



Teacher's Corner Lesson Plans

*Helping Teachers and Students Make the Most of
their Outdoor Classroom*

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The Urban Heat Island Effect

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Grade level: Grade 11.

Provincial curriculum links: Ontario.

Subject: Geography.

Keywords: Heat island, micro-climate, climate, temperature, shade, albedo, urban environment.

Description

In this activity, students will measure and compare variations in temperature in various micro-ecosystems in order to identify factors involved in creating the heat island effect. Students will need to have access to most of the school ground and may even need to leave the property briefly.

Curriculum Framework

This lesson is linked directly to the learning expectations described in the Ontario Curriculum for Grade 11 Physical Geography (CGF 3M).

The learning expectations are also broadly applicable to other Canadian curricula.

Strand: Geographic Foundations: Space and Systems

Specific Lesson Goals:

- demonstrate an understanding of the principal features of the earth's hydrosphere;
- explain the physical processes that create climate.

Strand: Human-Environment Interaction

Specific Lesson Goals:

- evaluate the impact of human life on natural systems;
- demonstrate an understanding of the importance of stewardship and sustainability as guiding principles for human use of the physical environment.

Strand: Global Connections

Specific Lesson Goals:

- analyze local, regional and global issues related to physical geography.

Strand: Understanding and Managing Change

Specific Lesson Goals:

- analyse the causes of climate change;
- explain how human uses of the earth, including uses involving technology, cause change in natural systems.

Strand: Methods of Geographic Inquiry

Specific Lesson Goals:

- use geographic skills, and methods, such as conducting a field study to gather, analyze and synthesize ideas and information;
- use a variety of methods and technologies to communicate the results of geographic inquiry and analysis effectively.

Preparation

Preparation time: Approximately 30 minutes to prepare 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: Thermometer, paper, student worksheets

Procedure

1. Brainstorm with the class a list of sites on the school ground (and beyond if permission is granted) that have a variety of characteristics. They may differ in exposure to UV radiation and shade, surface cover, topography, proximity to a building, human activities (e.g. parking lot versus playing field), etc.
2. As a class, choose 8 different sites around the school ground to investigate the air temperature. Hypothesize as to which sites will have higher and lower temperatures and explain why.
3. Divide the class into 8 groups. Assign a study site to each group.
4. Discuss the objectives and procedures for the investigation.
5. Outdoors, each group will record a detailed description of the physical characteristics of their study site on the worksheet.
6. Each group will measure the temperature 5 to 10 times throughout their study site and calculate the average temperature. Results are recorded on the worksheet.
7. Back in the classroom, share the site data collected by each group. Provide time for the students to respond to the discussion questions.

Discussion and Questions

Invite student groups to discuss their findings as a class. These questions may be discussed as a group and/or presented in student reports or presentations.

1. Explain, in detail, how the heat island effect impacts local microclimates.
2. Examine your observations and identify characteristics that seem to contribute to the heat island effect. List and describe them below.
3. Examine your observations and identify characteristics that seem to decrease the impact of the heat island effect. List and describe them below.
4. What are some of the possible health implications of the urban heat island effect? Based on your observation of micro-climates on the school grounds, how might students be affected?
5. Explain how a school or homeowner could help to reduce the impact of the heat island effect on the microclimate around their property.
6. Prepare a list of steps your school should undertake to reduce the impact of the heat island effect.

Student Evaluation

- Completion of worksheet
- Discussion and/or reports
- Peer and self-evaluation

Enrichment and Extension Activities

- Research and develop a Shade Strategy for your school grounds, including landscape design drawings and maps. Document the benefits of shade, the approximate cost of implementing your strategy, and a proposed timeline. If possible, arrange to present your strategy to school administrators.
- Write a report about the impact of the heat island effect on their micro-ecosystem. Include a detailed sketch map with the sites clearly labeled.
- Research the literature available on the heat island effect and write a report that investigates the impact of the heat island on urban climatic conditions and the potential for larger scale or even global impacts.

Educator Notes

- Urban centres are often noticeably warmer than the surrounding region. Why? Many of the activities and land uses in urban centres combine to create a “heat island”. Various research has indicated that urban centres may be heated by as much as 10 degrees Celsius in the summer as a result of high concentrations of concrete, human activities such as industrial process and cars, and the absence of tree cover. It is also believed that centres as small as 1000 people may generate a heat island.
- Some of the reasons for the heat island are concrete, asphalt, and glass that have replaced natural vegetation. The vertical surfaces of buildings that are added to a normally flat natural rural landscape absorb great amounts of incoming radiation. Furthermore, urban surfaces have a lower *albedo* and a greater ability to conduct heat. This results in a high capability to store heat. In addition, various human activity in urban areas can add large amounts of heat energy to the local energy balance through transportation, industrial processes, and the heating of buildings. For example, in winter, 2.5 times more heat is generated from the burning of fossil fuels in New York City than the heat absorbed from the sun. Conversely, in rural areas, evaporation and transpiration act to cool the land just as perspiration does for humans.
- 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 the heat island effect, visit: http://fcpp.org/publication_detail.php?PubID=709 or visit: <http://ersserver.uwaterloo.ca/jjkay/me772old/>
- For information about climatology and the atmosphere, visit: <http://www.physicalgeography.net/fundamentals/7w.html>
- For information on air pollution discussions in the City of Toronto, visit
 - http://www.city.toronto.on.ca/cleanairpartnership/pdf/finalpaper_solecki.pdf
 - http://www.city.toronto.on.ca/cleanairpartnership/pdf/finalpaper_stone.pdf
- For a series of FREE posters on climate change across Canada (posters provided by Natural Resources Canada), visit: http://adaptation.nrcan.gc.ca/posters/post-affich_en.asp?Poster=all

Worksheets

Student Worksheet

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