

Rooftop Gardens

Why is there a garden on the roof of Chicago's City Hall?

Theme

This lesson explores how a rooftop garden helps to lower the temperature of a building, and therefore keep the people inside cooler. Using Chicago City Hall as a case study, students will experiment with colors and plants and design their own rooftop garden.

Student Objectives

- be able to explain the connection between color and temperature
- state two things that trees, plants, and flowers can provide for buildings
- explain how a rooftop garden works
- create a drawing (or model) of a rooftop garden for their school, neighborhood building, or home

Activities

- conduct basic experiments with cloth and paper that illustrate how dark colors feel warmer than light colors when placed in the sun
- conduct basic experiments that illustrate how standing under a tree can make you feel cooler because the temperature is lower
- take a walk around the block and observe / record / draw how much sunlight falls on buildings and how many trees surround and shade them
- design a rooftop garden for an existing school, neighborhood, or residential building

Type

- indoor, desktop activities
- outdoor, walk-around-the-block activities

Timeframe

four class sessions of 40 minutes each

Materials

- several sheets of black construction paper
- several sheets of white construction paper
- *alternatives for Day One:*
 - ice cubes on individual plates, or
 - pieces of cloth, about the size of a dishcloth, one white, one dark colored, made of the same material
- a nearby tree with leaves
- **Handouts A and B** - photographs of City Hall's rooftop garden
- drawing paper (*for each student*), or recycled materials for building a model of a rooftop garden
- pencils, crayons



Vocabulary

rooftop garden

City Hall

heat/cold, hotter/cooler

shade/sun

temperature

thermometer

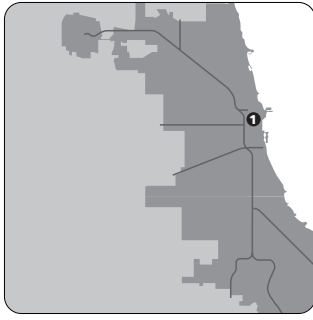
conservation using less of something

annual a plant that only lives one year

perennial a plant which lives and grows over several years

state tree of Illinois the white oak

state flower of Illinois the violet



Location Information

- **Chicago City Hall**
121 North LaSalle Street
Chicago, Illinois

Discussion Points

- How do Chicago's summer temperatures make you feel?
- What ways do you try to stay cool in the summertime?
- On a hot summer day, where is the best place to stand outside to stay cool?
- How do you try to keep your home cool in the summertime?
- Where is Chicago's City Hall? What happens inside this building?
- A quote from Mr. William Abolt, the former Commissioner of Chicago's Department of Environment in charge of the rooftop garden at City Hall: "The city is wearing dark clothes and it's making the city hotter. We want to dress the city in light colors."

Teacher Prep

- photocopy or scan **Handouts A and B** for display or projection
- scope out a route where there are examples of buildings that might be warmer or cooler due to sun and shade from trees; try to find a location where students can safely stand in the sun and then under a tree

Background Information for Teacher

Why is there a garden on the roof of Chicago's City Hall? The garden came about for one major reason—summer heat!

Before the rooftop garden was created on top of City Hall, the flat roof was covered in black tar paper. The dark color dramatically increased the amount of heat that the building absorbed, forcing City Hall's air conditioning system to work extra hard to keep workers in the building cool and comfortable.

So, in 1999, Chicago Mayor Richard M. Daley announced there would soon be a garden growing on the rooftop of City Hall at 121 North LaSalle Street, for the purpose of reducing heat build up. This new rooftop garden, designed by William McDonough + Partners of Charlottesville, Virginia, was the largest to be planted on a public building in a major city.

First the roof structure had to be reinforced to support the extra weight of the garden. Next, soil was added and 20,000 plants (prairie grasses, shrubs, vines, flowers, and two oak trees) were planted. The plants are watered only by rainfall. The summer of 2001 was the first full growing season for this rooftop garden. Birdhouses were later added and scientists have since identified several different species of birds and insects, including butterflies, dragonflies, and grasshoppers, who now call the roof their home.

On one of the hottest days of the summer in 2001, the 21,000 square foot garden area registered temperatures at 86° F in the areas with vegetation, while the light-colored walkways around the plants measured 110° F. On the other hand, the black tar surface on the roof of the Cook County side of the same building measured 168° F.

Although the rooftop garden at City Hall isn't open to the public, many office windows overlook it. Rather than looking at a roof covered by ugly tar paper, the thousands of people who work in surrounding buildings can now enjoy looking at a colorful and cooling garden.

Students who understand that the coolest place to stand outside on a hot summer day is beneath a leafy tree can easily understand the basic idea behind a rooftop garden. The temperature underneath a large leafy tree can be cooler by 3 or 4 degrees.

Activity Procedures

DAY ONE

1 Begin the lesson by talking about heat and cold. Which do your students like better? Would they rather be too hot or too cold? Is it easier to get warmer in the winter or cooler in the summer? What about buildings? Can buildings be kept cooler in the same way that people can be kept cooler?

Conduct one or two of the following experiments with your students:

2 Inside your classroom, place a piece of black construction paper and a piece of white construction paper in direct sunlight. Ask students which piece of paper they think will become warmer? Feel the paper after a few minutes. Were their hypotheses correct? (With 2nd grade students, the concepts of absorption and reflection may be too complicated. It may be enough to simply have them know that dark colors “keep” sunlight and lighter colors let sunlight “bounce off.”)

3 On a sunny day, go outside so students can feel the difference wearing a dark or light color can make. Wrap a piece of dark cloth around one arm, and a piece of light cloth around the other arm of a student. Have the student place both arms in direct sunlight. After a few minutes, ask the student if both arms feel like they are the same temperature, or does one arm feel warmer than the other? Which one feels warmer? (They should answer: the arm in the dark cloth.)

4 Have the entire class stand outside in direct sunlight for a few minutes. Then, move under the shade of a tree. How does it feel different? Look for places where the shadow of the tree falls on a building. Discuss how this might help the building stay cooler.

5 Place two ice cubes of the same size on two identical plates in direct sunlight. Put a black piece of paper under one ice cube and a white piece of paper under the other. Which ice cube do students think will melt first? Why? Time how long it takes for the ice cubes to melt. Discuss why the ice cube on the plate with dark paper melted first.

DAY TWO

6 Take a walk around the block near your school. As you walk, have students look for buildings they think will be hotter in the summer because they have no trees to shade them. Which buildings might stay cooler because of trees growing nearby? Bring along a clipboard and paper so that students can record the addresses and building names or draw sketches of these buildings. Or, bring along a camera to document what you find. Once back in the classroom, compile your information into a large chart or another type of graphic organizer to keep track of how many buildings had lots of trees around them and how many didn't.



Resources

The Gardener, Sarah Stewart, David Small, illust. New York: Farrar Straus Giroux, 1997.

Rosemarie's Roof Garden, Carmen Alexander. Port Orchard, WA: Little Blue Works, 2000.

The Tree That Grew Through the Roof, Thomas Berger, Marjan van Zeyl, illust. Edinburgh, Scotland: Floris Books, 2001.



Academic Standards

Illinois State Goals

11 Have a working knowledge of the processes of scientific inquiry and technological design to investigate questions, conduct experiments and solve problems.

12 Have a working knowledge of the fundamental concepts and principles of the life, physical, and earth/space sciences and their connections.

13 Have a working knowledge of the relationships among science, technology, and society in historical and contemporary concepts.

Chicago Academic Standards

11A Understand that science involves asking and answering questions and comparing experimental results to what is already known.

11B Design and conduct simple scientific investigations in which observations are made, data are gathered and organized, and reasonable conclusions are drawn.

11C Understand and apply the concepts, principles, and processes of technological design.

12C Describe and compare the properties and interactions of matter and energy.

13A Identify and describe major technological changes and their effects on people, tools, and nature.

13B Demonstrate an understanding of conservation and the need to protect renewable and non-renewable natural resources.

7 Once back in your classroom, ask your students to imagine planting some of the same kinds of trees they found near their school up on the school's roof. What do they think of this idea? Use the photographs on **Handouts A and B** and the Background Information about City Hall to explain the concept of a rooftop garden. Point out that it will only work with a flat roof. Discuss the advantages and possible disadvantages of having a garden on the roof. Did any of the buildings on your walk have no trees and a flat roof that might benefit from a rooftop garden?

DAY THREE

8 Have students use the knowledge they have gained through experiments and the neighborhood walk to re-design their school, their home, or one of the buildings they saw on the walk, so that the building could have a rooftop garden. Either draw the design with paper and pencils, or build a model using recycled materials such as milk cartons, egg cartons, cardboard boxes, and twigs.

DAY FOUR

9 Have students write letters or create a presentation for your school's principal or the mayor of your city proposing a rooftop garden. Or, have the class explain how their rooftop garden would work, the benefits of the idea, and the reasons why it should be created. They may choose to list specific plants (or colors of plants) they wish to grow there. Include drawings of their designs.

Extensions

- With your students, investigate the types of trees, flowers, and plants that grow best in your region and those that do not. Example: If a coconut tree would be planted on the rooftop garden, it would probably die during a Chicago winter. An oak or maple tree might be a better idea.
- If your class is studying temperature in science or math, try this experiment: Using two thermometers, place one thermometer directly in the sun and another in the shade. After a few minutes, compare the temperature readings of the thermometers. What do students notice?
- Introduce the concept of pollution and smog into your lesson. Discuss how trees and rooftop gardens can help to make our air cleaner and easier to breathe.
- If your school building has a flat roof (or a secure place on the ground), you may want to consider having your students plant their own garden. A child's plastic wading pool filled with dirt works well as a container for growing flowers or vegetables. Lettuce and radishes grow quickly.

Handout A



The rooftop garden at City Hall under construction, Chicago. (MARK FARINA, DEPARTMENT OF ENVIRONMENT, CITY OF CHICAGO, 2000)

Handout B



The finished rooftop garden at City Hall, Chicago. (MARK FARINA, DEPARTMENT OF ENVIRONMENT, CITY OF CHICAGO, 2002)