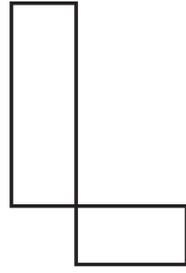


FAMILY TEACHING GUIDE

# Build Healthy Cities

Standards-based instructional  
resources for use at home

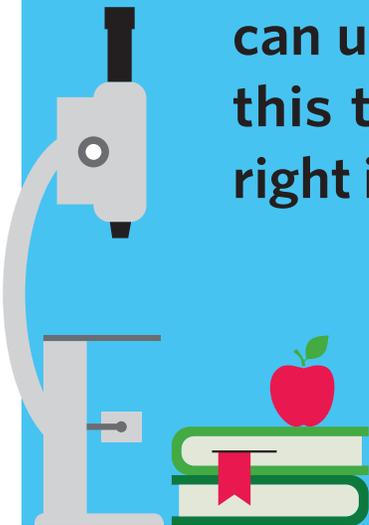


# **NATURE LAB**

Educator Resources



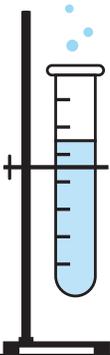
**Nature Lab is intended to share the places, science and conservation stories of The Nature Conservancy with the next generation, with a focus on helping students connect what they see on the screen to actions they can take in their own backyard. Our teaching guides offer educators standards-based instructional resources for classroom use but now you can use our resources at home too! Use this thematic guide to explore nature right inside your home.**





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DAY

**1**

## Introduction

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**By 2050,  
two-thirds of  
the world's  
population  
will live in  
urban areas.**

Cities are growing—fast. By 2050, two-thirds of the world's population will live in urban areas. An increasing urban population means that cities are expanding their footprint at an alarming rate. It also means fewer people have access to nature's benefits. Even in cities, we depend on natural habitat for food, clean water, clean air and our physical and mental health. With smart planning, science-based solutions and strong partnerships, we can make the green cities of tomorrow resilient, healthy and equitable.

There are amazing nature-based ways to keep our cities healthy and strong! This week, you will explore some of those ways, which include the energy-saving and cooling power of trees, green infrastructure that can be used to manage stormwater and the value of rich biodiversity in our home and school gardens! 



DAY

2

## Urban Trees

### ? ESSENTIAL QUESTION

# How do trees benefit humans and the environment?

We'll learn the value of trees and how nature works to provide clean water and air. Forests renew our air supply by absorbing carbon dioxide and producing oxygen. Trees also clean our air by filtering out dust and greenhouse gases. One tree can absorb ten pounds of air pollutants a year. Through shade and the evaporation of water from their leaves, trees can reduce energy use.

Research has shown that well thought out tree planting can lower summertime temperatures in cities and households by dramatically reducing air-conditioning bills and helping trap some of the greenhouse gases responsible for global warming. In addition to saving energy through cooling in the hotter months, trees provide a wind break during winter. This results in burning less fossil fuel to generate electricity for cooling and heating. Forests provide natural filtration and storage systems that process nearly two-thirds of the water supply in the United States. Their root systems hold soil in place, preventing erosion and absorbing water that may result in flooding. Trees provide food and shelter for both plants and animals. They reduce noise pollution by buffering sound waves and can even relieve psychological stresses with their beauty.

### → ACTIVITY



**WATCH:**  
[Urban Trees](#)

### “ DISCUSSION

**Q: Why do we plant trees in our yards and in our community? Are there places in the world where there are no trees? What are those places like?**

**A:** Ask students to consider how air benefits from trees. Four different benefits from air can be highlighted and clues can be provided to guide students in identifying each benefit. Students should identify:

- 1 Reduce wind
- 2 Tree leaves collect dust and capture pollutants
- 3 Tree roots, wood and leaves absorb carbon dioxide
- 4 Trees provide oxygen.

Ask students to consider how plants and animals benefit from trees. Three different benefits from plants and animals can be highlighted and clues can be provided to guide students in identifying each benefit. Students should identify:

- 1 Habitats
- 2 Food
- 3 Recreation

Explain that trees not only provide shade from the sun, they also transpire (release water vapor) through their leaves. This is an additional cooling benefit.

- **Run a quick experiment:** Use a bucket of water. Ask student to dip just one hand in the water to wet it, and then hold both hands briefly in front of the fan. Ask which hand felt cooler. Explain that the warmth of your skin and the air from the fan caused the water to

evaporate. That process cools your skin. Nature uses evaporative cooling every day. When we sweat, our perspiration evaporates, cooling us off. When a tree transpires, releasing moisture, that moisture evaporates, cooling the air.



Share your findings and reflections with us on social media and help us spread the word!

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**! TAKE ACTION**

Use the [Tree Benefit Calculator](#) to make a simple estimation of the benefits individual street-side trees provide. Patterns and trends with the type of tree planted, size, location and their energy savings can be investigated using this web tool. Consider: Do larger diameter trees provide greater energy savings? Why or why not? Is there a relationship between the size of the tree and the gallons of storm water runoff a tree can intercept?

Share your findings with us on social media and help us spread the word about the benefits of trees! Share with us [@TNCNatureLab](#) on [Twitter](#) and [Facebook](#) and [@nature\\_org](#) on [Instagram](#)!



DAY

3

## Urban Stormwater

### ESSENTIAL QUESTION

# How can we use green infrastructure solutions to better manage stormwater runoff in our cities?

After a downpour, rainwater courses rapidly over urban landscapes. The rain that falls over a town or city, sliding off roofs, down storm drains and over driveways and streets, is called urban runoff. When rain passes over these surfaces, it picks up pollutants, including sediment, motor oil, pesticides and fertilizers. The water that we use to wash our cars and water our gardens can also contribute to urban runoff. Because of the pollutants it contains, urban runoff can harm the larger bodies of water into which it drains. Conversely, rainwater that falls in a natural habitat runs over the soil surface and slowly percolates through the soil strata (layers), which mechanically and chemically remove contaminants from it before it goes into a water body.

Paved city streets, driveways and parking lots prevent rainwater from falling on the soil, which would filter pollutants with its network of plant roots and soil microbes. Even though lawns and gardens are pervious surfaces, when rain falls on lawns or gardens, the water often picks up chemicals that homeowners apply to keep their lawns green and their gardens weed-free. But pollutants aren't the only problem. The paved environment of the city guides the pace and volume of the runoff, resulting in erosion, flooding and overflowing storm sewers. These sewers drain enormous amounts of water directly to nearby lakes, streams and bays, without any treatment of contaminants in the runoff. Innovative cities such as Portland, Oregon and Seattle, Washington, are replacing portions of roofs and streets with plants and soil to restore the filtration of stormwater. After soil and plants are added along sidewalks and on roofs, rain follows a slower, cleaner path through the city and onward to rivers, lakes, and oceans.

Today, you will explore some examples of green infrastructure solutions that can be used in the urban environment to help manage stormwater runoff using natural solutions.

### ACTIVITY



#### WATCH:

[Sustainable Cities: Nature-Based Solutions in Urban Design](#)

### DISCUSSION

**Review the types of green infrastructure solutions for stormwater and discuss the benefits of each one.**

- **Rain Gardens:** Rain gardens collect and filter urban runoff in a shallow, depression before it reaches natural bodies of water. They can absorb up to 30% more runoff than a traditional lawn. They are typically landscaped with native plants that attract pollinators and provide habitat for urban wildlife.
- **Rain Barrels:** Rain barrels can serve multiple purposes. When rain lands on an impervious surface like your rooftop, the rain washes down into gutters, exits the downspouts, and pours out onto the ground. Then it either soaks in or makes its way to the nearest sewer drain and/or body of water. A rain barrel collects rain from a downspout and prevents this from happening. It also allows you to store water for the next time you need it—you can use this harvested water in your garden!
- **Stormwater Planter:** A stormwater planter is a small garden planter with water-tolerant vegetation. Stormwater planters can be located in a plaza and have storm drain spouts routed underground to them. They can also be located at the edges of roads, below the grade

of the curb and street, to store and filter stormwater during a storm. A cut in the curb allows stormwater to drain into the planter.

- **Bioswale:** Bioswales are designed to handle a large amount of urban runoff from a street or parking lot. A bioswale slows the speed of urban runoff and stores water until it can be filtered by the vegetation and soil in the bioswale. By serving as a temporary storage, a bioswale reduces the volume of runoff during a storm. A bioswale is usually trapezoidal with a flat bottom. Both the sides and the bottom of the trapezoid are planted with water and drought-tolerant plants. The plants must be as tall as the expected depth of stormwater flow. Bioswales are often 200 feet in length and 6 feet in width, but dimensions will vary depending on the site and soil conditions.
- **Green Roofs:** A green roof replaces a standard roof with vegetation and soil and/or gravel over a waterproof membrane. The roof's soil and vegetation capture rainfall, which either evaporates, transpires, or is slowly filtered and discharged to the stormwater system. Green roofs are designed to support the increased weight of the soil and vegetation. Because plants convert the sun's energy into humidity and soil moisture, green roofs keep houses cooler. Green roofs can help dampen the "urban heat island" effect, which is the increase in temperature in a city caused by the prevalence of dark surface areas that absorb the sun's energy. Green roofs also provide habitat for insects and birds.



Share your findings and reflections with us on social media and help us spread the word!

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**! TAKE ACTION**

On your next walk around your neighborhood, see if you can spot any of these green infrastructure solutions.

Take photos of any you see and share your findings with us on social media to help us spread the word about the benefits of green infrastructure solutions for stormwater.

Share with us [@TNCNatureLab](#) on [Twitter](#) and [Facebook](#) and [@nature\\_org](#) on [Instagram](#)!



DAY

# 4

## Gardens in the City

### ESSENTIAL QUESTION

# How does a garden model a natural living system?

Students will first investigate some of the ecological functions of a garden ecosystem and describe or model these functions to show how they operate and cooperate to form a living system; students then use a digital design tool to assess the ecological productivity of a natural area and design a virtual garden within the area to enhance its ecological productivity.

### ACTIVITY



WATCH:  
[Global Gardens](#)

### DISCUSSION

**Q: What makes a garden “a complete mini-ecosystem” (at 0:24-0:26)?**

**A:** Students should recognize that, like any ecosystem, a garden is a community of organisms—plants, animals, and microbes—interacting with their environment and each other.

**Q: Have students give examples of some interactions they saw in the video.**

**A:** Plants growing in the soil and producing food; butterflies, hummingbirds, and bees feeding on and pollinating flowers; earthworms burrowing in the soil.

**Q: Ask them to describe some interactions they could not see.**

**A:** Plants absorbing water, sunlight, and carbon dioxide for photosynthesis; bacteria breaking down organic matter in the soil; beetles and other insects feeding on plant leaves and vegetables; birds and other animals feeding on the insects and earthworms in the garden.

Guide students toward the understanding that a garden is not just a place to grow flowers and vegetables. It’s really a living system made up of many different organisms growing together, and all sustained by the soil, water, air, and sunlight of their environment.

**Q: The garden as a “mini-farm” and a “mini-watershed” (at 2:28-2:49). Discuss the following questions:**

**1 How does a garden function as a “mini-farm?”**

**A:** Students should recognize that gardens can produce food with the help of gardeners who care for the plants and pollinators who make it possible for the plants to reproduce.

**2 How does a garden function as a “mini-watershed?”**

**A:** Students should recognize that gardens filter rainwater that seeps through the garden soil and flows eventually to rivers and the ocean.

### TAKE ACTION

Write an autobiographical account of life in the garden from the point of view of a seed planted in the soil. This story would begin with the seed’s reaction to the organisms of the sub-soil habitat and the water filtration capacity of the soil, then follow the seed as it sprouts and becomes part of the garden’s surface habitat, where it will interact with pollinators, and



Share your stories and reflections with us on social media and help us spread the word!

continue to draw on the soil for water and nutrients to produce what those who planted the seed call food. Remind students as they plan their seed autobiographies that, in a garden as in nature, humans are also part of the living system and should figure into every episode of the story.

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DAY

# 5

## Biodiversity in the City

### ESSENTIAL QUESTION

## How does a garden model an ecosystem?

Many elements are interconnected and function together to create the natural and productive living system that is your garden. Look to the end of this activity guide for additional lesson plans, activity guides, and videos that can help you bring together soil, water, habitat, food, and community to explore your dynamic garden ecosystems. Students will learn how a garden functions as an ecosystem and will be able to describe that the greater the diversity of plant and animal life in the garden, the more effective the garden is as an ecological system, and the better able it is to help keep nature resilient and productive.

### ACTIVITY



**WATCH:**  
[Urban Habitat: Biodiversity in Our Cities](#)

### DISCUSSION

**Have students create a list of organisms they have noticed in the garden. Discuss the lists with students. Possible discussion points include:**

- Why do you think you've seen these organisms in the garden?
- Is there a scientific explanation for their presence?
- Which came first, the animals or the garden?

Explain that the garden is not only a home for plants but also a habitat for animals, a habitat that students have helped to create but which ecological processes, including the presence of biotic (living) and abiotic (non-living) factors, work to sustain.

What is the benefit of having lots of different kinds of organisms (biodiversity) in a habitat like the garden? Why is more biodiversity generally preferable in regard to the health of an ecosystem?

### TAKE ACTION

Use pages [16-19 in this educator's guide](#) to conduct a habitat survey in the garden to find out what species are part of this habitat and how they interact with one another and the garden environment.

#### Types of data to be collected:

- **Quantity:** For each animal that students observe, how many do they see?
- **Organism:** The animal's common name—for example, earthworm, honey bee, lady bug, ruby-throated hummingbird, chipmunk.
- **Type:** What kind of animal is it? bee, beetle, butterfly, dragonfly, grasshopper, moth—and general types—other insect, bird, mammal, other organism, etc.
- **Notes:** Observations on where they saw the animal and its behavior.
- **Photos:** Take photos of what you see!



Share your findings and reflections with us on social media and help us spread the word!

Share your findings with us on social media to help us spread the word about the benefits of gardens! Share with us **@TNCNatureLab** on **Twitter** and **Facebook** and **@nature\_org** on **Instagram** and help us spread the word!



DAY

6

## Water Security in Bogotá

### ? ESSENTIAL QUESTION

**How can students and the community get involved in protecting and improving the health of your watershed?**

Students will view and discuss the video *The Source of Life* that follows the journey of water from an area of rural Colombia to its capital city, Bogotá. They use the video as a jumping off point to explore the issues facing the watershed in which they live and to identify ways they can become involved in protecting their water along its journey. We'll understand watersheds, connecting to local watershed resources, engaging in watershed activities in the classroom, and identifying opportunities for watershed activism.

### → ACTIVITY



**WATCH:**  
[Water: The Source of Life](#)

\* As you watch the video, note the ideas that relate to the topic of watersheds or living in a watershed.

### “ DISCUSSION

**Discuss your ideas that relate to the topic of watersheds or living in a watershed.**

**Answers will vary:**

- A watershed can encompass many different ecosystems and types of land use;
- Some work in a watershed is about protecting land, other work is about supporting people, most work is about both.
- Working in a watershed may involve addressing the needs of a wide range of people and their needs—these are the stakeholders in a watershed project.
- Pollution in a watershed can come from many sources.
- Nature is a necessary ally in protecting water.

**Q: What is the source of most of the city of Bogotá's water?**

**A:** Chingaza National Park

**Q: What are the primary sources of pollution or contaminants in the water that travels from Chingaza to Bogotá?**

**A:** Agriculture, ranching activities

**Q: Why do you think you were shown this video?**

**Answers will vary:** The video makes it clear that water is connected in a watershed between its source and along its path (where it is used), that upstream and downstream areas are connected. We were shown the video to help us understand that what happens upstream can affect downstream users. Because the city of Bogotá receives the majority of its water from Chingaza National Park, it is important to protect the watershed that provides the city with water so the city can receive a good supply of high quality of water.

**Q: Think about what you know about your own watershed. What ideas might you use from the video as inspiration and understanding for exploring or working in your own watershed?**

**Answers will vary.**

To reinforce the features of a watershed, you may want to have students create a model of a watershed. The “crumpled paper” activity (and variations) provides a quick way for students to model the behavior of water in a watershed and is widely available online. Use this activity: [Crumpled Paper Watershed](#) (Alice Ferguson Foundation).



Share your reflections with us on social media and help us spread the word!

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**! TAKE ACTION**

Are your neighboring watersheds part of a larger watershed, in which the water drains into a larger body of water? Use this [interactive map](#) showing the largest scale watersheds in the U.S.

Develop a community watershed education campaign, including the following information about your community’s watershed:

- A map that identifies the watershed boundaries, the watershed in which yours is nested, and major bodies of water
- The overall condition of the water
- Regional current conservation and research activities
- Any relevant legislation or other news affecting the watershed
- How people can get involved and help at home

Share this information with your neighbors and wider community.



DAY

7

## Colombia's Páramo

### ESSENTIAL QUESTION

## How are cities connected to their water source?

Roughly the size of Texas and Oklahoma combined, Colombia is the second most biologically diverse country on Earth—home to 10% of Earth's plant and animal species! There are over 300 different ecosystems in Colombia and in this Virtual Field Trip, we will explore the magical páramo ecosystem and the stunning mountain landscapes found just beyond the capital city of Bogotá. We will see what it's like to walk among towering, furry, sunflower-like plants that capture the mist and rain, ultimately providing water for city residents downstream. We will see moss that can hold 40x its weight in water—it's true! They'll also learn about the incredible wildlife in the area including spectacled bears, tapirs, jaguars, and Andean condors. Along the way, students will explore where water comes from, how nature works to store and filter water, and how they can help protect water in their hometown.

### ACTIVITY



#### WATCH:

[The Journey of Water: From Colombia's Páramo to the Kitchen Sink](#)

### DISCUSSION

**Q: Where does the city of Bogota get most of its drinking water?**

**A:** From Chingaza National Park.

**Q: How do the plants in the páramo help people in Bogotá to have safe drinking water?**

**A:** The plants capture and store water and release it year-round, even during the dry season. The plants also help to filter and clean the water.

**Q: What are some of the things that can lower the quality of the water as it travels from Chingaza to Bogotá?**

**A:** Loose soil, fertilizers, and manure.

**Q: Take it further: Is the water where you live affected by any of these things? Why or why not?**

**Answers will vary:** If the water in your region, or the region in which students live, passes through agricultural areas, the answer is likely yes because these issues are the result of agricultural practices.

**Q: What is a water fund?**

**A:** When people, companies, and government agencies come together and contribute to protect water at its source. This can help farmers protect the ecosystem and still make a living.

**Q: What are some ways you can help protect water where you live?**

**A:** Learn about where your water comes from; Learn about your watershed and how people are working to protecting it; Join the effort to protect your watershed; conserve/don't waste water.

**Q: Take It further: Why is it important to protect water at its source?**

**A:** Because if we protect it at its source, we can be sure it is clean and safe to drink and use, not just for people, but for other animals and for plants for a long time to come.



Share your reflections with us on social media and help us spread the word!

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**! TAKE ACTION**

Close out your week of learning about ways to keep our cities healthy by shining a light on the important role nature can play in the health of our cities. Let's urge U.S. Congress to invest in the economy in ways that provide jobs while keeping our air, water and natural world safe. **Send your message** to Congress today and tell your leaders to make the most of nature's role in helping our economy.



Share your learnings!

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**You've  
earned it!**



From urban trees to biodiversity in our cities, you've learned a lot about how we can keep our cities healthy and you have much to be proud of!

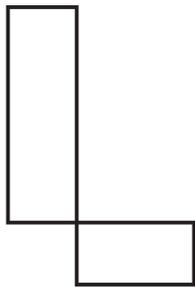
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