Urban Trees

Grades: 6th – 8th

Essential 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?

Lesson Overview:

Students will learn about how trees are an essential part of our lives with a focus on the role they play in urban areas, including energy considerations. They then consider threats posed to trees, including non-native insects, domestic animal waste, and erosion. Students then evaluate the potential impact of local tree conservation efforts and design a plan for their community.

A companion interactive whiteboard presentation that incorporates video and glossary terms used throughout this lesson is provided to use in classroom instruction (see Teacher's Guide for directions).
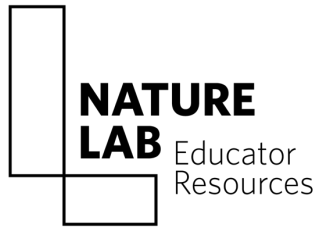
Nature Works Everywhere Themes:

- Clean air- Trees provide numerous benefits, including cleaning our air by filtering out dust, pollution and greenhouse gases
- Water- Trees provide numerous benefits, including providing natural filtration and storage systems.

Time Frame:

This lesson is designed to be completed in three 45-minute sessions.

Vocabulary:

- Transpiration: The evaporation of water from plants.
- Invasive Species: Any kind of living organism that is not native to an ecosystem and which causes harm.
- Energy: Anything that can carry out an action or maintain a process.
- 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.
- Microclimate: A small local area where the climate conditions differ from the larger surrounding area.

Videos and images used in associated Power Point lesson plan:

- Trees Introductory video
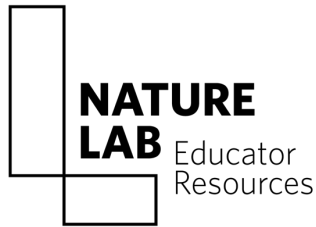- Scientist interview questions

Background for the Teacher:

In this lesson, students 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.

Federal research has shown that well thought out tree planting can lower summertime temperatures in cities and households by dramatically reducing air-conditioning bills and help 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.

Classroom Activities:

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Materials
For each group of students/individual student:
- Notebook paper/journal
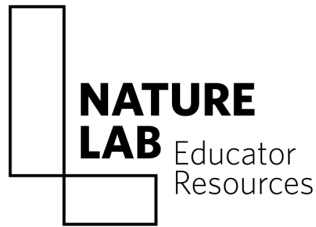- Map of school ground and/or community

Optional
- SmartPhone or tablet
- Fan (can be made from paper or powered)

Engage
How do trees benefit humans and the environment?

Presentation Slide 1-17

1. Share images illustrating a few examples of what trees do for us and ask students to brainstorm what all of the images are illustrating. Some examples may include a tire swing (recreation), shade from a tree, apples or oranges (food) and a hole in a tree or nest made by an animal (habitat). Explain to students that these are just a few of many examples of what trees do for us every day. Ask students to consider; 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?
2. Share with students the Trees overview video.
3. Explain to students that they will work to answer these questions during the lesson. Focus their attention on the guiding questions:
   a. How do trees benefit humans and the environment?
   b. What threats do trees face?
   c. What can people do to protect and promote trees in their community?
4. Display an image of a tree on a windy day and 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 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. Audio of wind may support students with identify the benefits of reducing wind and collecting dust and pollutants. Sharing an image of photosynthesis may support students in identifying trees absorbing carbon dioxide and providing oxygen as other benefits air has because of trees.
5. Display an image of a tree on a rainy day and ask students to consider how water benefits from trees. Four different benefits from water can be highlighted and clues can

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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. An additional image of a tree on a city street may clue students in identifying filtering pollutants. Audio of running water during a storm may support students identifying the benefits of trees collecting water or slowing water. A newspaper headline of a drought with a healthy tree may support students with identifying that trees can store water over time.

6. Display an image of a tree with evidence of animal habitats and food and 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 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.

7. Share the scientist video answering the question, "What benefits do trees bring to our lives?" After the video ask students what other benefits were observed in the video. Anticipated responses may be; wood, jobs, fiber, reducing asthma and trees are pleasing to look at. Ask students if they can brainstorm even more!

8. Provide students with the definition of Transpiration.

9. 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. Have students line up and file by a bucket of water. Ask each student to dip just one hand in the water to wet it, and then hold both hands briefly in front of the fan. After all students have tried this, 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.

OPTIONAL Engage Investigation (Directions 9-14)

10. Ask students to predict the temperature difference of soil in the shade of a tree versus the sun.

11. If the school grounds have a tree choose a site where the sun location is well away from any structure because the structure might radiate heat onto the soil where the thermometer is located. The thermometer can be concealed and will not affect the reading because the tip of the probe is detecting the soil heat, not the round gauge on top of the probe. The site in the shade should not be too close to a tree trunk. Leave probes in the ground for at least a half hour to adjust to the soil temperature.

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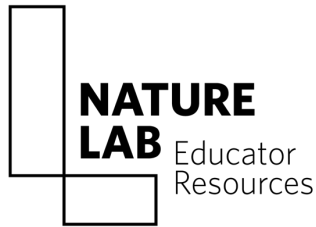
12. Visit the site together as a class to record data or small groups of students can rotate each day to collect data. A data table should include information for students to record the date, temperature in sun, temperature in shade, windy or calm air and cloudy or sunny skies. If the school grounds do not have a tree mock data can be provided. Trees in the shade will typically be 5-10 degrees cooler.

13. Ask students to analyze the soil temperatures in each location and form a conclusion. What patterns emerge? Why would a living organism prefer to be in the shade or sun? What could happen if shade was not available? Who could use this data? How could they use it?

14. Provide students with the definition of Microclimate.

15. Explain to students that the shade from a forest tree creates a microclimate suitable for many species of plants and animals to survive and flourish. Many small plants have adapted to the understory of a forest, and need protection from the direct rays of the sun. The forest soil is cool and moist, which is good for plants and provides cooler temperatures in the surrounding area. Ask students to consider how trees providing cooler temperatures can benefit humans. How could trees impact energy costs of buildings?

16. Provide students with the definition of Energy.

17. The Tree Benefit Calculator 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 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? https://www.arborday.org/calculator/index.cfm?


Explore
What threats do trees face?

Presentation Slides 18-30

1. 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 local school grounds or community to identify the trees species that thrive and identify current threats to tree species.

2. Student partners or teams can create maps of the entire school grounds, working first to draw the main structures, boundaries and pathways. Another option is to use Google
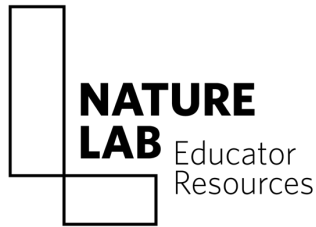
maps to generate an image of your school. If there are not any trees present on the school grounds, students can survey trees in the community.

3. Students will survey the grounds by identifying the types of trees. If the school grounds have many trees on the property, consider gridding the property and assigning students' specific areas to survey. If there is a limited amount of trees, students can survey the entire school. It is suggested students note the species on their map by numbering each tree location and having a chart to record the corresponding name.

4. Students can choose from a couple options to identify trees on the property. Provide students with the definition of Dichotomous Key. A tree identification key can be found under Additional Resources for students to use. Students can also download the free app for LeafSnap. Directions for how to download and use LeafSnap can be found under Additional Resources.

5. Facilitate students sharing out 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 the board as a bar graph representing the different responses. Students will use this data later when identifying threats and developing an action plan.

6. Explain to students that trees in different settings may have different threats. Guide students to consider and compare the impacts of trees on suburban and urban settings and the impact these settings have on trees. Share the scientist video answering the question, "How do trees impact urban areas?" Ask students to identify the setting their trees are in and how that may impact their tree species.

7. Provide students with the definition of Invasive Species. Share the scientist video answering the question, "How are invasive insects affecting the North American tree population?" Review images and evidence of the Asian Longhorned Beetle and Emerald Ash Borer impacting trees and share the tree species they impact. Are any of the trees on the school grounds or community threated by these insects?

8. Guide students into investigating other threats to trees: domesticated animal waste, tall buildings and small lots. Students can revisit the school grounds to observe if these are threats to their trees. They can further investigate threats by using the resource SelecTree under Additional Resources. This site allows students to identify potential threats to specific tree species.

Explain
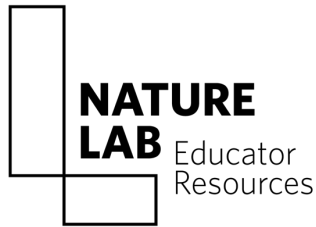
What can people do to protect and promote trees in their community?

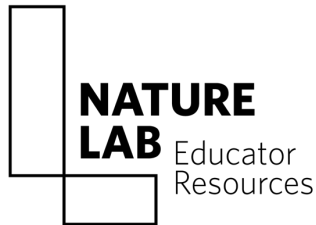Presentation Slides 31-33

1. Students will develop an action plan in small groups to help trees on the school grounds or in their community. Students may choose to revisit trees from earlier in the lesson and document tree species and invasive species using suggested citizen science apps, clean tree beds of animal waste, design and post signs to educate communities about curbing their dogs, or pruning a tree.
2. Provide directions for students to chart out the threats that were identified on the school grounds or community and include a column for possible solutions. Share the scientist video answering the question, "What can be done to stop the spread of invasive species?" Guide students to consider solutions explored in the video.
3. Share the scientist video answering 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 school grounds, home or community building to plant a tree after viewing the video, guidelines are provided by the Arbor Day Foundation located in the Additional Resources, and can help them with their planning. These include how to plan to plant trees to shade a home, planting trees to shade paved areas and to break the wind and reduce blowing snow and dust. Students can use a map of their school grounds or community to design where they would plant trees. 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.
4. Summarize with students by asking them to reflect on their action plan. What would be the impact of their action? How would it benefit trees? How would their plan benefit their community?

Extend Slides

Presentation Slide 34

1. If The Giving Tree[i] story is available teachers may consider sharing in its entirety. Ask students, in what ways does this story relate to our relationship with trees?
2. Teachers may also consider participating in the following citizen science projects with students;
   a. http://www.scistarter.com/project/614-Leafsnap

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    b. http://www.scistarter.com/project/472-National%20Tree%20Benefit%20Calculator
    c. http://www.scistarter.com/project/655-PlantTracker
    d. http://www.scistarter.com/project/632-Tiny%20Terrors%20Project
    e. http://www.scistarter.com/project/496-Invaders%20of%20Texas
    f. http://www.scistarter.com/project/492-PhillyTreeMap
    g. http://www.scistarter.com/project/485-The%20American%20Chestnut%20Foundation
    h. http://www.scistarter.com/project/478-Track%20Invasive%20Species%20
    i. http://www.scistarter.com/project/457-Cloned%20Plants%20Project
    j. http://www.scistarter.com/project/351-Tree%20Trackers%21

Evaluate

Specific questions:
1. How do trees benefit humans and the environment?
2. What threats do trees face?
3. What can people do to protect and promote trees in their community?

Additional resources and further reading

Leafsnap
http://leafsnap.com/
An electronic field guide that uses visual recognition software to identify tree species from photographs of their leaves.

Tree Identification Key
http://www.dec.ny.gov/docs/lands_forests_pdf/treeidkey.pdf
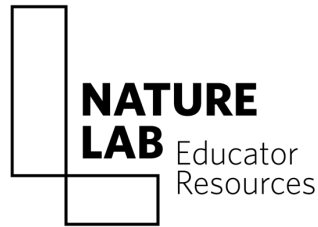A PDF dichotomous key to identify trees.

Center for Urban Forest Research (CUFR)
http://www.fs.fed.us/psw/programs/uesd/uep/
CUFR, a unit of the US Forest Service, is the leading research institute studying the environmental benefits of urban forests.

National Arbor Day Foundation

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http://www.arborday.org/
Their mission is to inspire people to plant, nurture, and celebrate trees.

SelecTree
http://selectree.calpoly.edu/
SelecTree is an interactive tree selection website developed by the Urban Forest Ecosystems Institute at Cal Poly.

National Tree Benefits Calculator
http://www.treebenefits.com/calculator/
The NTBC is an online tool that uses information from iTree to calculate the benefits of individual trees.

CITYgreen
http://www.americanforests.org/what-we-do/what-we-do-urban-forests/
CITYgreen is GIS software to analyze the ecological and economic benefits of tree canopy and other green space.

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[i] Shel Silverstein the giving tree excerpt: http://www.goodreads.com/work/quotes/30530-the-giving-tree

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