

Lesson 4 CREATE GREEN SPACE

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

Green roofs are a place for people to enjoy natural green space.

Growing plants on a roof is challenging since green roofs are different from gardens on the ground below. Plants behave differently in higher temperatures and more shallow soil. But even in the middle of Saint Paul, certain plants attract wildlife like hummingbirds, bees and butterflies. Plants with berries also provide winter food for birds and animals.



Green roof at Brit's Pub in Minneapolis

Green roofs provide habitat for wildlife

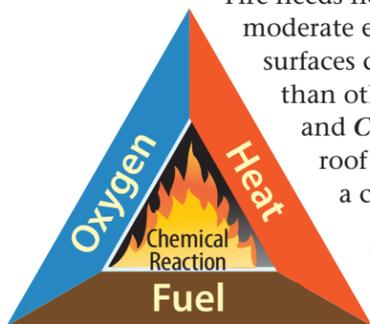
Habitat is the environment in which an animal or plant lives or grows. Growing a garden on a roof offers some unique challenges, but the payoff is that we can create habitats that provide food and a place for wildlife to live in or migrate through.

If you were a bird, what might you find of the roof for yourself in summer? Winter?

Certain plants slow the movement of fire

Fire needs heat, fuel and oxygen to start and grow. Green roofs moderate extreme temperature changes, which make their surfaces cooler in the summer and warmer in the winter than other roofing materials. Succulent plants like *Sedum* and *Cacti* are full of water, so if 50% of the plants on a roof are Sedum, the roof has better fire resistance than a conventional roof.

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



Attracting wildlife

Suppose you were designing a green roof. Which plants would you select to attract wildlife? Choose the plant you think might attract each type of wildlife and note it below:

Birds: _____

Bees: _____

Butterflies: _____



GREENROOFS GREENCITIES

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 (CO₂) in the atmosphere.

CLEAN WATER

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

CREATE GREEN SPACE

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



What is a green roof?

Green roofs are made of special lightweight soils and plants built on top of a waterproof material. Green roofs are good for people and good for the environment. They can provide green space for people to enjoy, and help cool cities in the summer. They reduce the amount of polluted stormwater flowing off hard surfaces like regular roofs, streets and parking lots. They also create a place for insects, birds, and butterflies in the city.

How is a green roof constructed?

A green roof is made up of plants, special lightweight soil, and a drainage layer over a waterproof mat. Additional layers such as a root barrier to keep plant roots from poking through the waterproof mat, and a drainage layer to keep too much water from flooding plant roots may also be included.

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Lesson 1 COOL CITIES

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

On a hot day, the temperature in a city's center is up to ten degrees Fahrenheit warmer than in surrounding areas. That's because cities have a lot of dark-colored, paved surfaces. Dark surfaces absorb the sun's heat, and paved surfaces like asphalt and concrete trap the heat.

What is the Urban Heat Island Effect?

Scientists call this temperature increase the Urban Heat Island Effect because concentrated "islands" of heat form when cities replace natural land cover with pavement, buildings and roads.

What two factors cause Urban Heat Islands to form in a city?

- _____
- _____

Plants help reduce the temperature.

- The plants on a green roof help reduce the temperature in a city.
- They act as a shade barrier.
- They lower air temperature through evapotranspiration.

Precipitation (rain or snow) waters plants. Plants release or "transpire" water through pores in their leaves called stomata. In a way, plants sweat like people.

The water on a plant's leaves draws heat as it evaporates. This cools the surrounding air in the process.

Saving energy

During hot summer months, green roofs help reduce a building's cooling costs because they shade the roof surface and prevent the roof from heating up.

When air temperatures are cooler, the need for air conditioning decreases and energy consumption is reduced.

Evapotranspiration is the combination of what two natural processes?

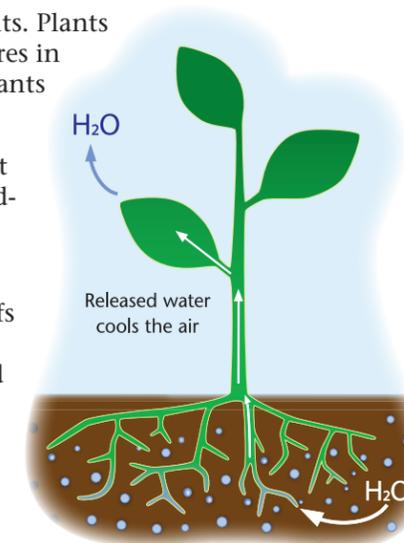
_____ + _____

What's your opinion?

People and the environment would benefit if green roofs were put on some new and existing buildings where you live. Do you agree or disagree? Explain your choice:

Think about it

What areas in your city contribute to the urban heat island effect? Are there some places that help reduce the effect?



Lesson 2

CLEAN AIR

Green roofs slow the growth of carbon dioxide (CO₂) in the atmosphere.

Particles in the air

You may have noticed specks of dust floating around in the air. This is called particulate matter—dust and soot so small that it floats in the air. It is an indication of air pollution.

Air pollution is a serious environmental problem in most big cities. Polluted air is bad for our health, and it hurts plants and animals too. It damages buildings and it can even change the weather.

Particulate matter gets into the air when things are burned.

Greenhouse gases

An environmental problem that happens when we burn certain materials like coal, oil and natural gases is that we create greenhouse gases. Why do scientists call these gases “greenhouse gases”?

Plants filter particulate matter

The leaves on plants act like filters capturing particulate matter like dust, soot and pollen and removing them from the air. This is good for the air we breathe, and it's good for the environment because particulate matter in polluted air captures and holds the sun's heat. Clean air holds less heat.

Plants slow the growth of CO₂

In the process of photosynthesis, plants remove carbon dioxide (CO₂) from the air and release oxygen. This slows the increase of CO₂ levels in Earth's atmosphere.

Photosynthesis is the way a plant makes food for itself. Chlorophyll in the “green” part of the leaves captures energy from the sun and this powers the building of food from very simple ingredients—CO₂ and water.

The process of photosynthesis consumes CO₂ and releases oxygen (O₂).



NASA photo of air pollution

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.

Lesson 3

CLEAN WATER

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

Did you ever wonder where all the water goes after a heavy rainstorm? As Saint Paul grows and natural areas are converted to buildings and roads, there are fewer places for rainwater to soak into the ground. Rainwater washes pollution like dirt, leaves and trash from streets and parking lots into storm drains that flow to our lakes and the Mississippi River. The green roof absorbs the rainwater which prevents water pollution.

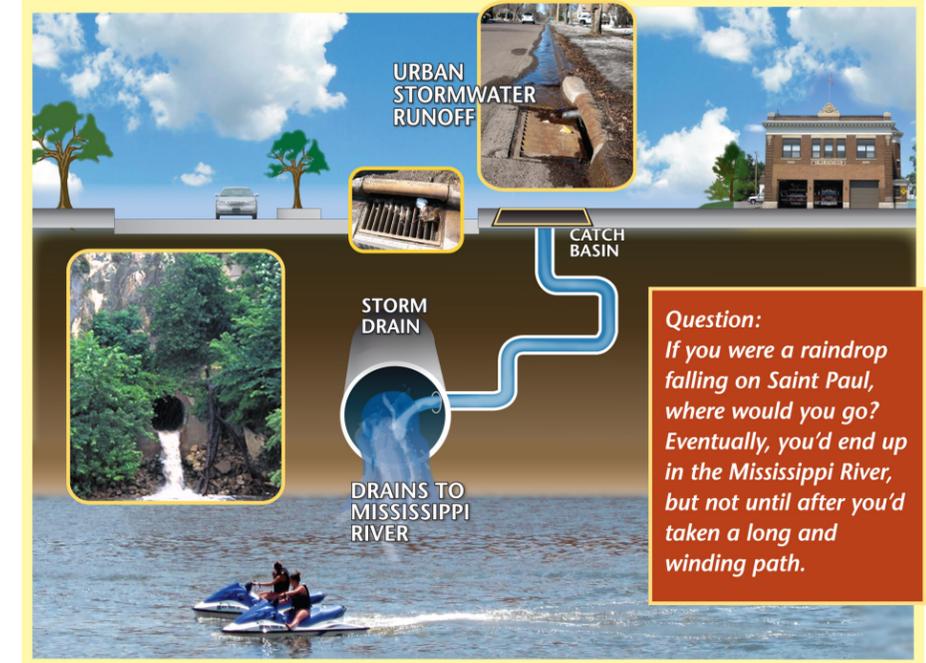
Green roofs prevent water pollution

Water quality refers to how clean water is, and how usable it is to plants, animals and people. In natural areas, water is cleaned when it soaks into the ground which refills lakes, rivers and groundwater. On the ground, plants improve water quality because their roots create channels in the soil that allow rainwater to soak in.

Green roof plants do not have deep roots like in a regular garden, but they still decrease water pollution by preventing water from running off the roof. This roof also creates a natural green space in the middle of Saint Paul.

Green roof design helps absorb water

This green roof intercepts rainwater that would otherwise fall on hard surfaces and flow directly to the Mississippi River. It replaces green space that was lost when buildings, streets and parking lots were built.



Plants and soil filter rainwater

Rain may contain things that are not good for the environment including excess elements like nitrogen (N) and phosphorus (P) from leaves, grass clippings or fertilizer that rainwater picks up in the street. A green roof's plants and soil filter these elements from the water and prevent them from getting into lakes and rivers.

Why is too much nitrogen and phosphorus bad for water quality?

Do you know steps you can take to protect water quality?



Students stencil the message 'Don't Pollute' beside Saint Paul storm drains