



P2 / WHAT WILL YOU DO?

Learn how you can go outside in your schoolyard and examine trees and estimate their environmental benefits.



P4/ MEASURING A TREE

This section provides an overview of measuring the Diameter at Breast Height (DBH) of a tree to determine its size.



P5/ DATA WORKSHEET

This section shows you how to complete a field data entry sheet when you are working outside with your trees.



P6 / DATA ENTRY & PROCESSING

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



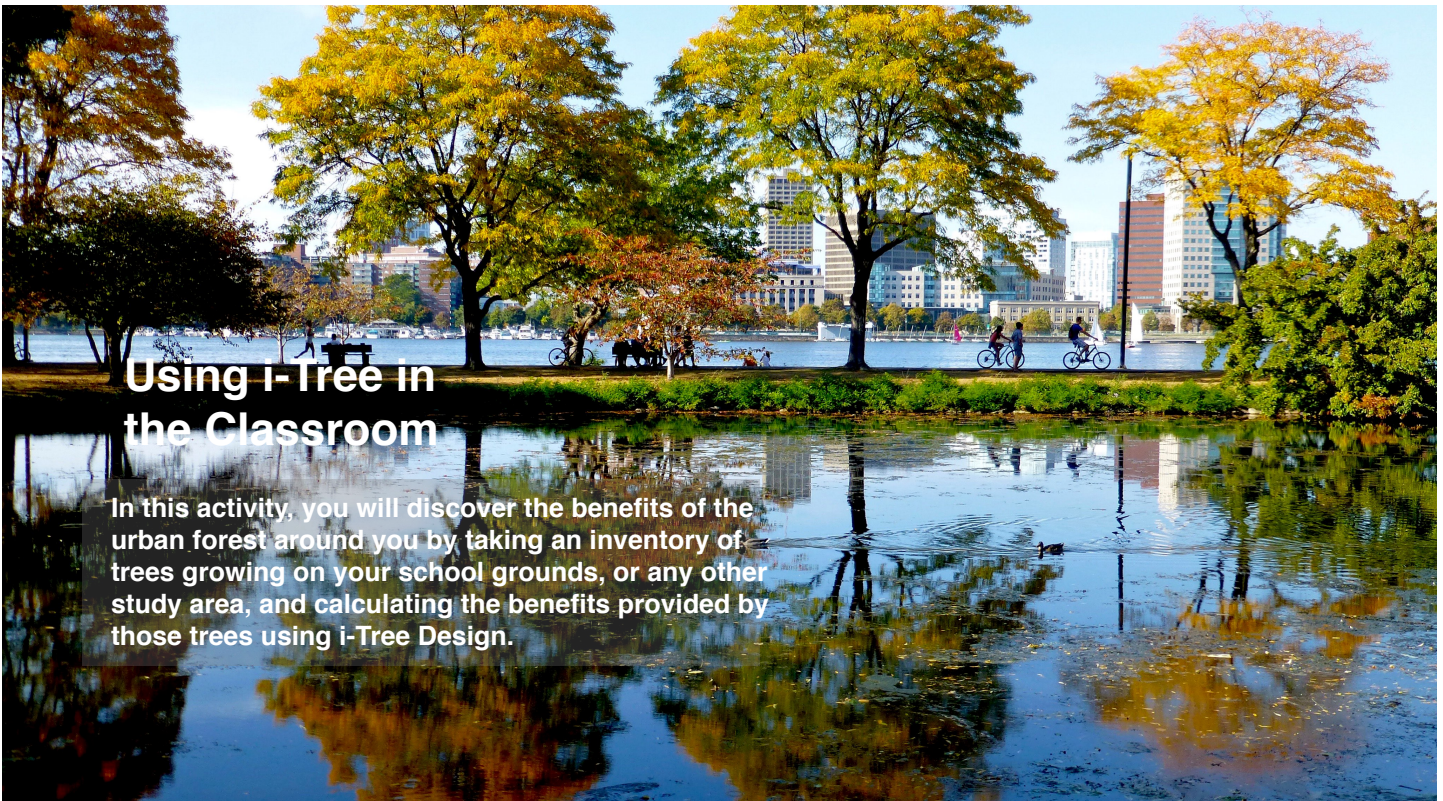
Learning Lab

Learning About Tree Benefits Using i-Tree Design

STUDENT GUIDE

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Ver 4.0



Using i-Tree in the Classroom

In this activity, you will discover the benefits of the urban forest around you by taking an inventory of trees growing on your 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 you discover the benefits of the urban forest around you by learning how to conduct an inventory of the trees growing on your school's property. After identifying and measuring the trees, you will enter your data into an online calculator to determine the value and benefit that the trees provide. This exercise will show you how the data that you collected can be used to calculate the benefits of your 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* you will be able to calculate 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 presents an opportunity for you to explore the trees around you, and help you

to better understand how they can make a difference in the quality of the environment and how much they actually help to make your community more livable. Without trees the air would be dirtier, the waterways would be more polluted, your house and school would be hotter in the summer and your neighborhood would not be environmentally sustainable. The trees help to keep the ecosystem in balance and ensure that the urban forest will keep providing benefits to you for many years to come. Have fun, and enjoy this adventure into your 'urban forest'.

What You Will Be Doing

PREPARATION
AND DATA
COLLECTION

PART ONE

GETTING READY



You will be assigned a team to work with on this exercise. Make sure that you have all the tools that you will need for studying the trees outside. A list of the equipment will be provided by your teacher.

You will learn to measure the size of a tree by determining its *Diameter at Breast Height (DBH)*, using a tape measure. This is the standard measurement that is used to determine the size of a tree. There are several ways to measure the diameter, and your teacher will show you the type of measuring tool that you will be using.

Your teacher will also distribute the *Field Data Worksheets* (Appendix A) and review the information on the sheets, and explain how to use the worksheet when you get outside to examine the trees on the school grounds. Also, you will learn to read a Google Map and identify the location of trees on the map.

You will also need to know a bit about how to determine the species of trees that you will examine. Your teacher will introduce a simple *Tree Identification Guide* that will help you to know what kind of tree you are looking at. This might take a bit of work, but you can also use online resources or visit the Arbor Day Foundation at <http://arbordayfoundation.org/trees/whattree/fullonline.cfm>

OUTSIDE EXPLORATION



Make sure that you have all your tools and worksheets and head outside and look for trees that you can find growing nearby. You can start anywhere you want, but you might want to make sure that the tree is actually growing on school property. It makes sense to start at one side of your map, examining trees as you move up and down, or across the map.

Tree Number. The first tree you find should be noted on your Google Map, and recorded as Tree #1 on the map and field data sheet.

Tree Species. You will then look at the tree and examine its characteristics (leaves, bark, branches, etc.) to determine its species. Record the species on your data sheet.

Condition. Next, look at the tree a bit more closely, and determine its condition, and record that on the worksheet.

DBH. Finally, measure the DBH of the tree and record the measurement on the sheet in inches.

Notes. If you see anything that you want to study later, add that to the 'Notes' section on the work sheet.

CHECK YOUR PROGRESS



Don't forget to mark your Tree ID and location on the Google Map, and keep track of your progress, so that you complete data collection on all the trees on the grounds, and don't miss any as you move across the school property. Once you have completed collecting information on all of the trees you can then proceed to the indoor

What You Will Be Doing

PART TWO

REVIEW YOUR DATA



Once you have collected all of your field data on the worksheets, you should check the sheet to make sure that all of the information on the trees has been recorded. If you have missed something, you can go back outside and check the tree for the information that you are missing. Also, please make sure that the data sheet is filled out legibly, and that the names of all of the members of your team are noted on the sheet, as well as the date that you completed the field work.

I-TREE DATA ENTRY



Your teacher will work with you to complete the data entry component of this study, which includes transferring all of your information from the worksheet into the i-Tree Design online software program. You will be tracing the outline of your school building and placing icons on a digital map, indicating where your trees are growing outside.



You will be transferring the data from your worksheet to the program, working on one tree at a time, and saving your data. A step by step process is outlined later in this manual.

I-TREE ANALYSIS



Once you have entered all of the information on your trees, you can complete the analysis and reporting, using the i-Tree software. Your teacher will help you in carrying out this step and will provide you with ideas on how to analyze your results. Be thorough and creative in your analysis, so you can get the most out of this exercise.

Detailed step by step instructions for the analysis and reporting components are also found later in this manual.



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.

Field Data Worksheets

TREE CONDITION EVALUATION

Team Name: _____
 Date: _____
 School: _____

Class/Teacher: _____



Tree #	Genus/Species	DBH	Excellent/Good	Fair	Poor	Dead	Notes

The Field Data Worksheet is a simple and easy to use tool for recording information about trees on your school grounds or other study areas.

Overview



The Field Data Worksheet is used outside on the school grounds to document information related to each tree in the study area, including species, size, and overall condition.

Procedure

Before leaving the classroom for their outside fieldwork, students will complete the top section of the Field Data Worksheet and take a map of the study area. Once outside, the remainder of the Field Data Worksheet is very simple to complete. Students will assign a unique ID number (eg. 1, 2, 3,...) to each tree, and record its genus and/or species, DBH, condition, and any other notes.

About Tree Condition

During the inventory of the trees on the school grounds, you should also rate the condition of the trees. The following guidelines will help you to determine how to rate your tree's condition. Keep in mind that if you think a tree does not look healthy, it probably isn't. You can use similar types of trees in the area to base your judgments of what the tree you are rating should look like. Once you become more familiar with how specific trees are supposed to look, rating their condition will be easy.

EXCELLENT/GOOD

- Full canopy
- Little to no mechanical damage to trunk
- No dieback of branches over 2" diameter in the upper crown
- No suckering (upright shoots growing from the roots or branches that appear out of place)



FAIR

- Thinning canopy (tree may look different than similar trees around it)
- Significant damage to trunk caused by insects or disease
- Premature fall coloring on foliage (leaves turn colors before they are supposed too)



POOR

- Tree health is declining
- Visible dead branches over 2" in diameter in canopy
- Significant dieback of living branches (the tips have no leaves)
- Severe mechanical damage to trunk, including decay
- Bark may be peeling in dead or dying areas



DEAD/DYING

- No live foliage visible during the growing season (spring through fall)

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.

The screenshot shows the i-Tree Design website interface. At the top, there is a navigation menu with links for Home, About, Applications, Utilities, Resources, Support, and News. The main content area is titled "i-Tree Design v6.0" and contains a detailed description of the tool's capabilities. Below the text, there is a form where a street address is entered: "260 Surrey Road Springfield, MA". The "GO!" button next to the address field is circled in red. Below the form, there is a button labeled "Load Previously Saved Project". At the bottom of the page, there is a small image of a tree and a bar chart labeled "EXAMPLE" showing CO2 levels.

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

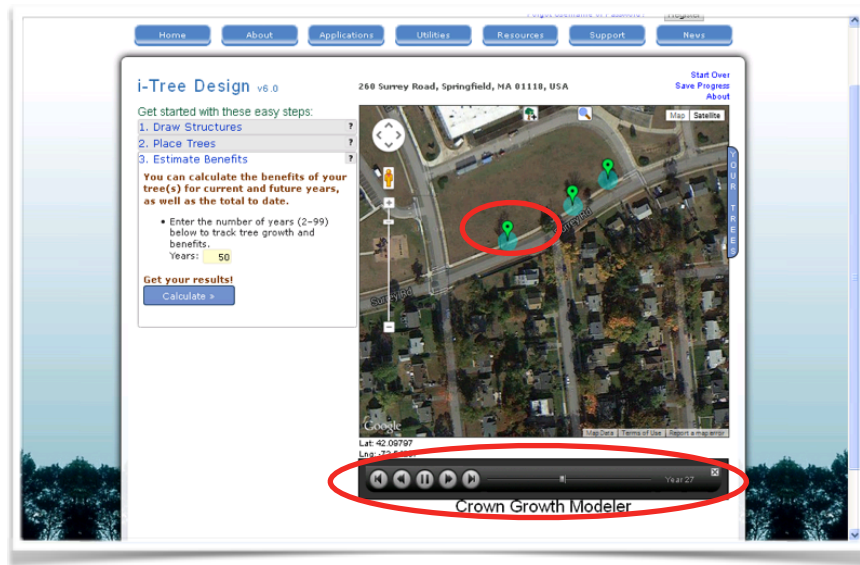


from the left dropdown menu. For example, one of your trees may be a Norway Maple that has a 24 inch DBH. Click on the tree icon at the top of the Google Earth photo, and drag to the specific location of the tree on the map. Drop the tree pin/symbol at that location. If you need to delete a tree because 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.



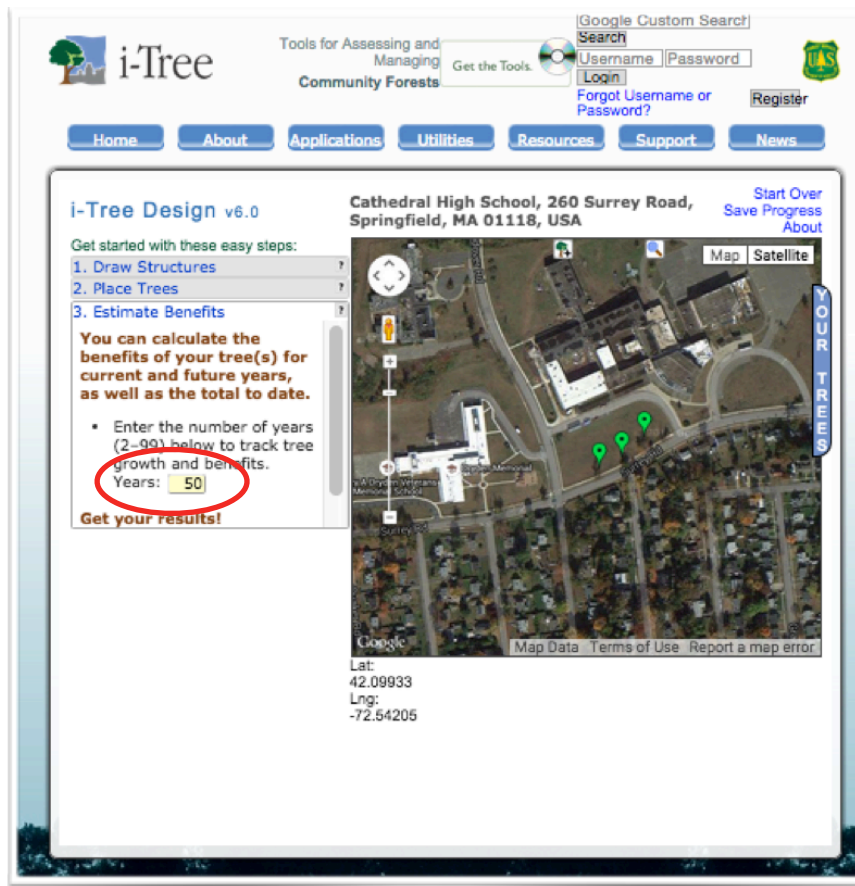
Model Crown Growth

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.



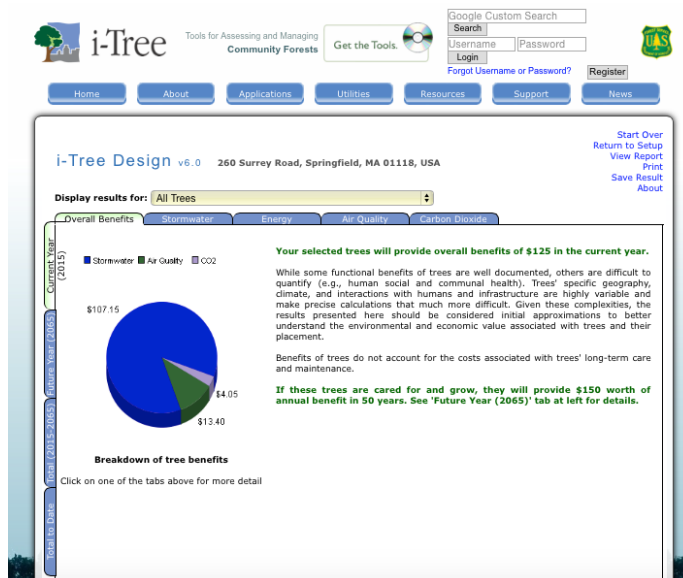
Estimate Benefits

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.

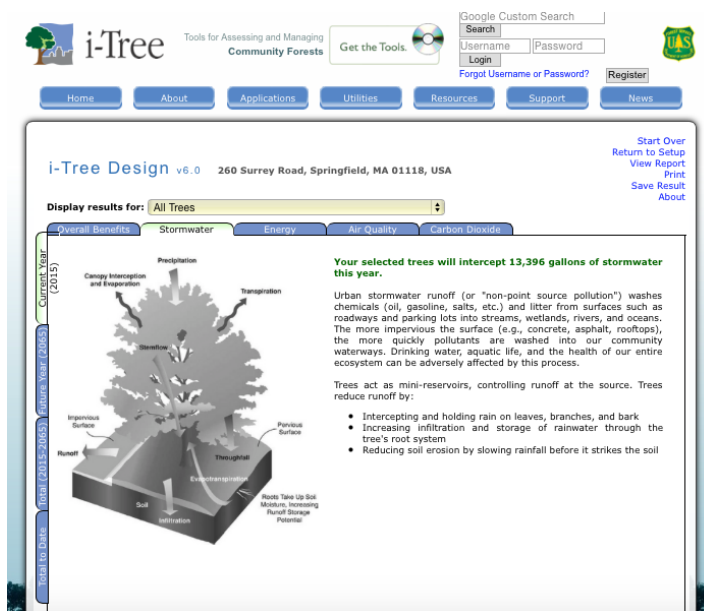


Step 4: Interpreting the Results and Reporting

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.

