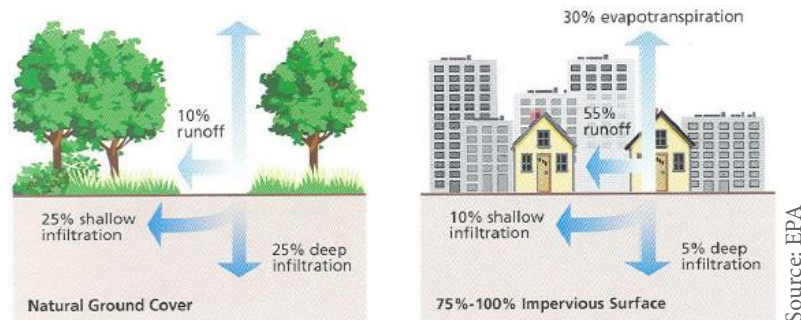


Systems Thinking: Impervious Surfaces Analysis Activity

Overview: Paved surfaces are everywhere. In the United States alone, pavements and other impervious surfaces cover more than 43,000 square miles—an area nearly the size of Ohio—according to research published in the 15 June 2004 issue of *Eos*, the newsletter of the American Geophysical Union. Bruce Ferguson, director of the University of Georgia School of Environmental Design and author of the 2005 book *Porous Pavements*, says that a quarter of a million U.S. acres are either paved or repaved every year. Impervious surfaces can be concrete or asphalt, they can be roofs or parking lots, but they all have at least one thing in common—water runs off of them, not through them. And with that runoff comes a host of problems. In this activity students will use Google Earth to calculate how much total surface area is impervious to water infiltration (part of the water cycle) at your school site.



Benchmarks:

- 5.1.3.4.2 *Create and analyze different kinds of maps of the student's community and of Minnesota. For example: Weather maps, city maps, aerial photos, regional maps, or online map resources.*
- 5.3.4.1.3 *Compare the impact of individual decisions on natural systems. For example: Choosing paper or plastic bags impacts landfills as well as ocean life cycles.*
- 5.4.4.1.1 *Give examples of beneficial and harmful human interaction with natural systems. For example: Recreation, pollution, wildlife management.*

Learning Objectives:

1. Students will be able to explain how impervious surfaces affect the water cycle.
2. Students will be able to use a mathematical equation to calculate the Area of impervious surfaces on their school yard site. (Length x Width = Area)
3. Students will be able to explain possible solutions to increase infiltration in the water cycle.

Materials needed:

- Teachers will need desktop computers with access to Google Earth. If they do not have it on the computers needed for the lesson, go to the District main page and click the big red Help Button and request that the software be installed. Please check ahead of time and give them at least a week to install.

Terms:

- **Area**- The number of square units needed to cover a surface like a wall, floor or other two-dimensional shape.
- **Impervious**- Materials that water cannot penetrate.
- **Infiltration**- Water soaking into the soil at the ground level.
- **Water Cycle**- Condensation, Precipitation, Infiltration and Evapotranspiration

How to Start:

Discuss these terms and concepts with your class: impervious, infiltration, area, and water cycle. Have students open up Google Earth on their computer. You may need to have students work in pairs or groups based on the number of computers available. Have them zoom in to find Minnesota, Rochester, and their school site. They will be using the measuring tool bar to find the area of the school campus by measuring the length and width



in feet. Then have them measure the impervious (hard) surfaces and add them up. Some shapes will be harder to measure so there will be some error. Have students brainstorm possible impervious surfaces before going on computers.

1. Find your school site

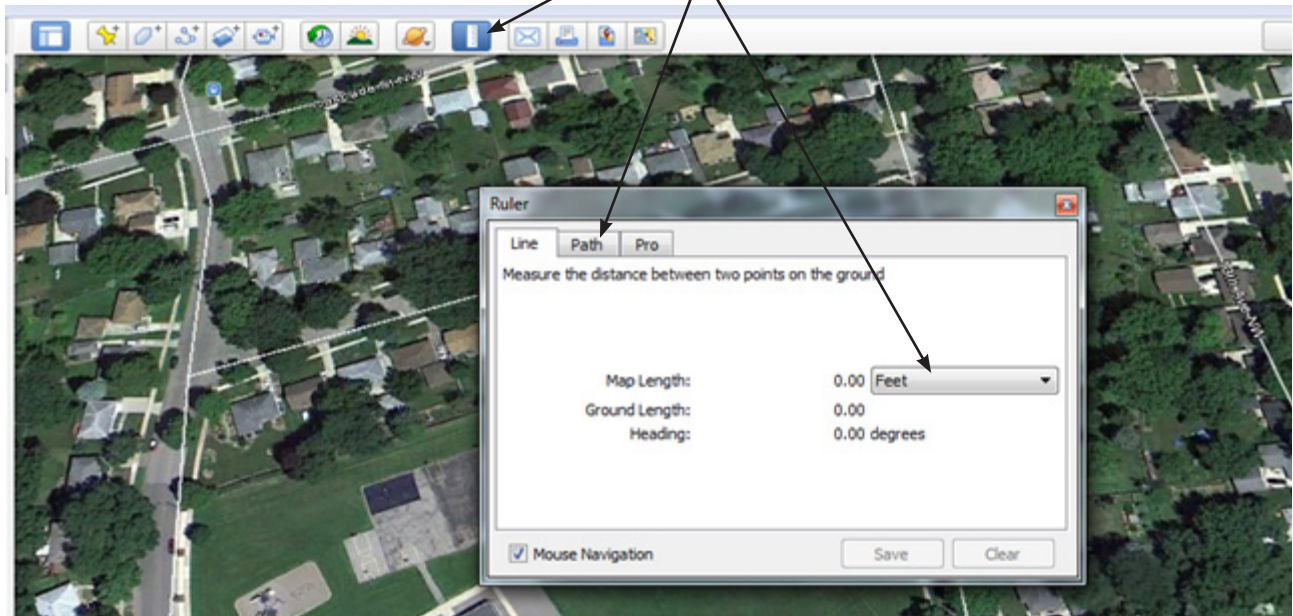
- Zoom in until the entire school ground are visible.

2. Prepare tools

- Click the measuring tool.
- Choose path tab.
- Select units.

3. Measure hard surfaces

- Using the mouse, click along the perimeter of hard surfaces including school buildings and parking lots.



Students will use Google Images to calculate total impervious surfaces vs. natural surfaces and complete the following questions.

1. What is the total square footage for the school site?
2. What is the total square footage of the impervious surfaces?
3. What percent of the school site is impervious?
4. What is the impact of your school site's impervious surfaces and the effect on infiltration (Water Cycle)?
5. Where does the water from the school roof go when it rains at your school site?
6. Where does the water from the other impervious surfaces go when it rains/snow melts at your site?
7. What are some ways we can we slow it down and increase infiltration into the ground? Use online search tools for potential storm water solutions. *Example searches: slow water down, increasing infiltration rate, storm water management.*

Wrap Up:

Teachers will need to calculate the answers to questions 1-3. Correct the worksheet with the class. One answer we are looking for on #7 is the use of a raingarden. The following presentation gives examples of storm water management techniques <http://www.johnadamsmns.new.rschoolday.com/sites/johnadamsmns.new.rschoolday.com/files/RAB%20Continuing%20ED%20Presentation%202.28.2013.pdf>

Enrichment:

- Analyze a small section of the city of Rochester and suggest storm water management practices that would decrease impervious surfaces in the city or a suburb.
- Take a tour of Cascade Meadow Wetlands and Environmental Science Center and see what solutions they use to increase infiltration by decreasing impervious surfaces.

