construct sidewalks. Collect data to see if light coloured interlock freezes before black asphalt does. Which is the safest type of sidewalk?
- Over time as the soil moves, freezes and thaws with the seasons, interlock stones can drift apart. Concrete and stone retaining walls that hold back a slope of earth can gradually be pushed over as the soil creeps downslope. Find examples of both situations in the local neighbourhood. Research possible solutions for each problem.
- Examine deteriorating asphalt sidewalks and roads. Look for “mini pingoes” caused by the freezing and thawing of water (frost heave). Compare these examples to those in the Arctic which average 100 metres in diameter and 300 meters in height.
- Find examples of frost heave in the neighbourhood (e.g. fence posts pushed out of the ground by the freeze-thaw cycle in winter).
- Look for local examples of trees affected by downslope creep. The gradual downward movement of a tree on a steep slope causes it to tip over. The tree can still grow vertically but forms a knee at the bottom.
- Examine older buildings and other structures in the local neighbourhood for signs of erosion (e.g. churches, legislative buildings, gravestone monuments).

Educator Notes

- Weathering is a slow process. Some materials used to build the school erode faster than others. The conditions causing the deterioration may be chemical, physical (temperature change) and biological activity.
- The durability of building materials varies with climate, composition and degree of exposure to weather.
- The materials used to construct the school are either grown, mined or synthetic. They may be sourced locally, or may come from other regions and countries.
- Students should have prior knowledge of the processes of chemical, physical and biological weathering, and their effects on building materials.
- Examine the exterior of the school building and adjacent walkways, driveways and fences for examples of weathering. Identify each type of building material that is affected.
- If possible, make arrangements to obtain one or more digital cameras.
- The lesson “I Want a Gravestone That Lasts!”, also in this series, can be used as a follow-up investigation.
- 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 about Rocks and Minerals Everywhere, visit: <http://www.nps.gov/brca/Geodetect/Rocks%20&%20Minerals/Modern%20min%20use.htm>
- For information about the history and use of bricks, visit: <http://irc.nrc-cnrc.gc.ca/cbd/cbd169e.html>
- For information about the stone, paving and interlock industry in Canada, visit: <http://www.stonework.ca>; or visit: <http://www.uppercanadastone.com/products/precast/Weathering>
- For information about weathering, visit: <http://www.geographypages.co.uk/weathering.htm>
- For information about chemical and mechanical weathering, visit: <http://www.ux1.eiu.edu/~cfjps/1300/weathering.html>
- For information about damage caused by salt and freezing/thawing, visit: <http://www.phys.tue.nl/nfcmr/damage.html>

- For information about pingoes, visit: <http://www.arctic.uoguelph.ca/cpe/environments/land/features/freeze-thaw/pingoes.htm>
- For information about de-icing compounds and the Utah landscape, visit: <http://extension.usu.edu/files/gardpubs/deicers.htm>
- For information about building green, visit: http://www.scienceyear.com/outthere/index.html?page=/outthere/environ/build_green2.html

Worksheets

Student Worksheet

Date: _____

Group Members: _____

In this activity, you will evaluate how well your school's exterior building materials stand up to natural and human-caused weathering.

1. Examine the school's exterior walls, doors, fences, signs, monuments, windows, walkways and driveways for evidence of chemical, physical and biological weathering.
2. For each example of weathering, record the following information in the chart below:
 - (a) Location.
 - (b) Evaluation of the extent of weathering using a scale from 1 (minimal effects) to 10 (most worn).
 - (c) Description of the effects of weathering.
 - (d) Type of weathering (physical/chemical/biological and natural/human).
 - (e) Composition of building material.
 - (f) Source of building material (e.g. grown, mined, synthetic).
 - (g) Approximate age of building material.
3. If a digital camera is available, take a picture of each occurrence of weathering found.

Example 1

Location:	
Extent of weathering (circle one):	1 2 3 4 5 6 7 8 9 10
Description of weathering:	
Type of weathering:	
Building material:	
Source of building material:	
Approximate age of structure:	

Example 2

Location:	
Extent of weathering (circle one):	1 2 3 4 5 6 7 8 9 10
Description of weathering:	
Type of weathering:	
Building material:	
Source of building material:	
Approximate age of structure:	

Example 3

Location:	
Extent of weathering (circle one):	1 2 3 4 5 6 7 8 9 10
Description of weathering:	
Type of weathering:	
Building material:	
Source of building material:	
Approximate age of structure:	

Example 4

Location:	
Extent of weathering (circle one):	1 2 3 4 5 6 7 8 9 10
Description of weathering:	
Type of weathering:	
Building material:	
Source of building material:	
Approximate age of structure:	