



P2 / ORGANIZATION

Learn about the supplies, resources and learning goals in this section. Planning for your learning lab activities is outlined in this component.



P3 / INSTRUCTIONAL PROCESS

This section provides an overview of the steps necessary to successfully complete the inventory and analysis of your school ground trees.



P4 / FIELD INSTRUMENTS

Setting up for the classes outside field data collection is outlined in this section, including an overview of suggested instructional tools.



P6 / DATA PROCESSING

This section provides instruction on how to use the online *i-Tree Design* software to analyze collected data and produce reports.

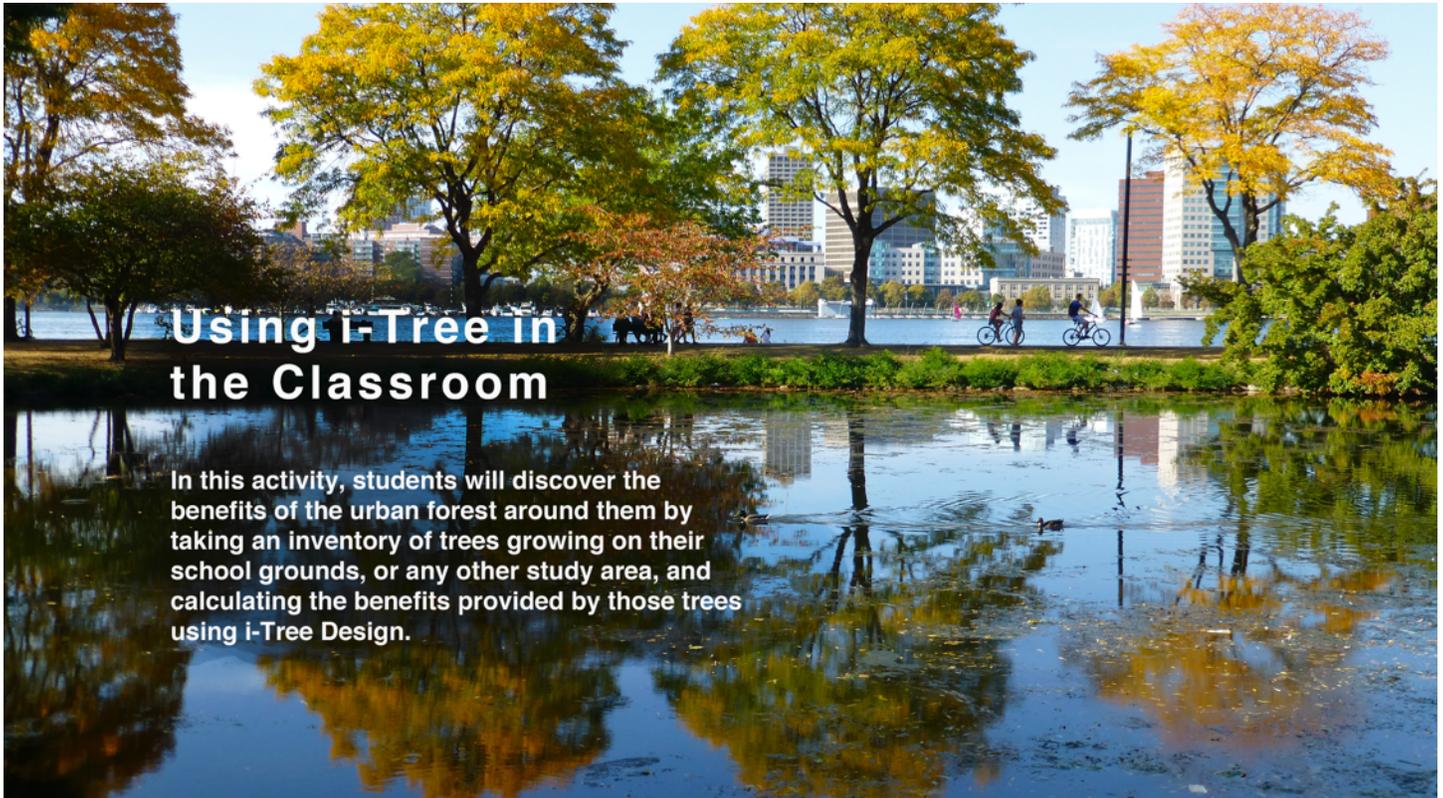


Learning Lab

Learning About Tree Benefits Using i-Tree Design

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Ver 5.0



Using i-Tree in the Classroom

In this activity, students will discover the benefits of the urban forest around them by taking an inventory of trees growing on their school grounds, or any other study area, and calculating the benefits provided by those trees using i-Tree Design.

The i-Tree Learning Lab is an exercise that will help students discover the benefits of the urban forest around them by learning how to conduct an inventory of the trees growing in their school yard. After identifying and measuring the trees, they will enter their data into an online calculator to determine the value and benefit that the trees provide. This exercise will show them how the data they collected can be used to calculate the benefits of their school's trees. This activity is based on the *i-Tree Design* software, which Urban Foresters and many other

professionals use to assess the benefits and costs associated with urban trees.

The software was developed by the U.S. Forest Service and its partners. By using *i-Tree Design* students will be able to quantify the dollar value of aesthetic and annual environmental benefits: energy conservation, air quality improvement, CO₂ reduction, stormwater control, and property value of a tree or set of trees.

This Learning Lab exercise

is one of a series of *i-Tree* classroom and field exercises that can be used to help students learn about the urban forest around them.

An additional variety of exercises for various student levels is also available online. Please visit www.itree.edu for more instructional resources.

“STUDENTS WILL DISCOVER THE BENEFITS OF THE URBAN FOREST AROUND THEM.”

Organization and Outcomes

Using *i-Tree Design* the students are going to learn how to conduct an inventory of trees on their school's property. When they complete their outside field work, the students will enter their inventory field data into *i-Tree Design*, which will enable them to create reports that outline the benefits provided by the trees in the study area.

The following topics found in the *Next Generation Science Standards* are related to the material covered in this *i-Tree Learning Lab* —

ESS: EARTH AND SPACE SCIENCES

MS-ESS3-3 - Apply scientific principles to design a method for monitoring and minimizing a human impact on the environment.

HS-ESS3-3 - Create a computational simulation to illustrate the relationships among management of natural resources, the sustainability of human populations, and biodiversity.

HS-ESS3-4 - Evaluate or refine a technological solution that reduces impacts of human activities on natural systems

LS: LIFE SCIENCES

MS-LS2-3 - Develop a model to describe the cycling of matter and flow of energy among living and nonliving parts of an ecosystem.

MS-LS2-5 - Evaluate competing design solutions for maintaining biodiversity and ecosystem services.



HS-LS2-4 - Use mathematical representations to support claims for the cycling of matter and flow of energy among organisms in an ecosystem.

HS-LS2-6 - Evaluate the claims, evidence, and reasoning that the complex interactions in ecosystems maintain relatively consistent numbers and types of organisms in stable conditions, but changing conditions may result in a new ecosystem.

HS-LS2-7 - Design, evaluate, and refine a solution for reducing the impacts of human activities on the environment and biodiversity.

ETS: ENGINEERING, TECHNOLOGY, AND APPLICATION OF SCIENCE

HS-ETS1-3 - Evaluate a solution to a complex real-world problem based on prioritized criteria and trade-offs that account for a range of constraints, including cost, safety, reliability, and aesthetics, as well as possible social, cultural, and environmental impacts.

HS-ETS1-4 - Use a computer simulation to model the impact of proposed solutions to a complex real-world problem with numerous criteria and constraints on interactions within and between systems relevant to the problem.

Lab Exercise Details

FIELD WORK
LAB WORK

OVERVIEW

Grade Level: Middle to High School

Approximate Time Required: 120 Minutes

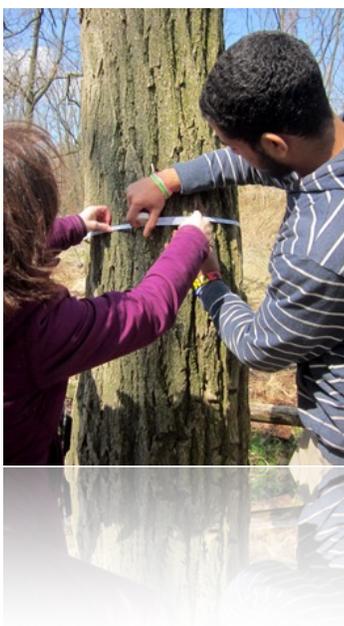
(2 Labs: 60 Minutes Field Work; 60 Minutes Lab Work)

Exercise Materials:

- Computer with internet connection
- Measuring tape(s) or DBH tape(s)
- Map/Air photo of study area
- Field Data Worksheets (Appendix A)
- Tree ID field guide(s)
- Notebook and pencil(s)
- Ribbon and safety pins (Optional)
- Camera (Optional)

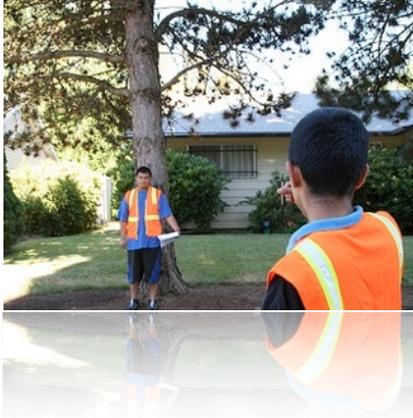
ADDITIONAL INFO

The *i-Tree* website (www.itreetools.org) provides background and support materials for urban forest inventory and assessment field exercises, which may be of value to students who would like to learn more about tree inventories.



Instructional Process

KEY
COMPONENTS



PREPARATION

Divide the class into small groups (2's or 3's, depending on how many trees you wish to survey). Each group will identify, assess, and measure their study trees. Back in the classroom, students will input this information into *i-Tree Design* to determine the value and benefit of their trees.

OUTSIDE FIELD WORK

Refer to the *Field Data Worksheets* (Appendix A) and *Diameter at Breast Height (DBH)* sections (page 4). Take the students outside with measuring tapes, simple tree identification (ID) field guides, and field data worksheets. Have each group look at a different tree and measure the tree using the procedures outlined in the tree diameter measurement section. Next, have students identify the tree genus, and/or species, using the tree ID guides, or have them gather a few leaves or photos of the tree that will help them identify it using online resources. The Arbor Day Foundation has a useful online tree identification guide which can be found at <http://arbordayfoundation.org/trees/whattree/fullonline.cfm>

ANALYSIS

Refer to the *i-Tree Design* section (pages 6-9). Have the students transfer the field data into the computer using the website www.itreetools.org. Once this is completed, the students can view information on the benefits and value of the trees growing in the study area. Use the tabs to explore detailed information about each tree's property value, stormwater, energy, air quality and CO₂ benefits.

WRAP UP

Once the value and benefits of the trees that were surveyed are established, ask the class to briefly analyze and discuss why this information is valuable, from an environmental and practical perspective.

ASSESSMENT REPORT

Have the students write up a summary of their work, including the analysis and information they were able to calculate using *i-Tree Design*. This activity may lead to further discussion and extension of the exercise activities.

EXTENSIONS

To improve their school yard, students can plant one or more new trees that will help establish a sustainable tree canopy on the school grounds. Using native trees is preferred. To find out which trees would be best for the location, contact your state forester or extension agent, or utilize web resources. *i-Tree Species* (www.itreetools.org/species) may also be used for advanced tree species selection.

RESOURCES

Many web-based resources are available that will help students realize the most learning from this hands-on exercise, as well as explore the fundamentals of urban forests and the value of trees in our cities. Please refer to www.itreetools.edu and Appendix B for a list of valuable online resources.



DBH Diameter at Breast Height

DBH is an abbreviation for the term Diameter at Breast Height. It is the measurement to record the size of a tree, and can easily be calculated by students of any grade level. The DBH is always measured at 4.5 feet above ground level.



The size of a tree can be measured with a variety of tools, but using a tape measure provides the most accurate method for determining the size of a tree's trunk.

Overview



DBH is used by foresters and arborists to determine the approximate size and age of a tree. If you will be examining many trees, the students may want to note where 4.5 feet is on their body so they don't have to measure from the ground each time. A simple ribbon can be pinned to their shirt, noting the location that they will use to measure the DBH.

Types of Measuring Tapes You Can Use

If you have access to one, use a standard Forester's DBH tape. These can be purchased at a nominal cost at a forestry supply vendor. Don't worry if you cannot find a DBH tape, as a regular measuring tape works fine, with a simple math conversion. A diameter tape (DBH tape) differs from a standard measuring tape in that it is calibrated to directly measure tree diameter by dividing circumference by π (pi). You can take the measurement from a standard measuring tape and convert it to diameter using a simple math formula.

PROCEDURE

To measuring the tree, wrap the measuring tape completely around the tree (as though putting on a belt), exactly 4.5 feet from the ground. Pull the end of



This image shows a 16" DBH measurement.

the tape until '0' on the tape reaches the tape again. Read the number where zero meets the tape. This number is the circumference of the tree at breast height. (Note: If using a DBH tape – your number will be the actual DBH.) Please refer to Appendix C if the tree has multiple trunks.

CONVERTING CIRCUMFERENCE TO DBH

If using a standard measuring tape, the measurement will then have to be converted to DBH in order to accurately assess the tree benefits utilizing *i-Tree*



Design. You can do this by converting each measurement individually, or by setting up a formula in a spreadsheet program such as Excel or Numbers.

To convert the diameter to circumference, use the following formula:
Diameter = circumference divided by π (the number 3.14)

Example: If the circumference of the tree is 46.5 inches,
Diameter = $46.5/3.14$
Diameter = ~ 14.8 – this would be your DBH measurement.

Using i-Tree Design



OVERVIEW

i-Tree Design allows anyone to make a simple estimation of the benefits provided by individual trees. With inputs of location, species, tree size, and condition, users will receive an understanding of tree benefits related to greenhouse gas mitigation, air quality improvements, and stormwater interception. With the additional step of drawing a building footprint – and virtually “planting” or placing a tree – tree effects on building energy use can be evaluated.

Tree benefits are estimated for (a) the current year, (b) a user-specified forecast year sometime in the future, (c) the projected total benefits across that future timespan, and (d) the total benefits provided to date (based on estimated tree age). Multiple trees and buildings can be added to compare benefits or to provide a full accounting of a property's trees.

This tool is intended as a simple and accessible starting point for understanding the value of individual trees or a small population of trees to a community.

PROCEDURE

Step 1: On a computer, navigate to www.itreetools.org. Go to the Applications menu and select i-Tree Design from the drop down menu.

Step 2: To the right of the webpage, enter your school address or the area you are studying. Be specific, making sure you add your street address and city. A pop-up dialog box will appear, confirming your address information.



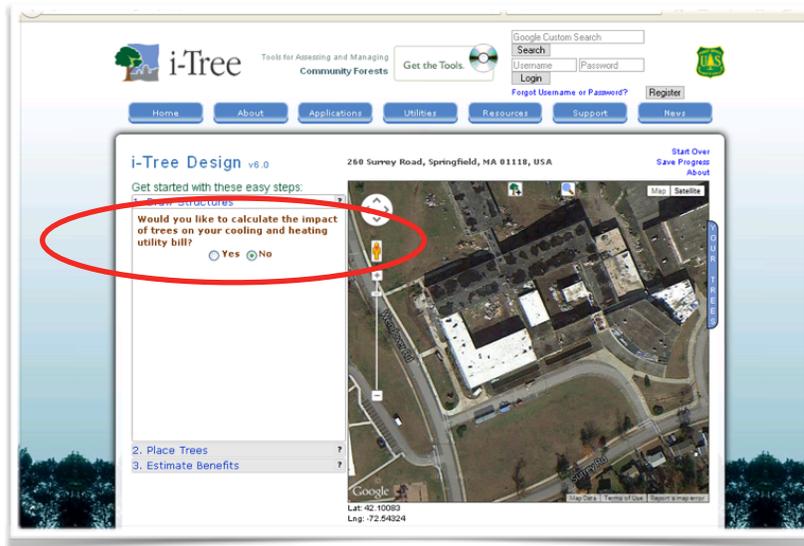
Step 3: Entering Your Data

Draw Structures

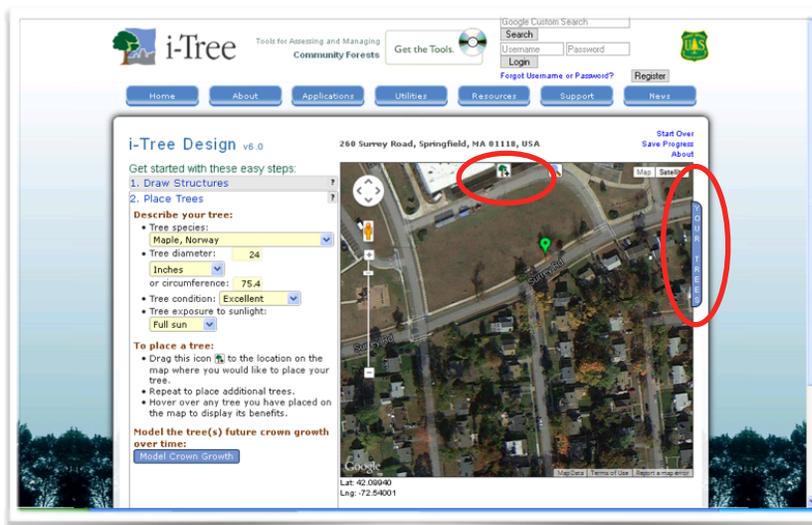
At this determine if you want to calculate the impact of your energy savings. **Note:** If you click Yes, this will require additional steps to be taken. If you want to calculate your energy savings, click yes; otherwise, click no. (If you click yes, please see Appendix D).

Place Trees

In this step, place the trees that you have recorded outside onto your map. Begin by selecting your tree species and size

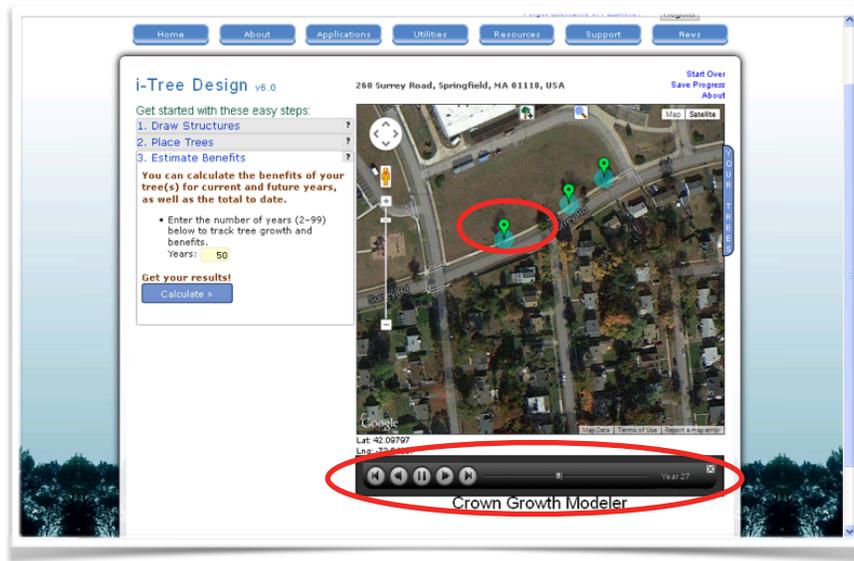


from the left dropdown menu. For example, one of your trees may be a Norway Maple that has a 24 inch DBH. Click on the tree icon at the top of the Google Earth photo, and drag to the specific location of the tree on the map. Drop the tree pin/symbol at that location. If you need to delete a tree because it was misplaced, just navigate to the tab on the right of the image, labeled 'Your Trees,' and click 'Delete'. Add additional trees from the inventory, and navigate around your photo as needed.



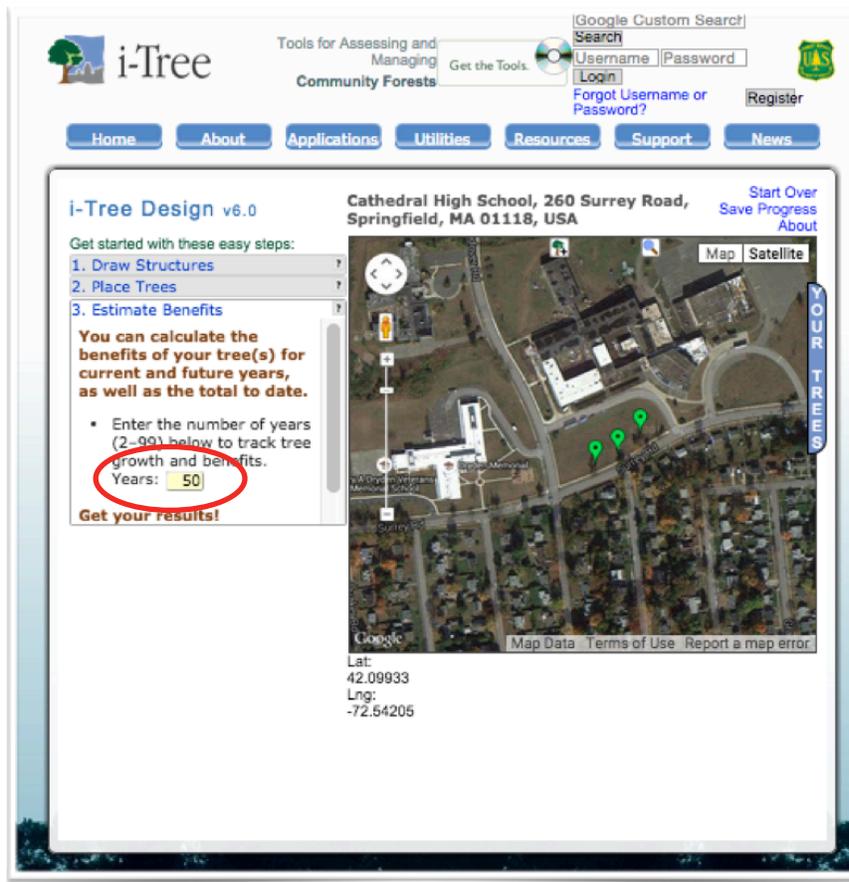
Model Crown Growth

If you want to model the future growth of the tree crowns, click the 'model crown growth' button. The crown growth modeler will interactively demonstrate the growth of the crown as a shaded circle, which expands over time.



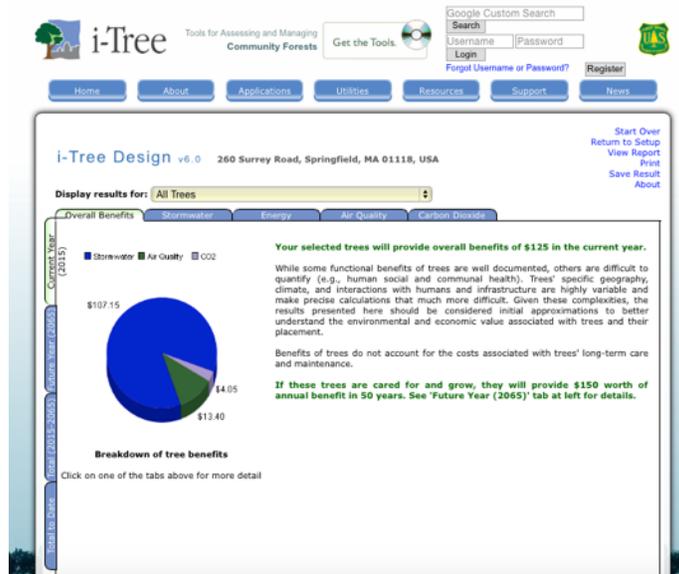
Estimate Benefits

Enter the number of years in the box for which you would like to calculate the projected benefits into the future, and click the 'Calculate' button.

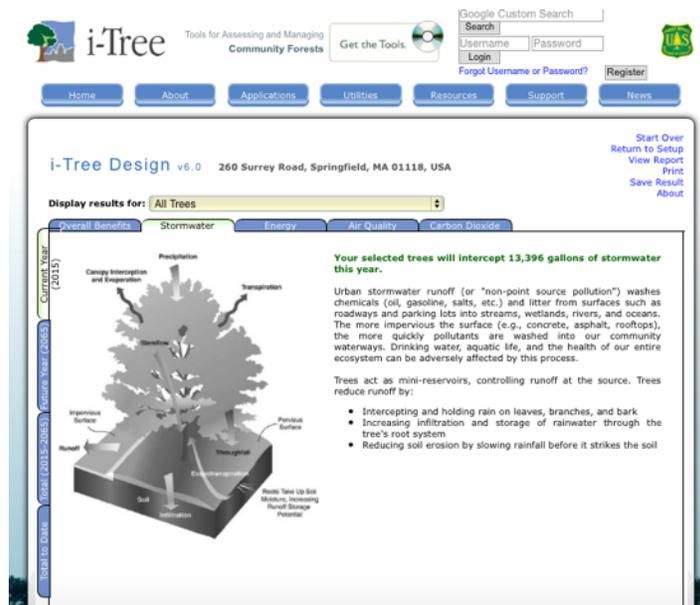


Step 4: Interpreting the Results

Overall Benefits: This graphic will provide results that outline the overall ecosystem services (benefits) provided by the trees. To fully utilize the reporting capabilities of the software, you can use the following as a guide. All of the trees are listed in a dropdown menu, so in addition to all the trees combined, you can view the benefits for each individual tree.



Using the four tabs on the left, you can view the tree benefits over time. The first tab, labeled 'Current Year,' shows the benefits the tree presently provide. The second tab, labeled 'Future Year,' shows the benefits the trees will provide in a chosen future year. The third tab, which is labeled 'Total (Present Year-Chosen Year in the Future),' shows the cumulative benefits of the trees from the present year to the selected year in the future. The last tab, 'Total to Date,' shows the total benefits that the trees provided from the time the trees were 2" in diameter up until the present.



All of these tab options provide students with the opportunity to look at trees over time and to better understand the increased value of trees and their benefits last they increases in size. Additionally the stormwater, energy, air quality and CO₂ tabs can be individually accessed to examine these environmental benefits in more detail. For example, if you click on the stormwater tab, you can see how much stormwater your trees will intercept in this year and subsequent years.