



Teacher's Corner Lesson Plans

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Catch My Drift: Snow Pile Sedimentology

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Grade level: Grade 12.

Provincial curriculum links: Ontario and Pan Canadian.

Subject: Science.

Keywords: Climate, snow, snowdrift, snow pile, crystals, superposition, sedimentology, stratigraphy, avalanches.

Description

In this activity, students will analyze snow pile sedimentology and erosion by applying the techniques geologists use to study rock strata.

Curriculum Framework

A: Ontario Curriculum Grade 12 Earth and Space Science (SES 4U)

Strand:

Introduction to Earth Sciences

Specific Lesson Goals:

- demonstrate an understanding of the major tools and techniques that various Earth scientists use to conduct research on the basic structure and processes of the planet.

B: Pan-Canadian Curriculum

Skills: 213-1 implement appropriate sampling procedures.

213-3 use instruments effectively and accurately for collecting data.

Preparation

Preparation time: Approximately 45 minutes to analyze snow or drift/snow pile sites, photocopy student worksheets, read educator notes (provided) and review references/resources (as noted below).

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

Resources required:

- Measuring tapes
- compass
- map of school property
- snow shovels
- digital camera (optional)
- hand lens
- thermometer
- student worksheets

Procedure

1. Introduce the lesson by discussing where and how snow drifts form on the school property. Brainstorm information that can be revealed by analyzing a cross-section of a deep snow pile. Make a comparison to an archaeological dig.
2. Discuss the objectives and procedures for the investigation.
3. Organize students into groups of two to four members. Distribute special tasks (e.g. group leader, equipment manager, data collector, digger, measurer, etc.).
4. Back in the classroom, provide time to complete the follow-up discussion questions.

Discussion and Questions**Discussion and Questions:**

1. Explain why snow drifts form at the various locations on the school property.
2. Can the layering be related to individual snowfalls? Support your research.
3. Account for any differences in hardness, grain size, grain shape and colour between the snow layers.
4. Account for the presence of any impurities in the snow layers.
5. Compare the results of your snow pile sedimentology with the findings of other groups. How are they similar? How are they different? Suggest possible reasons.
6. Plot a graph of snow depth versus snow temperature. What is the correlation between snow depth and snow temperature? Would the soil be frozen underneath the snowdrift? Support your answer.
7. If you observed erosion features, account for the degree of particle sorting, shape of sediment formation and the meandering behaviour of runoff.
8. Suggest a remedial action to slow the rate of erosion of the snowdrift.

9. Do snow fences have to be installed each winter on the school property? Where, on the school property, would you recommend that snow fences be installed? Justify your answer.
1. Cite an example of a practical application of the study of snow pile sedimentology.
2. Explain how the skills used to investigate snow pile sedimentology can be applied by geologists.

Student Evaluation

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

Enrichment and Extension Activities

- Look up the various types of snow crystals, then go outside and catch snowflakes on a cold, black piece of paper or on a dark mitten/glove. Examine them with a magnifying glass and try to identify them. Is each snowflake the same? Do any of the flakes appear broken? What may have caused them to break?
- Try to simulate an avalanche with snow, or with sand. Avalanches occur when layers of new snow begin to pile up over the hardened, older layers. Due to the pressure created, the new layers slide over the hardened surface below.
- Research how to construct a quin-zhee (a snow shelter).
- Research where the sand and salt (or alternative materials) applied to local roads in the winter come from. Are different grades of sand used on major highways and minor roads? Why is salt used in some parts of Canada (e.g., Ontario) but not in others (e.g., B.C.)?
- Collect some sand and pan for gold. Sand in some parts of Canada contains gold. Test the panned sand with a magnet to discover if magnetite (a common heavy mineral) is present.

Educator Notes

- The Law of Superposition applies to the build up of large snow piles and snowdrifts. The oldest layer is at the bottom and the youngest is at the top. This is comparative to rock layers (i.e. strata) in outcrops.
- The study of snow piles (or snow drifts) on the school property will allow students to correlate between two or more “outcrops” of snow and provide useful information as they relate their history.

- A vertical cut through deep snow reveals a wealth of information. It is like an archaeological dig. For example, a recent, cold snowfall might be the first soft layer, followed by last week's freezing rain (a crust), then heavy snow underneath shows the last thaw, and icy crystalline snow at the bottom shows where the earth's heat has affected the snow.
- The kinds of measurements made in this investigation can simulate the work done in the study of avalanches. Precautionary steps can be taken by releasing dangerous snow accumulations before they cause injury or death.
- Students should have prior knowledge of how snow drifts form, erosion features on snow drifts, the Law of Superposition and scales used to measure snow hardness, grain size and grain shape.
- Snowdrifts occur when something slows snow-laden wind, forcing it to dump some of its load. The over hang is termed a cornice.
- The delicate crystals of fallen snow are transformed into granular crystals due to evaporation and recondensation. The evaporation of the fine points causes the air around the crystals to become moist. The moisture then recondenses and deposits particles of ice on the flatter, smoother crystal surfaces.
- As snowflakes fall through the atmosphere, they may pick up dust and small particles emitted into the air by industry. Snow lying near roads and parking lots may also become dirty due to the pollutants from car exhaust systems.
- 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 stratigraphy and superposition, visit: <http://en.wikipedia.org/wiki/Stratigraphy>
- For information about the science of snow, visit: <http://www.wonderofwater.ca/Content/Water/ScienceOfSnow.htm>
- For information about "Have Snow Shovel, Will Travel: a history of snow removal", visit: <http://nsidc.org/snow/shovel.html>
- For information about avalanches in Canada, visit: http://sts.gsc.nrcan.gc.ca/landslides/index_e.asp?Cald=9+Pgld=21
- For information about the Glaciology Lab: Snow, visit: <http://www.uoguelph.ca/~geology/glacial/snow.html>

- For information about winter de-icing agents for the homeowner, visit: <http://ianrpubs.unl.edu/horticulture/g1121.htm>
- For information on sand and gravel resources in Canada, visit: <http://www.ainc-inac.gc.ca/pr/pub/bldg/snd/sgb.e.html>
- For information on road salt, visit: http://www.cee.vt.edu/program_areas/environmental/teach/gwprimer/roadsalt/roadsalt.html

Worksheets

Student Worksheet

Date: _____

Group Members: _____

In this activity, you will examine the formation, cross-section profile and erosion features of snowdrifts.

1. Indicate on the school map where snow drifts form.
2. Select a snowdrift. Sketch its shape and label the cornice (overhang).
3. Measure the width of the snowdrift.
4. Measure the depth of snow at the cornice.
5. Look for erosion features where the snowdrift is melting. You might see (in miniature) a meandering river, formation of alluvial fans and sorting by grain size. Photograph or sketch the erosion features and briefly describe them.
6. Which areas of the snowdrift are more prone to erosion? Explain why.
7. Use the shovel to dig one or more cross-sections in the snowdrift. Closely examine each layer (strata) of snow. Measure and sketch each layer. Record what you see between the layers (e.g. top melting zone, dust layer) on the drift diagram.
8. Record in the chart below the following descriptions for each snow layer: colour, presence or absence of sand and other impurities, and use the scales to determine hardness, grain size and grain shape. Take the temperature readings by inserting the thermometer horizontally into the drift. Measure the air temperature at waist height and at ground surface.

Hardness and Penetrating Object

1. Very Soft.....Fist
2. Soft.....4 Fingers
3. Medium.....1 Finger
4. Hard.....Pencil

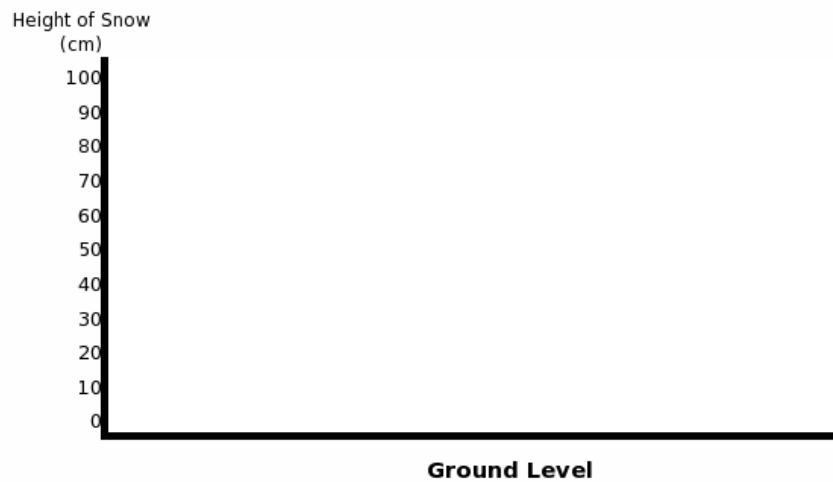


Figure 1: Snow Drift Cross-Section

5. Very Hard.....Knife

Grain Size

1. Very Fine....0.5mm
2. Fine.....0.5 - 1mm
3. Medium....1 - 2 mm
4. Coarse.....2 - 4 mm
5. Very Coarse...+ 4mm

Grain Shape

1. New Snow
2. Partly Settled
3. Granular Rounded
4. Granular with full crystals
5. Ice

Air Temperature:C Surface Temperature:C

Layer Height, Colour Above Ground (cm)	Colour	Types of Impurities	Hardness	Grain Size	Grain Shape	Temp. (C)