Climate Heroes!
The Power of Trees
TEACHER'S GUIDE

Grades: 3-8 **Subjects**: Science and Geography

Purpose: This guide contains a set of discussion questions and answers for any grade level, which can be used during and after the virtual field trip. It also contains links to additional resources ranging from lessons, activities, videos, demonstrations, experiments, and multimedia presentations.

Essential Question: What is the role of trees in the quest to tackle climate change?

Supporting Questions:

- How do trees benefit humans and the environment?
- What threats do trees face?
- What can people do to protect and promote trees in their community?

Description:

Trees are our climate superheroes! They have tremendous superpowers. Trees provide so many benefits to our everyday lives. They filter clean air, provide fresh drinking water, help curb climate change, and create homes for thousands of species of plants and animals.

The world's trees and forests are one of our greatest assets. Trees keep the air we breathe clean and help us stay healthy. Trees are also an important natural solution in our fight against climate change. Forests play a key role largely because of their ability to sequester, or store, carbon—just one mature tree can sequester as much as 48 pounds of carbon per year. That keeps carbon out of the atmosphere, so naturally, the more forests the better.

In this virtual field trip, we introduce students to the power of trees! From Louisville, Kentucky in the United States to St. Vincent and the Grenadines in the Caribbean, trees are playing critical roles in both fending off the impacts of climate change and improving our resilience in the face of those impacts. Students will learn why trees are our climate heroes, how we can harness their superpowers, and how they can get involved in their communities to protect and restore the health of trees.

Materials

Video supporting this lesson plan:

- Climate Heroes: The Power of Trees
  - Vimeo: https://vimeo.com/674486010
  - YouTube: https://youtu.be/ilXeGlybjJQ

Interactive Kahoot game:

- Climate Heroes: The Power of Trees
  - https://create.kahoot.it/share/trees-are-climate-superheroes/3189ec1b-71f5-4931-ae4a-fcdf7ee415dc

Additional videos:

- Healthy Trees, Healthy Cities Training Series, Introduction:
- https://youtu.be/y-o4kGhYTfw
- Healthy Trees, Healthy Cities Training Series, How to Calculate DBH: https://youtu.be/yoMkfPpS_b0
- Healthy Trees, Healthy Cities Training Series, Fine Twig Dieback: https://youtu.be/xO1NqQcG4wM
- Healthy Trees, Healthy Cities Training Series, Leaf Discoloration: https://youtu.be/lNi6-kkjHgY
- Healthy Trees, Healthy Cities Training Series, Lead Defoliation: https://youtu.be/SZnqGwXplxU
- Healthy Trees, Healthy Cities Training Series, Crown Vigor: https://youtu.be/V90Q1jAOlOI
- Healthy Trees, Healthy Cities Training Series, Crown Transparency: https://youtu.be/Fi88Uy8CPiw
- Healthy Trees, Healthy Cities Training Series, Crown Light Exposure: https://youtu.be/zylyBx11Bh8
- Insects, Disease, Drought, and Fire https://www.youtube.com/watch?v=e_cOMAioE54
- Urban Trees #5: Factors http://vimeo.com/78368570

Materials for Teacher:

- Computer with Internet connection, LCD projector, screen
- Healthy Trees, Healthy Cities App (for extension activity only)*
- Image of a tree on a windy day (image also available in Appendix A below)
- Image of a tree on a rainy day (image also available in Appendix A below)
- Image of a tree with evidence of animal habitats (image also available in Appendix A below)

Materials for students:

- Discussion questions
- SelecTree (http://selectree.calpoly.edu/)
- Tree Benefit Calculator (https://www.arborday.org/calculator/index.cfm?)
- A tree identification key (http://www.dec.ny.gov/docs/lands_forests_pdf/treeidkey.pdf)
- Leafsnap (http://leafsnap.com/) *optional*

Standards:

Next Generation Science Standards

Disciplinary Core Ideas:

- LS4.D Biodiversity and Humans
- ESS3.A Natural Resources
- ESS3.C Human Impacts on Earth Systems

Crosscutting Concepts:

- Patterns
- Cause and Effect
- Stability and Change
- Influence of Engineering, Technology, and Science on Society and the Natural World

Science and Engineering Practices:

- Asking Questions and Defining Problems
- Planning and Carrying Out Investigations
- Constructing Explanations and Designing Solutions
- Engaging in Argument from Evidence

Common Core Standards

3rd-5th Grade ELA Reading: Informational Text

- CCSS.ELA-LITERACY.RI.3.4 Determine the meaning of general academic and domain-specific words and phrases in a text relevant to a *grade 3-5 topic or subject area.*
- CCSS.ELA-LITERACY.RI.3-5.9 Integrate information from several texts on the same topic in order to write or speak about the subject knowledgeably.

6th-8th Grade Science and Technical Subjects

- CCSS.ELA-Literacy.RST.6-8.3 Follow precisely a multi-step procedure when carrying out experiments, taking measurements, or performing technical tasks.
- CCSS.ELA-Literacy.RST.6-8.4 Determine the meaning of symbols, key terms, and other domain-specific words and phrases as they are used in a specific scientific or technical context.
- CCSS.ELA-Literacy.RST.6-8.4 Determine the meaning of symbols, key terms, and other domain-specific words and phrases as they are used in a specific scientific or technical context.
- CCSS.ELA-Literacy.RST.6-8.7 Integrate quantitative or technical information expressed in words in a text with a version of that information expressed visually (e.g. in a flowchart, diagram, model, graph, or table).

Vocabulary:

- **Sequester:** isolate and hide away
- **Erode:** gradually wear away
- **Greenhouse gases:** gases that absorb and emit radiant energy within the thermal infrared range, causing the greenhouse effect. These include water vapor, carbon dioxide, methane, nitrous oxide, and fluorinated gases.
- **Cellulose:** an insoluble substance which is the main constituent of plant cell walls
- **Mangrove:** a shrub or tree that grows in coastal saline or brackish water

Discussion Questions: You can use or adapt these questions for a follow-up discussion with your students after viewing the virtual field trip or you pause as you go along.

1. What are some of the largest living things on our planet?
   Answer: Trees

2. Why is our climate becoming warmer?
   Answer: Greenhouse gases in our atmosphere trap heat from the sun and warm our planet. This is often referred to as "global warming" or "climate change"

3. What is one simple way trees help cool our planet?
   Answer: Shade

4. How do trees help keep our planet from warming?
   Answer: Trees can trap and store, or sequester, carbon dioxide in the form of cellulose so that it doesn't go into our atmosphere and traps heat.

5. How are trees improving human health in Louisville, Kentucky (USA)?
   Answer: Trees are being planted in areas of concentrated pollution.

6. Why are studies like the Green Heart Project important?
   Answer: Studies like these can show the impact of trees and other cities can use this evidence to replicate their work and improve well-being around the world.

7. What is another impact of climate change in addition to hotter temperatures?
   Answer: Severe storms (students might also identify bigger waves or erosion)

8. How are severe storms impacting coastal communities?
   Answer: Storms are causing bigger waves that erode coastlines, eliminating protection from communities that live near rivers and oceans.

9. How are mangroves helping coastline communities fend off the impacts of climate change?
   Answer: Mangroves bear the brunt of storms and protect structures on land from being as severely damaged.

10. Why is it important to protect older trees?
    Answer: Older and larger trees store more carbon than younger ones. If we protect our oldest trees, the can sequester more carbon dioxide and better prevent faster global warming.

11. What are three causes of trees death?
    Answer: longer and harsher droughts, more severe outbreaks of insects and disease, and increasingly catastrophic wildfires. Climate change is magnifying these.

Part I

Introduction:

Ask students to brainstorm answers to the following question: **Why do we need trees?**

After 5 minutes of brainstorming, conduct the following questioning:

- Display an image of a tree on a windy day and ask students to consider how trees affect the "air" around us. Four different benefits can be highlighted and clues can be provided to guide students in identifying each benefit. Students will identify 1) reduce wind 2) tree leaves collect dust and capture pollutants 3) tree roots, wood and leaves absorb carbon dioxide and 4) trees provide oxygen. Sharing an image of **the photosynthetic process** may support students in identifying that trees take in carbon dioxide and produce oxygen.
- Display an image of a tree on a rainy day and ask students to consider how water and trees work together in cities. Four different benefits from water can be highlighted and clues can be provided to guide students in identifying each benefit. Students will identify 1) filtering pollutants 2) collecting water 3) slowing water to prevent flooding and 4) distributing water over time for drought prevention.
- Display an image of a tree with evidence of animal habitats and food and ask students to consider how humans 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 will identify 1) habitats 2) food 3) recreation. An additional image of a tree swing or tree rope course can be included for students to identify recreation.

Video:

- **Show** Climate Heroes: The Power of Trees **(MINUTES 00:00-05:00)**
- Students should answer discussion questions #1-6 while watching this portion
    - Vimeo: https://vimeo.com/674486010
    - YouTube: https://youtu.be/ilXeGlybjJQ

Reflection:

Pose the question again: **Why do we need trees?** Ask students to think about the trees they see around their community and the benefits they provide. If possible, go for a walk around your community. Ask students to create a visual representation of the trees in their community and some of their benefits. This can be done through a digital presentation, drawing, painting, or any other visual format.

Part II

Introduction:

Ask students to brainstorm answers to the following question: **We talk a lot about humans protecting and planting trees. But, in what ways can trees protect humans?**

Video:

- **Show** Climate Heroes: The Power of Trees **(MINUTES 05:00-END)**
- Students should answer discussion questions #7-10 while watching this portion
    - Vimeo: https://vimeo.com/674486010
    - YouTube: https://youtu.be/ilXeGlybjJQ

Reflection:

The Tree Benefit Calculator (https://www.arborday.org/calculator/index.cfm?) allows students 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.

- **Ask students to think about the benefits of trees in their neighborhood or city and 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?** Students may write a response to these questions or you may lead small-group discussions and ask the group to share their reflections with the class.

Part III:

Introduction:

Ask students to brainstorm answers to the following question: **What threats do trees face?**

Video:
Watch **Insects, Disease, Drought, and Fire** (https://www.youtube.com/watch?v=e_cOMAioE54)

Reflection:
Guide students into investigating other threats to trees: domesticated animal waste, being torn down to put tall buildings and small lots on the land, etc. Use internet resources to investigate these threats. Students can then take a neighborhood stroll to observe if these are threats to **their** trees. Discuss which threats they identified in their neighborhood and what can be done to minimize them.

Students can further investigate threats by using the resource **SelecTree** (http://selectree.calpoly.edu/) . This site allows students to identify potential threats to specific tree species.

Part IV

Introduction:

Ask students to brainstorm answers to the following question: **What are the most impactful ways to protect trees in my own community?**

Explain to students that they will be developing action plans to protect or promote tree conservation in order to save and/or maintain forested areas for the benefit of their local community and future generations. To successfully plan their project, they will need to survey their community to identify the trees species that thrive and identify current threats to tree species.

Activity:

Students should create maps of their neighborhood or community, working first to draw the main structures, boundaries and pathways. Another option for map creation is to use Google Maps (https://www.google.com/maps) to generate an image of your neighborhood and have students draw and label on top of the printed image. For a more tech intensive approach, have students use Google My Maps (https://www.google.com/maps/d/). Google My Maps will allow students to draw and label items on the map while online.

Students will survey the grounds by identifying the types of trees. It is suggested students note the species on their map by numbering each tree location and having a chart to record the corresponding name.

Students can choose from a couple options to identify trees on the property. Provide students with the definition of **dichotomous key** – a method for determining the identity of something by going through a series of choices that leads the user to the correct name of the item. A tree identification key can be found here: http://www.dec.ny.gov/docs/lands_forests_pdf/treeidkey.pdf.

Students can also download the free app for **Leafsnap** (http://leafsnap.com/).

Facilitate students sharing their data. Provide students with a stack of small sticky notes. For each tree they identified on the school grounds or their community, ask them to write each tree species on a sticky note. Arrange the notes on a table or wall as a bar graph representing the different responses. Students use this data in developing an action plan.

Reflection:

An action plan typically includes defining a goal, generating a list of actions, preparing a timeline, allocating resources, identifying possible problems, developing strategies for monitoring, assigning tasks and implementing the plan. **Students should reflect on how they might implement an action plan for their own community.**

Part V:

Optional Extension: *Plant a Tree!*

Introduction:

Ask students to brainstorm answers to the following question: **What must be considered when planting a new tree in my community?**

Video:

Share the scientist video **Urban Trees #5: Factors** (http://vimeo.com/78368570), which answers the question, "What factors need to be considered when planting or adopting a tree in an urban community?" If students are interested in evaluating their home or community to plant a tree after viewing the video, the videos and handouts below by The Nature Conservancy can help them with their planning. Students can use a map of their school grounds or community to design where they would plant trees.

Other videos by The Nature Conservancy that support this lesson:

- **Healthy Trees Healthy Cities: Planting**

https://www.youtube.com/watch?v=wvMqCcm3ZJ4&feature=youtu.be

- **Healthy Trees Healthy Cities: Pruning**

https://www.youtube.com/watch?v=M1wVL5InBxM&feature=youtu.be

- **Healthy Trees Healthy Cities: Stewardship**

https://www.youtube.com/watch?v=3IEoe0X3w08&feature=youtu.be

PDFs by The Nature Conservancy that support this lesson:

Best Management Practices: Right Tree, Right Place – choosing the right tree depends on many factors including soil type, climate, and the amount of space the tree will have both underground and overhead

https://www.conservationgateway.org/ConservationPractices/cities/hthc/library/Documents/Documents/BMP_Right%20Tree%20Right%20Place.pdf

Best Management Practices: Tools of the Trade – Resources for planting, pruning, and stewarding your trees – young or old.

https://www.conservationgateway.org/ConservationPractices/cities/hthc/library/Documents/Documents/BMP_Tools%20of%20the%20Trade.pdf

Best Management Practices: Watering Your Tree – Watering is one of the most important things you can do to help a newly-planted or young tree establish in its new home and ensure mature trees live to their fullest potential.

https://www.conservationgateway.org/ConservationPractices/cities/hthc/library/Documents/Documents/BMP_Watering%20Your%20Tree.pdf

Best Management Practices: Tree Monitoring Schedule – To coordinate the regular care of trees in your community, use this Tree Monitoring Schedule to organize friends, family, and neighbors in three day blocks. Daily care should include checking soil moisture levels and watering if needed, weeding around base of the tree if necessary, removing debris, checking for signs of pests and diseases, and noting overall health.

https://www.conservationgateway.org/ConservationPractices/cities/hthc/library/Documents/Documents/BMP_Tree%20Monitoring%20Schedule.pdf

Reflection: Students should reflect on the ways they will care for their tree should they choose to plant one.

Part VI:

Optional Extension: *Care for a Tree!*

Introduction:

Watch these short videos to learn a simple, scientifically-based methodology you can use to check on the health of your community's trees.

You'll need:

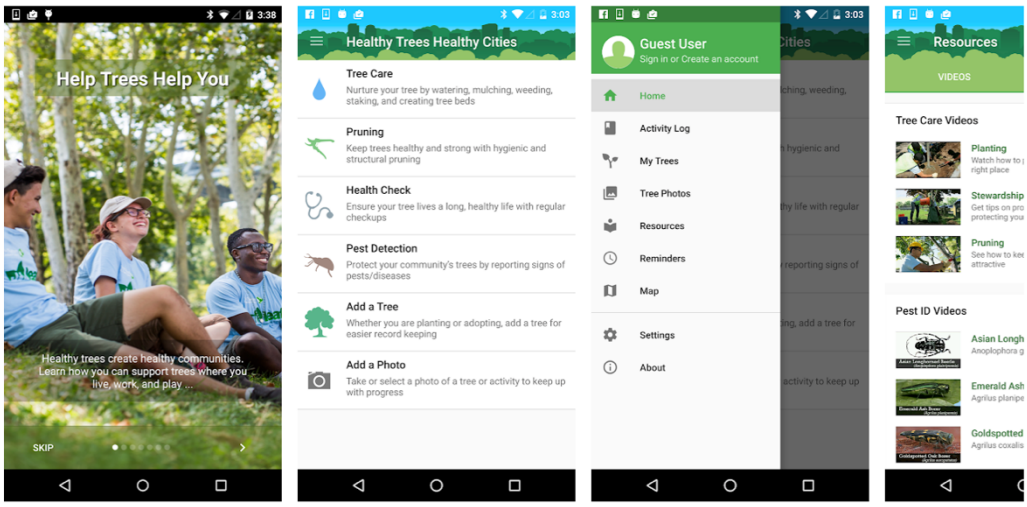
- A device with the Healthy Trees, Healthy Cities app
- Brightly colored clothing
- Tape, string, measuring tape
- Binoculars (for larger trees)

Videos:

- Healthy Trees, Healthy Cities Training Series, Introduction:
- https://youtu.be/y-o4kGhYTfw
- Healthy Trees, Healthy Cities Training Series, How to Calculate DBH: https://youtu.be/yoMkfPpS_b0
- Healthy Trees, Healthy Cities Training Series, Fine Twig Dieback: https://youtu.be/xO1NqQcG4wM
- Healthy Trees, Healthy Cities Training Series, Leaf Discoloration: https://youtu.be/lNi6-kkjHgY
- Healthy Trees, Healthy Cities Training Series, Lead Defoliation: https://youtu.be/SZnqGwXplxU
- Healthy Trees, Healthy Cities Training Series, Crown Vigor: https://youtu.be/V90Q1jAOlOI
- Healthy Trees, Healthy Cities Training Series, Crown Transparency: https://youtu.be/Fi88Uy8CPiw
- Healthy Trees, Healthy Cities Training Series, Crown Light Exposure: https://youtu.be/zylyBx11Bh8

Activity:

Follow the instructions in each short video to assess the health of trees. Provide the data you collect to scientists via the Healthy Trees, Healthy Cities app. Download the app for Apple and Android.



Reflection: After you've contributed data on the health of trees in your community to the Healthy Trees, Healthy Cities app, reflect on the following: **How can community members like YOU contribute to the protection of trees and why is it important to get involved?**

Nature Lab Related Resources: The following lesson plans and videos can be used to supplement the virtual field trip.

Changing Climate, Changing Cities

Grade Levels: 6-8

Get a front-row, ground-level seat to the challenges cities face as they confront this force of nature, the solutions experts are promoting to mitigate it.

https://www.nature.org/en-us/about-us/who-we-are/how-we-work/youth-engagement/nature-lab/virtual-field-trips/

Coastline Erosion Protection

Grade Levels: 6-12

There are multiple ways to protect coastlines. In this lesson, students compare strong (but expensive) construction materials with the less robust (but cheaper) oyster reefs. Students use an online tool to find historic tide data in a selected coastal location and explore the use of different materials in protecting coastlines.

https://www.nature.org/en-us/about-us/who-we-are/how-we-work/youth-engagement/nature-lab/high-school-lesson-plans/

You're the Scientist! Citizen Science

Grade Levels: 3-8

Students will learn about how they can get involved in scientific research as citizen scientists!

https://www.nature.org/en-us/about-us/who-we-are/how-we-work/youth-engagement/nature-lab/virtual-field-trips/

Reforestation: Impact on Climate

Grade Levels: 3-8

Students explore how reforestation can help decrease carbon dioxide and greenhouse gases in the atmosphere, thereby minimizing climate change and improving air quality.

https://www.nature.org/en-us/about-us/who-we-are/how-we-work/youth-engagement/nature-lab/middle-school-lesson-plans/?tab_q=tab_container_copy-tab_element_2004782022

Other Related Resources

Classroom Resources (All Grades)

- **Healthy Trees, Heathy Cities:** Healthy Trees, Healthy Cities (HTHC) is a collaborative initiative to promote the long-term health of urban trees by providing free tools and resources such as a smart-phone application ("app"), web-based project management dashboard, and training resources. https://healthytreeshealthycitiesapp.org/index.cfm
- **Plant a Billion:** The Nature Conservancy's Plant a Billion Trees campaign is a major forest restoration effort with a goal of planting a billion trees across the planet. https://www.nature.org/en-us/get-involved/how-to-help/plant-a-billion/
- **6 Ways Trees Benefit All of Us:** Article explaining how from a city park to a vast forest, trees deliver for us when we help them thrive. https://www.nature.org/en-us/what-we-do/our-priorities/build-healthy-cities/cities-stories/benefits-of-trees-forests/
- **Yes, Trees are a Viable Climate Solution**: Article explaining we can't reach global climate goals without cutting emissions—but we can't reach them without nature either. https://www.nature.org/en-us/what-we-do/our-insights/perspectives/yes-trees-are-a-viable-climate-solution/
- **Right Tree, Right Place guide sheet:** This sheet helps one determine where to plan a new tree and which tree to plant. https://bugwoodcloud.org/hthc/resources/html/BMP_Right%20Tree%20Right%20Place/index.html
- **U.S Forest Service Discover the Forest:** The Discover the Forest campaign, a public service campaign created by the Ad Council in partnership with the U.S. Forest Service, encourages parents of tweens to experience the outdoors with their family to strengthen their connection with nature and each other. https://discovertheforest.org
- **Natural Inquirer** is a science journal written by Forest Service scientists for middle-school students. http://www.naturalinquirer.org/
- **FSNatureLIVE!** brings together webinars and information about pollinators, climate change, wetlands, bats, bird migration, butterflies and rainforests. http://fsnaturelive.org/

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Carrier

Appendix A


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Image Credit: Raul Lieberwirth via CC BY-NC-ND 2.0