



Climate Change through Tree Planting



Lesson written and contributed by the [LEAF Program](#)

Nutshell

In this lesson, students will explore the role trees can play in addressing climate change. Students will brainstorm and discuss the benefits that trees provide. They will design a tree planting effort with the opportunity to develop a tree planting plan for their school or community.

Big Ideas

The Big Ideas are connections to the Wisconsin K-12 forestry education and urban forest education conceptual guides. The conceptual guides can be accessed at: http://www.uwsp.edu/cnr/leaf/Educators/lesson_guides.aspx.

Humans value forests for their aesthetic, cultural, ecological, economic, educational, and recreational benefits. *Forestry Education subconcept 23*

Management starts with planning. Wisconsin foresters prepare forest management plans based on landowner goals and objectives, capabilities of the forest site, and tools available (e.g., planting, harvesting, using prescribed fire). *Forestry Education subconcept 44*

All citizens have a responsibility to be stewards of the environment that sustains human life. This includes making informed decisions about forest resources. *Forestry Education subconcept 53*

The tree canopy retains stormwater, reduces heat island effects, absorbs pollutants, and provides wildlife habitat. These benefits are important and quantifiable. *Urban Forest subconcept 6*

Urban forests affect the physical and psychological health of human residents. *Urban Forest subconcept 7*

A healthy urban forest can provide economic benefits including reduced energy use costs, reduced stormwater runoff, and increased property value. *Urban Forest subconcept 8*

Objectives

Upon completing the lesson, students will be able to:

- Understand how tree planting is one way to be a good steward of the environment.
- Understand the multiple benefits trees provide, including impacts to climate change and sustainability impacts.
- Implement a tree planting project on the school grounds, school forest, outdoor classroom, and/or in the community.

Subject Areas

Language Arts, Social Studies, Science

Lesson/Activity Time

1: BRAINSTORM	5 minutes <i>(Note: if the webquest is used, add an additional 15 - 30 minutes)</i>
2: FOCUS ON CLIMATE CHANGE	20 minutes (plus possible extensions)
3: DESIGN A TREE PLANTING	45 minutes (plus possible extensions)
Alternate 3: TREE INVENTORY	90 minutes (plus possible extensions)
Conclusion: ENVISION A FUTURE	30 minutes

Teaching Site

CLASSROOM

SCHOOL GROUNDS and surrounding neighborhood, school forest, or other outdoor space can be used if using Alternate Activity 3 and Extensions.

Materials List

- Whiteboard, flipchart, or smartboard
- Access to internet (if using webquest)
- Tree Planting Design Diagram and Worksheet for each student

Background

The information below, except where noted, was taken from the LEAF Urban Forest Lesson Guide:

<http://www.uwsp.edu/cnr/leaf/Adobe/Urban/PDFUrbanGuide.pdf> *The information provided is in reference to urban forests, but these benefits and values also apply to rural forests.*

Canopy, or tree canopy, is a term used to describe the leaves and branches of a tree or group of trees. In an urban forest, tree canopy is important to the potential benefits the forest may provide. In general, the more area it covers and the denser the canopy, the more benefits the trees can provide. Although one tree is better than none, 100 are better still. Whether the benefits are from one tree or many trees, they are all still real and most can be quantified in some way. Often, forest benefits are divided into three categories: social, economic, and ecologic. It is difficult to divide the benefits that the urban forest canopy provides into these categories because so many benefits fall into more than one.

Social Benefits

Just as with a rural forest, an urban forest provides many benefits. Numerous studies have been done about the social and psychological benefits of “green” in urban environments. The findings of the studies make a strong case for the importance of urban forests. Urban public housing residents who lived in buildings without trees and grass nearby were asked about how they cope with major life issues. They reported more procrastination and assessed their issues as more severe than residents with green nearby.

A study done with children with Attention Deficit Disorder (ADD) found that children with ADD were better able to focus and concentrate after playing in natural, green settings, than in settings where concrete was predominant.

Apartment buildings with high levels of greenery have been shown to have approximately half the number of crimes than those with little or no greenery. The results proved true for both property crimes and violent crimes. A similar study found that residents living in areas without nearby nature reported more aggression and violence than those living with nearby green. In addition to these specific studies, access to nature also provides humans with other social benefits. Parks and other green spaces provide a space for people to play, walk, jog, birdwatch, or just sit quietly. These activities are good for our physical health in a society that is increasingly sedentary. It is also good for our mental health by providing a place to unwind. Trees also reduce noise levels.

Economic Benefits

The economic benefits of urban forests are increasingly being documented. Economics often becomes the language used when it comes to urban forest management. Budgets of municipalities must cover an array of services, and the benefits of an urban ecosystem must often be proven to secure funding. In a study that considered the costs and benefits of municipal forests in five U.S. cities, the researchers found that for every dollar spent on trees, the benefits returned were worth from \$1.37 to \$3.09. A little math tells us this is clearly a good investment.

Trees save money through reduced energy costs. Cities create what is referred to as a heat island. The concrete, asphalt, buildings, and other surfaces absorb and hold heat from the sun. During hot summer days, cities can be five to nine degrees warmer than surrounding areas. Shading, evapotranspiration, and wind speed reduction provided by trees help conserve energy in buildings. A study conducted in Minneapolis, Minnesota, showed that trees placed in the proper location can reduce total heating and cooling costs by eight percent.

Homeowners not only reduce costs of heating and cooling their homes, but increase the value of their property by planting trees. Research suggests that property value can increase three to seven percent when trees are present. Trees also make homes and neighborhoods more desirable places to live. One economic benefit that urban trees can provide, but often don't, is one based on products. Municipalities and tree services across the country have come up with ways to use the wood that is cut from an urban forest. Products range from specialty furniture, to musical instruments, to lumber for park shelters, to artwork. The income from selling products from the wood of trees being removed could be used to defray the cost associated with the removal, making trees an even better investment.

Ecologic Benefits

Benefits often fall into more than one category. Such is the case for energy savings. Not only does reducing energy consumption save money, it has ecological benefits as well. With reduced energy consumption comes reduced pollution, which improves air quality. According to a publication by the USDA Forest Service, urban forests provide four main air quality benefits:

1. Trees absorb gaseous pollutants (e.g., ozone, nitrogen oxides, sulfur dioxide) through leaf surfaces.
2. Trees intercept particulate matter (e.g., dust, ash, pollen, smoke).
 - a. They bind or dissolve water-soluble pollutants onto moist leaf surfaces.
 - b. They capture and store larger particulates on leaf surfaces which may be waxy, resinous, hairy, or scaly. They also capture and store particulates on rough bark surfaces.
3. Trees capture carbon dioxide and release oxygen through photosynthesis.
4. Trees transpire water and shade surfaces, which lowers air temperatures, thereby reducing ozone levels.

Water runoff from rainfall can be a challenge in cities. Most of the methods used for runoff control (such as storm sewers) create a host of problems such as pollution, failure to recharge groundwater, and loss of wildlife. Trees have a positive impact on this problem. For example:

- Leaves and branch surfaces intercept and store rainfall, thereby reducing runoff volumes and delaying the onset of peak flows.
- Roots create air spaces in soil and therefore increase the rate at which soil absorbs rainfall and the capacity of soil to store water. This reduces runoff.
- Tree canopies reduce soil erosion by diminishing the impact of raindrops on bare soil.
- Transpiration through tree leaves reduces soil moisture, increasing the soil's capacity to store rainfall.
- When runoff is reduced, the number of pollutants entering groundwater, rivers, and lakes decreases.

Reducing water runoff from storms with trees also falls into the economic benefit category. As water is slowed and absorbed or evaporated, it avoids being forced into a storm sewer. Less water entering the storm sewer system means less cost to treat it.

Don't forget that trees provide habitat for animals in urban areas, just as they do in rural forests. This increased wildlife presence makes a healthier ecosystem and certainly makes it a more interesting place for us to live.

Trees and Climate Change

The information about how trees impact climate change is taken from the National Arbor Day website <http://www.arborday.org/globalwarming/treesHelp.cfm>, and the American Forest Foundation website www.americanforests.org/resources/climatechange/

Deciduous trees, planted on the west, east and south sides, will keep your house cool in the summer and let the sun warm your home in the winter, reducing energy use.

Just three trees, properly placed around a house, can save up to 30% of energy use.

Trees or shrubs planted to shade air conditioners help cool a building more efficiently, using less electricity. A unit operating in the shade uses as much as 10% less electricity than the same one operating in the sun.

Neighborhoods with well-shaded streets can be up to 6–10° F cooler than neighborhoods without street trees, reducing the heat-island effect, and reducing energy needs.

Shaded parking lots keep automobiles cooler, reducing emissions from fuel tanks and engines, and helping reduce the heat-island effect in communities.

Trees absorb carbon dioxide (CO₂), the primary gas causing global climate change. Trees retain the carbon (C) from the CO₂ molecule and release oxygen (O₂) into the atmosphere. The retained carbon makes up half the dry weight of a tree.

Forests are the world's second largest carbon reservoirs (oceans are the largest). Unlike oceans, however, we can grow new forests. One acre of forestland will sequester between 150 - 200 tons of CO₂ in its first 40 years.

Procedure

ACTIVITY 1: Brainstorm benefits that trees provide

1. Using a whiteboard, smartboard, or flipchart to record responses, lead a brainstorm of the benefits that trees provide. A wide variety of responses are appropriate, and ideas are included in the background section of this lesson. Be sure that students are offering benefits from both urban and rural forests and a diversity of values including social, economic and environmental benefits. If needed, prompt responses to list benefits of both forest types. Also, prompt students to provide responses related to climate change if they aren't offering them on their own (e.g., provide shade, reduce energy costs, store carbon).

If desired, you could provide students with links to websites listed below and have them complete a webquest in place of the brainstorm. Following the webquest, discuss with the students the responses they found to the question: *What benefits do trees provide?*

Websites for webquest:

www.ecokids.ca/pub/eco_info/topics/climate/tree_planting/why_plant_trees.cfm

<http://www.arboday.org/trees/benefits.cfm>

For a fun musical connection, you can sing the “*Why Plant Trees*” song found at:

http://www.dnr.state.wi.us/forestry/Uf/awareness/arbor_day_pdfs/why-plant-trees.pdf

ACTIVITY 2: Focus on Climate Change

Following the general discussion on benefits of trees and forests, the discussion will focus on trees' impacts on climate change.

1. Share with students that you are going to explore trees' connection to climate change.
2. Share that scientists who study the earth's climate believe it is changing. The earth is becoming warmer than it has since humans lived on the earth. Most scientists believe that the warming is caused by human activities such as the burning of fossil fuels. This is due to the role that certain gases play in the greenhouse effect – the trapping of heat within earth's atmosphere.
3. Ask students to write down a list of benefits trees provide to climate change and how the trees do it. You can provide a chart (example below) the students can use to record the responses.

What impacts do trees have on climate change?	How do they do this?
Ex: keep houses cool so they don't need as much air conditioning in the summer	Block the sun's light with their branches and leaves
Ex: take carbon dioxide out of the air	Photosynthesis

4. After a few minutes, have students share their lists. Discuss their answers as a whole class.
5. Share with students that, in general, trees help address climate change two different ways: 1) Trees decrease fossil fuel used for heating and cooling. By providing shade, serving as wind breaks, and reducing summer temperatures through transpiration of water, trees reduce heating or cooling needs. Electricity needing for cooling comes primarily from coal fired power plants. Heat is produced by natural gas or propane. 2) Trees absorb carbon dioxide. They use it during photosynthesis to make food and the structure of the tree.
6. Explain to students that, in some cases, the impact that a tree has on climate change is dependent on its location. This is most true for trees that reduce fossil fuel use. To be effective wind breaks, evergreen trees need to be planted nearby and upwind from buildings. Ask students why evergreen trees are the best windbreak trees (they keep their needles all year long and therefore block more wind in the winter than deciduous trees). To be effective shade trees, deciduous trees should be planted on the west, east and south side of building to provide shade from the summer sun while allowing the winter sun to reach the building. Of course, all living trees absorb carbon dioxide. So, the location of trees to address climate change through carbon storage isn't as important.

Additional activities and background to support the Focus on Climate Change discussions:

- Much more background information and activities on climate change can be found in the Wisconsin DNR Climate Change activity guide at <http://dnr.wi.gov/eeek/teacher/climatechangeuide.htm>
- Further explore the greenhouse effect with the "Greenhouse Effect in Jar" activity from the Franklin Institute at <http://sln.fi.edu/tfi/activity/earth/earth-5.html>
- For more information on how photosynthesis works, see the explanation in "Planting Trees in Your Community Forest" publication, page 10 at <http://pubs.cas.psu.edu/FreePubs/pdfs/uh125.pdf>
- More information about locating trees to save energy can be found on the *Forests Where We Live* "Planting Trees around Your Home" page at www.lpb.org/programs/forest/plantguide.html and the *National Arbor Day Foundation's* "How to Plant Trees to Conserve Energy" page at <http://www.arborday.org/globalwarming/summerShade.cfm>
- For other considerations on tree planting, utilize the "Planting Trees in Your Community Forest" publication, pages 15 – 18 at <http://pubs.cas.psu.edu/FreePubs/pdfs/uh125.pdf>

ACTIVITY 3: Designing a Tree Planting

Tell the students that they are going to design a tree planting to address climate change.

1. Using the Tree Planting Design diagram provided, have students work in pairs or small groups to determine where in the community they will plant trees. Have students draw trees on the diagram. Students should use different symbols or drawings to represent deciduous and evergreen trees. Students should also number their trees as they draw them. If large groups of trees are planted, a number can be assigned to the whole group. Students should place at least 5 trees on the diagram.
2. When they have completed their planting design, have the students complete the Tree Planting Design Worksheet. Students will record the trees they placed on the diagram by number and explain why they planted each tree in its location.
3. Have students share their designs and the reasoning behind where they planted the trees.

ALTERNATE ACTIVITY 3: Tree Inventory

1. Instead of using the diagram provided, have the students create a map and tree inventory of their school ground or neighborhood. Based on the inventory and map, have students recommend locations for tree planting on the school grounds and/or neighborhood.
2. When they have completed their planting design, have the students complete the Tree Planting Design Worksheet. Students will record the trees they placed on the diagram by number and explain why they planted each tree in its location.
3. Have students share their designs and the reasoning behind where they planted the trees.

Extension 1

Have students conduct a tree planting based on their recommendations.

1. Present the plan for tree planting to the school administration, community groups, municipal government, Department of Natural Resources foresters, and other stakeholders to get their feedback.
2. Following feedback, order trees from the appropriate place – seedlings can be ordered from the DNR State Nursery Program when plantings for conservation purposes. <http://www.dnr.state.wi.us/forestry/nursery/> or private nurseries <http://www.dnr.state.wi.us/forestry/Nursery/Order/bareroot.htm> Landscape trees can be obtained from private nurseries and landscape supply businesses. See <http://www.wislf.org>
3. Start planting! Planting support can be provided by DNR foresters or private nursery or landscape supply staff.
4. Consider inviting local media to share the students work and to help educate the public about the impact trees and forests have on climate change.

If you conduct a tree planting, the LEAF Fourth Grade Lesson Guide field enhancement “Caring for the Future of Forests” lesson will be helpful. You can access the lesson at <http://www.uwsp.edu/cnr/leaf/Adobe/FieldEnhancements/4FE3.pdf>

CONCLUSION: Envision the Future

Have the students envision ways their school and community would be better because of tree planting. Have the students write a descriptive story set 30 years in the future in your community in which they completed a tree planting project. What do they see? What do they feel? How do they like being there? What difference did their tree planting make?

Tree Planting Design Worksheet

Names: _____

Tree Number	Type of Tree Deciduous or Evergreen? <i>(tree species can also be used)</i>	Why was the tree planted where it was? How will this tree impact climate change?

Tree Planting Design Diagram

- 1) Determine where you would like to plant trees to have an impact on climate change.
- 2) Determine whether a deciduous or evergreen tree should be planted in each location.
- 3) Draw the trees in the diagram. Draw deciduous and evergreen trees differently.

