

### Overview

The city of Saint Paul constructed a Green Roof Interpretive Center and Garden Classroom on top of the new Saint Paul Fire Department Headquarters Building. The first of its kind in the state, this public educational center will be located on a multi-purpose plaza on the second floor of the building where visitors will find an array of permanent and perennial interpretive and educational activities. These lessons have been developed to help middle school students understand the environmental benefits of green roofs.

### Outcomes

After completing the Green Roofs, Green Cities activities students will:

- Define green roof
- Explain four key environmental benefits of green roofs
- Describe the role plants play in improving air and water quality

### Teacher Preparation

Prepare for teaching the Green Roofs, Green Cities lessons by:

- Reviewing this lesson outline and Student Workbook
- Review Green Roof info
- Familiarize yourself with green roofs and their environmental benefits. *See Links.*
- Copy a Student Workbook for each student, or student group completing the workbook

### Opening

Introduce the ideas of 1) protecting the environment, and 2) reducing pollution.

- Why is it important to take care of the environment, and reduce pollution?
- What steps are we taking at school to protect the environment or reduce pollution? What are you doing at home?

### Introduce the topic of green roofs.

- Explain that one way to protect the environment and reduce pollution is on the roofs of buildings!
- Ask if anyone has heard about green roofs. What do you know about them? Do you know about any green roofs in Saint Paul?
- Show some example photos of buildings with green roofs in Saint Paul or Minneapolis. Show photographs of green roofs in other cities, countries. *See [mngreenroofs.org](http://mngreenroofs.org).*

### Explain green roofs and briefly explain their environmental benefits.

- A green roof replaces a traditional roof with a light-weight, living system of soil, compost, and plants. It creates a green space on a roof that would normally be just a dark, hot space where nothing lives.
- Green roof plants and the soil and gravel that hold them filter rainwater. The plants produce oxygen that helps clean the air.
- A green roof helps to reduce a building's heating and cooling costs because it insulates the roof. They help

lessen what called the Urban Heat Island Effect, which occurs when buildings warm up so much that they heat up the air around them.

Explain students will have the opportunity to learn more about green roofs and their environmental benefits as they complete the Green Roofs, Green Cities lessons. Share with students any future plans to visit the St. Paul Fire Department green roof.

Introduce the Green Roofs, Green Cities workbook.

### Post-lesson Student Evaluation

Through class discussion, determine students' understanding of and attitude toward green roofs and their environmental benefits.

- How would you explain to someone what a green roof is?
- In your opinion, what is the most important environmental benefit of green roofs? Why?
- What's your opinion—would people and the environment benefit if green roofs were built on new and existing buildings in our city?
- Do you think it's a good idea for cities to provide tax incentives or grants for people to build green roofs? Why or why not?

### Lesson Themes

#### COOL CITIES

Green roofs conserve energy by reducing the temperature on the roof and the surrounding area.

#### CLEAN AIR

Green roofs slow the growth of carbon dioxide (CO<sub>2</sub>) in the atmosphere.

#### CLEAN WATER

Green roofs reduce the runoff of rain or melting snow into storm sewers.

#### CREATE GREEN SPACE

Green roofs create green space for people to enjoy, and to support insects, birds, and other wildlife.

### Green Roof Facts and Answers

- What two factors cause Urban Heat Islands to form in a city?
  1. cities are made up of concentrated impervious areas
  2. paved areas absorb and trap heat
- Plants help reduce the temperature
  1. The plants on a green roof help reduce the temperature in a city
  2. They act as a shade barrier
  3. They lower air temperature through evapotranspiration
- Evapotranspiration is the combination of what two natural processes?
 

transpiration + evaporation

- Why are too many nutrients bad for water quality?

While a little algae is good, too much algae is bad in lakes and rivers. Algae feeds on nutrients, overgrows, then uses up oxygen in the water as it decomposes. Have you seen a green, smelly lake in summer? That's from too much algae.

- Do you know steps you can take to protect water quality?
  1. Keep leaves and grass clippings out of the street
  2. Pick up litter
  3. Pick up after your pet
- If you were a bee, bird or butterfly, what might you find of the roof for yourself in summer? Winter?
  1. Flowers in bloom in summer for pollen
  2. Berries to eat in winter

- **Search:** Can you find *Sedum* or other succulents on the roof? How can you tell they contain a lot of water?



1. Succulent plants store water in their fleshy leaves

- There are two types of green roofs:

**Extensive green roofs** are lightweight and fairly inexpensive to construct and maintain. An extensive green roof usually has a thin layer of lightweight engineered soil.

**Intensive green roofs** are more like a garden. They can hold deeper soil, so a wider variety of plants may be used.

Green roofs also protect the roof from sunlight and temperature changes so the roof lasts 2-3 times longer. This leads to less old roof material being thrown away in landfills.

- The temperature on conventional city rooftops can easily reach 150 to 175 degrees or higher in the summer. On a hot day, how much lower could the temperature on a green be in comparison to a conventional roof?

50° F to 90° F

- What is the primary green house gas?

Carbon dioxide (CO<sub>2</sub>)

- What is a watershed?

A **watershed** is the area of land where water from rain or snowmelt runs off and drains to a waterbody, such as a river, lake or pond. Watershed boundaries are defined by hills, mountains or other higher ground. Because all water eventually flows to particular waterbody, all land is located in a distinct watershed. A good analogy of a watershed is a bathtub. The "sides of the bathtub" define the boundary of the watershed while the "bottom of the tub" is the land area" that slopes slightly towards the "drain" or waterbody.

- Experience with green roofs in Germany shows that they can have a lifespan of 40 to 50 years. What is the typical lifespan of a conventional roof?

15-20 years

## Vocabulary

**greenhouse gases**—Gases in the Earth's atmosphere that prevent heat energy the Earth has absorbed from the sun from escaping back into space.

**impervious surface**—An artificial surface that doesn't allow water to flow through it.

**particulate matter**—Small particles of dust and soot that float in the air; they are an indication of air pollution.

**photosynthesis**—The way a plant makes food for itself. The plant absorbs carbon dioxide and releases oxygen.

**stormwater runoff**—Water that flows over the ground surface into the storm drain system.

**Urban Heat Island Effect**—Increased summertime temperatures in cities that occur when natural land is replaced with buildings, pavement, and roads that trap heat.

**watershed**—The land that catches rainwater and then drains it into streams, rivers, lakes, or groundwater.

## Resource links

**Minnesota Green Roofs Council** – *education information, and locations of local green roofs*  
<http://www.mngreenroofs.org/>

**Green Roofs for Healthy Cities** – *nonprofit green roof promotion collaborative*  
<http://www.greenroofs.org/>

**US Environmental Protection Agency** – *green roof purpose and benefits*  
<http://www.epa.gov/heatisland/mitigation/greenroofs.htm>

**Green Roof Industry Portal** – *green roof promotion and education from industry professionals*  
<http://www.greenroofs.com/>

