

Objective: Students will identify areas of a developed property with potential thermal energy increase from UHI effect based on land cover surface types

Curriculum Standards:

- NGSS ESS3.C Human Impacts on Earths Systems
- MD E-Lit Standard 5 Topic A: Human Impact on Natural Processes
Indicator 1: Analyze the effects of human activities on earth's natural processes.
- MD E-Lit Standard 6 Topic B: Human-Induced Changes and Human Health
- MD E-Lit Standard 7 Topic A: Environmental Quality

Materials Needed:

- Computer with access to internet
- Google Maps access
- Worksheet
- Calculator
- Teacher: general knowledge of schoolyard property boundaries is useful.

Teacher Directions:

Review with students the concept of land cover and the types of land use can change the temperatures of the surrounding area (air, surface and water temperatures). In Part I of this lesson, students use an online tool, "Google My Maps", to view aerial photographs of their schoolyard and inventory the types of land cover and land use. Other online tools may be used, however be sure to preview these tools for up to date aerial photographs that accurately represent the schoolyard.

Students will use the My Maps "measure" tool to estimate the area for each land type, compile similar land types, and calculate the percent each area covers for the entire schoolyard.

If schoolyard boundaries are unclear, assist the students in understanding what land is owned by the school. Define in advance if students are only to use their own school or auxiliary school buildings. For example, will they use an entire school campus shared by an elementary school nearby?

In Part 2, students walk around their schoolyard to observe school features on their inventory worksheet, and to verify the accuracy of the online information. In some cases aerial photography is out of date, compared to actual development at the school. Student should mark differences on their worksheet, add additional features to their inventory that they feel may impact urban heat. Recalculations may be required. Photographs of these areas are a useful

Terms to Know

>Impervious Surface (IS): surfaces that allow little or no stormwater infiltration into the ground

>Permeability: the ability of water and air to move through a surface (permeate it).

>Land cover: the material on the earth surface, such as the vegetation (natural or planted) or man-made constructions (buildings, etc.). Water, ice, bare rock & sand are also a type of land cover.

>Land use: how people use the landscape – whether for development, conservation, or mixed

NOTE! Google "My Maps" is different than "Google Maps"

- Either search "My Maps" OR
- Go to Google Maps, Select Menu, Select "My Places", "Maps" tab (on right)

<http://ccwsscience.org>

tool for documenting the inventory, which may be used in future presentations. One student per group could be in charge of photographing each item on the inventory.

At the conclusion of the site visit, students are to ensure their worksheet is complete, updating the inventory of impervious surfaces and land cover uses on the school's property.

Scoring the schoolyard based on %IS

Students will score their schoolyard based on the TOTAL % impervious surface calculated during the inventory activities.

Synthesizing the information gathered during the inventory

Students can work in small groups to discuss and compile the areas they observed as the largest contributors of urban heat on their school yard. Based on their background research in Lesson 2, students should be able to list some of the root causes of the issue (i.e., practices and policies) and also to identify what are the effects of the issues they found. Use Figure 1 as an illustration to visualize causes and effects of an issue.

Policies are laws or rules in place that are meant to tell people what to do.
Practices are what people actually do. Includes business practices and community practices.

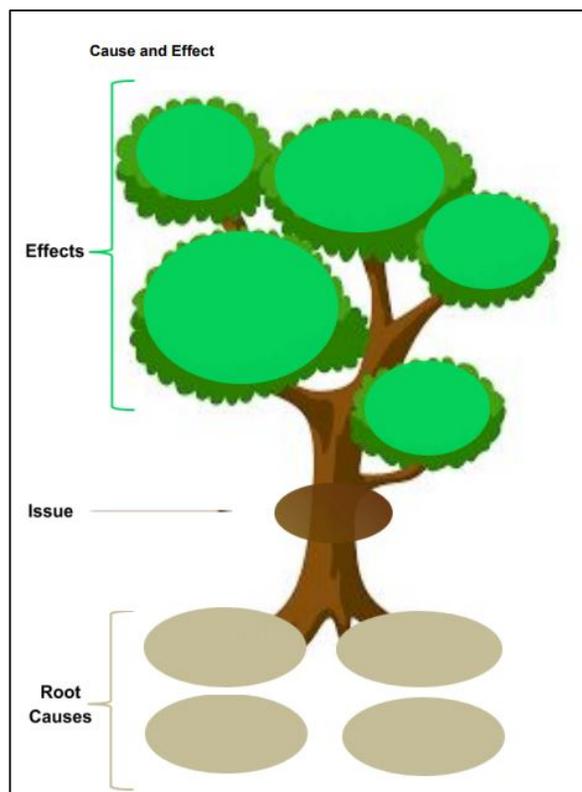


Figure 1: Cause & Effect Image. The tree trunk represents the issue. The roots "feed" the issue. The leaves are a result of the issue.

Recall the level of communities, defined in the introduction to help student identify people who could influence change to a problem.

Example:

What are some root causes of the school's % impervious surface	What are the environmental effects from this problem?	Who has the ability to influence change on this problem?
<i>Ex: policies, practices, phenomena</i> Lots of cars needing to park	Increased surface and air temperatures no trees - loss of habitat	>School administration - school community >Board of Ed policy - school community

If desired, **start the conversation above on how some of the root causes could be altered by changing practices, habits and/or policies.** In the example above, if there were more buses used or public transportation to the school, the number of cars could decrease.

4. Follow the stream as best you can. Where does the water discharge to?

5. Zoom in to view your schoolyard more closely. Identify the various types of land cover/surface types and complete the table on the back of this page as best you can. Use My Maps 'Measure' tool to calculate the area of each type of land cover. In some cases, you may need to measure similar areas separately and add the land cover areas together. Example: several parking lots could be measured separately.

-Land Cover/Surface Type examples: asphalt, concrete, grass, artificial turf, roof shingles, crop, wetlands

-Permeability: Pervious (P), Semi-pervious (S), Impervious (I)

Permeability is the ability of water and air to move through a surface (permeate it).

- A PERVIOUS surface allows water to move freely through it (infiltrate or soak through)
- An IMPERVIOUS surface does not allow any water to move through it.
- A SEMI-PERVIOUS surface is one that allows water to pass but at a reduced rate.

-Sky Conditions/Cloud Cover: At least one student should complete the GLOBE worksheet for Sky Conditions (Atmosphere Investigation/Surface Temperature Data Sheet)

6. Calculate the schoolyard's total % Impervious Surface: Add up the individual areas of impervious surface in your table and divide by the total area of the property, identified in Step 1.

$$\% \text{ IMPERVIOUS SURFACE} = \frac{\text{Area of all impervious surfaces}}{\text{Total property area}}$$



Part I: Complete the following table using online tools (e.g., Google Maps) and (Part II) conduct a tour of the school.

Date: _____

Weather: **Sunny | Overcast | Partly Cloudy | Rain | Snow**
(Circle all that apply)

Air Temperature _____ °C

Part 1: Complete using Online Tools (Google My Maps)

Part 2: Outside Visit

	Land Cover / Surface Type	Land Use / Location	Estimate Size/ Area (acres or m ²)	Permeability (P, I, S)	Color	Is the area shaded? (Y/N)	Comments	Photo (Y/N)
<i>Ex</i>	<i>metal roof</i>	<i>Main school building</i>	<i>2 acres</i>	<i>I</i>	<i>Blue</i>	<i>N</i>		
1								
2								
3								
4								
5								
6								
7								
8								
9								
10								

Using the previous table, combine the areas of similar land cover and calculate the % of the total school area

A.	B.	C.
Schoolyard Land Cover Type	Add up the Total Area of this Land Cover Type	% of total size of schoolyard (B ÷ area in Question 1 on this worksheet X 100%)
Black asphalt		
Concrete		
Artificial Turf		
Roof: Metal		
Roof: Shingle		
Tennis Courts:		
Grass		
<i>Other:</i>		
TOTAL for all IMPERVIOUS SURFACES ONLY →		

What land cover occupies the most area of the schoolyard?

...the least area?

Part 2: Conduct a schoolyard tour (site visit) (Part 2)

- Verify your information and complete the second part of the table.
- Add additional areas of concern to your list
- Take photographs of areas that are of concern to your group.

#1 Percent Impervious Surface of Schoolyard Property

Score your schoolyard's potential urban heat impact below:

Enter the % Impervious Surface for your school property

→

%IS=

%IS	SCORE
<0.3%	5
<4%	4
>4%	3
<10%	2
>10%	1
>25%	0

SCORE

*Policies are laws or rules in place that are meant to tell people what to do.
 Practices are what people actually do.

Synthesize the information:

What are some root causes of the school's % impervious surface	What are the environmental effects from this problem?	Who has the ability to influence change on this problem?
<i>Ex: policies, practices, phenomena</i>		