



GROWING GREEN

EDUCATOR GUIDE (Grade 5)

Thank you for registering for the *Growing Green* program with New England Botanic Garden at Tower Hill. This in-school program for 5th and 6th graders will take place across two consecutive years, consisting of three one-hour lessons per grade. This guide provides an overview to the *Growing Green* program for 5th grade. These lessons will introduce environmental justice topics related to water and air pollution, the urban tree canopy, and the heat island effect. The optional pre- and post-visit activities on the following pages relate to topics that will be taught during each of the three lessons. The activities can be used to introduce new topics to your students prior to each lesson or extend student learning beyond each lesson. You are not mandated to complete any of the suggested activities or complete any units of study prior to this program.

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Overview

This three-lesson series will introduce students to plant-based solutions to environmental issues and injustices in their city. The Water Pollution lesson will teach students about the water cycle in the city of Worcester and provide them with an opportunity to design and test solutions to help keep our water clean. The City Trees lesson will review the benefits of trees and teach about the impact they have in the city and their community. The Tree Equity lesson will introduce the concept of environmental justice, review tree distribution in their city, and allow students to design a more sustainable and equitable neighborhood.

The *Growing Green* series will be divided into three 60-minute workshops. Throughout each program, Teacher Naturalists will guide students through discussions and hands-on activities that require students to work in small groups and individually at times. Students will be encouraged to make observations, explore, and ask questions throughout.

Learning Objectives

Students will...

- Understand the urban water cycle and how our built environment impacts water pollution.
- Review photosynthesis and understand how trees benefit our environment and our health.
- Learn about environmental justice and how this impacts their community.

Vocabulary

States of Matter: *the distinct form in which matter can exist as either a solid, liquid, or gas.*

Evaporation: *the process of changing liquid into vapor by heating it up.*

Transpiration: *the release of water vapor through the openings in the leaves of plants.*

Condensation: *when water vapor gathers as a cloud, cools, and changes to liquid.*

Precipitation: *when water becomes heavier than air and falls in the form of rain, sleet, hail, or snow.*

Infiltration: *when water soaks into the surface of the ground.*

Watershed: *an area of land that drains or "sheds" rainfall into a body of water, such as a river, reservoir, or ocean.*

Stormwater Runoff: *after heavy rain or ice melt fully saturate the soil, the leftover water runs over the landscape*

Pervious: *a substance that liquid can pass through.*

Impervious: *substance that liquid cannot pass through.*

Pollution: *when harmful materials enter an environment and cause damage to the air, water, and land.*

Wastewater: *water that has been used and is ready to be treated at the water treatment plant.*

Filtration: *when solid matter is separated from liquid using a filter structure that allows liquid to pass through.*

Photosynthesis: *water and carbon dioxide are converted into sugar and oxygen using energy from the sun.*

Tree Canopy: *the layers of branches and leaves that provide shade over the ground.*

Tree Identification: *using characteristics of trees (leaves, branching, bark, etc.) to find out the species.*

Justice: *fixing the system to offer equal access to both tools and opportunities.*

Tree Equity: *having enough trees in an area so that all people can experience the benefits.*

Heat Island Effect: *when a city experiences much warmer temperatures than rural areas due to human activities.*

Environmental Sustainability: *ways we protect and conserve the environment and its resources.*

Environmental Justice: *when all people regardless of race, income, etc., are fairly treated and meaningfully involved in the development, implementation, and enforcement of environmental laws.*



IN ALIGNMENT WITH THE 2016 MASSACHUSETTS SCIENCE AND TECHNOLOGY/ENGINEERING CURRICULUM FRAMEWORKS



Standards

GRADE 5

- 5-ESS2-1. Use a model to describe the cycling of water through a watershed through evaporation, precipitation, absorption, surface runoff, and condensation.
- 5-ESS3-2(MA). Test a simple system designed to filter particulates out of water and propose one change to the design to improve it.
- 5.3-5-ETS3-1(MA). Use informational text to provide examples of improvements to existing technologies (innovations) and the development of new technologies (inventions). Recognize that technology is any modification of the natural or designed world done to fulfill human needs or wants.
- 5-LS1-1. Ask testable questions about the process by which plants use air, water, and energy from sunlight to produce sugars and plant materials needed for growth and reproduction
- 5-ESS3-1. Obtain and combine information about ways communities reduce human impact on the Earth's resources and environment by changing an agricultural, industrial, or community practice or process.

Lesson 1: Water Pollution

PRE and POST VISIT ACTIVITY GUIDE

The following optional pre and post-visit activities are designed to support concepts that will be addressed during the Water Pollution lesson.

WHERE'S THE WATER?

Students will test a plant's ability to release water vapor through its leaves, while also observing if this process called transpiration can clean dirty water.

MATERIALS

Plant	Scale
Rubber Band	Water
Plastic Bag	Food Coloring



Bring a plant to school and lead students through an experiment to test transpiration and filtration properties. Review how plants collect water and how they use that water for photosynthesis. Explain that extra water is released through pores in the plant's leaves (stomata) in the form of water vapor, called transpiration.

INVESTIGATIVE QUESTIONS: Can a plant clean water through the process of transpiration? How much water does a plant release through transpiration?

- Challenge students to make hypotheses.
- To setup, weigh the plastic bag and have students make observations about the plant.
- Mix water and food coloring, then water plant.
- Place plastic bag over plant with rubber band.
- Place plant in sunlight for 60 minutes.
- Observe the color of the condensation.
- Remove bag and weigh to calculate the amount of water released from transpiration.

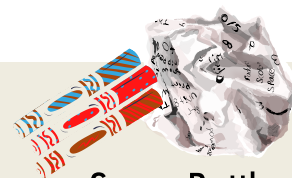
Discuss the results and what attributes of the plants could have impacted these results (size, number of leaves, species, etc.). Ask students what questions the experiment left them with and brainstorm ways you can alter the experiment to find the answers to these questions.

WATERSHED MODELS

Students will learn what a watershed is and how stormwater can carry pollutants across the landscape and into waterways.

MATERIALS

Recycled Paper	Spray Bottle
Washable Markers	Newspaper



Ask students to explain how water travels during a storm. Review the terms infiltration and stormwater runoff. Explain that today we will be learning about something called the watershed. Explain that when it rains or snow melts, water travels over the land making its way to rivers and bodies of water. Draw and label the parts of an example watershed as a class.

1. Cover tables with newspaper and provide each student with markers and two pieces of recycled paper.
2. Have students crumple paper into a ball and gently unfold to create peaks and valleys.
3. Ask students to draw rivers and lakes onto their paper with a blue marker in the places they would naturally form if it was land.
4. Now a rainstorm comes, have students spray the paper and observe how the water travels.
5. Repeat step 2 & 3 with the second paper.
6. Use a green marker to add plants and a brown marker to add animals and soil.
7. Add homes, cars, roads, and buildings by drawing shapes with a red marker.
8. Have students spray paper and observe.

Discuss the results, explaining that soil erosion, animal waste, and human pollutants travel across the watershed and enter our waterways.

HOMEWORK

We have a limited amount of clean, fresh, water on earth. Have students brainstorm how humans use water and then ask them to explore watercalculator.org to learn about their water footprint and the concept of virtual water. Ask students to track their water usage for a week and reflect on the results as a class.

Lesson 2: City Trees

PRE and POST VISIT ACTIVITY GUIDE

The following optional pre and post-visit activities are designed to support concepts that will be addressed during the City Trees lesson.

OUR SCHOOL TREES

Students will research and collect data on the trees in their school yard or local park to create a class field guide that identifies each tree.

MATERIALS

Paper
Pencil

Computer
Art Supplies



Brainstorm as a class the different types of trees that you might find growing outside. Explain that there are thousands of different species of trees and dendrologists (tree scientists) create field guides to help people identify the unique characteristics of each tree. Today we are going to create a class field guide to document the trees that grow near our school.

Assign each student or group of students a tree to research and identify. Explain that they will be responsible for making a field guide page for their tree that reviews the leaves, bark, buds, flowers, and fruit.

- Take students outside to make observations about the characteristics of their tree.
- Allow students to use the field guides from your Tree Science Kit to identify their tree.
- Give students pencils, paper, and crayons to take notes and do bark and/or leaf rubbings.
- Invite students to share with the class some observations they made.
- In the classroom, invite students to use the tree.oplin.org website to identify their tree.
- Allow students time to create their field guide page by drawing pictures, printing photos, and writing notes about the characteristics.
- Display the pages around the room and have students present their tree.

POET-TREE

Students will practice making scientific observations of city trees and use the language arts to communicate what they know and wonder.

MATERIALS

Paper
Pencil



Explain to students that they will have an opportunity to write a poem about a city tree. They can write about the tree they studied for their field guide or a different tree in their city.

- Provide students with pictures or take them outside to observe the trees.
- Ask students to write a list about what they notice about their tree.
- Ask students to write a list about what they wonder about their tree.
- Ask students to write a list about what their tree reminds them of.
- Ask students to write questions they have about their city trees.
- Tell students they will use these notes to write a short poem about their tree. Give students 10-15 minutes to write.
- Allow students time to share their poems out loud if they want to.

Tree Fall

*Dry leaves flutter and spin in the wind,
Bark curls and falls to the ground.
I wonder what it means to lose these leaves.
Will the tree continue to grow?
What would it mean if all the trees fall?
No shade,
No green,
No home for animals or food to eat.
Without this tree we might not be.*

HOMework

Invite students to participate in the Massachusetts 2023 Arbor Day Poster Contest. Encourage students to think about the benefits trees bring to their community as they create their designs. This year's theme is [It's Time for Trees](#). Submissions due March 15, 2023.

Lesson 3: Tree Equity

PRE and POST VISIT ACTIVITY GUIDE

The following optional pre and post-visit activities are designed to support concepts that will be addressed during the Tree Equity workshop.

WHAT'S FAIR?

Students will explore the difference between being treated fairly or unfairly, and will be able to reflect on an unfair event in their life.

MATERIALS

Pencils
Art Supplies



Before school starts divide the class into two groups by the month in which they were born and select a "favored group". These groups do not have to be the same size. Separate the desks into two groups and assign seats, making sure students sit with their preselected group. When students enter the room ask them to sit in their assigned seat and do not tell them why.

- Give every student in the favored group a new pencil to use for the day. Explain that these students will receive other special privileges including no homework and extra recess time.
- Start teaching your scheduled lesson for the day. When interacting with students only call on those from the favored group. If students in the non-favored group start to complain simply say you don't see a problem.
- After some time stop and explain the exercise to the students and how you picked the favored group by their birthdays.
- Write the words "fair" and "justice" on the board and define each word as a class. Ask the group if they think it was fair that one group had special privileges. What should change?
- Share real world examples of inequality and discuss as a class what happened and what needs to change to bring about justice.
- Give each student a piece of paper and have them draw a situation where they were not treated fairly and write a description. Flip the paper over and draw how the same situation could change to become fair.

TAKING ACTION

Students will review the Tree Equity Score resource and use the information to draft a letter to city and state officials to advocate for more community trees.

MATERIALS

Paper

Pencil

Computer



After completing the Tree Equity workshop students will be familiar with the resource treeequityscore.org. Use this activity to further explore this resource with your students and teach them about advocacy.

- Review the words "justice" and "equity" with students and ask them to explain what "tree equity" means.
- Invite students to explore treeequityscore.org on their computers. Instruct students to:
 - Search for Worcester, MA
 - Click on any census block
 - Click "Municipal Report" to review the citywide tree equity report
- Discuss findings and ask: "Who is be impacted by this inequality? How many trees need to be planted to get all city blocks to a score of 75?"
- Review why trees are important and the benefits they provide. Ask: "Who will be impacted by planting more trees and how? How does this make you feel?"
- Download this data and explain to students that they will work individually or together to write a letter to their city and state officials to advocate for the planting of more trees. They can reference this data for their arguments.
- After letters are complete email them with the data sheet to the [Worcester City Council](#) and [State Representative Jim McGovern](#).

HOMEWORK

Have students pick a tree in their school yard or local park to visit each week. Using your Tree Science Kit, work as a class to track the health of your tree. Make observations and take notes; look for root rot, leaf discoloration, and track growth by measuring the trunk, etc. Review the [Healthy Trees, Healthy Cities](#) resource videos for tips on how to monitor your tree.