A conservation education project to enhance outdoor classrooms at schools, nature centers, and parks.

Tree Trails curriculum was developed by Texas A&M Forest Service in cooperation with Texas Urban Forestry Council and was supported by a grant from the USDA Forest Service.

Presented by

KEEP PINELLAS BEAUTIFUL
KEEP AMERICA BEAUTIFUL AFFILIATE
Tree Trails is a conservation education project to enhance outdoor classrooms at schools, nature centers and public parks. The project creates an education trail focused on trees. Students actively participate in selecting trees, mapping and identifying those trees, and then immersing themselves in related topics like tree structure and function, benefits of trees, tree health, history of famous trees, and ultimately producing and participating in a service learning experience.

Tree Trails serves schools in the digital age with a high-tech online, easy-to-use, educationally sound project that gets kids outside and active in the environment. Tree Trails includes lesson modules for elementary and secondary audiences and provides a research-based instructional approach that integrates language arts, mathematics, science, social studies, technology and state testing measures, with online and outdoor activities to create learning forests at schools.

Texas A&M Forest Service, Texas Urban Forestry Council and Keep America Beautiful are excited to expand their educational role directly into K-12 school classrooms with this program. These organizations believe that environmental awareness is a critical component of youth education that leads to improved stewardship of our natural resources.

**Lesson Modules**

Tree Trails lesson modules are free and accessible online for elementary and secondary levels. An online user-generated GIS mapping system allows you to enter the tree trail data and displays the trails.

The topics included in the modules are:
- Mapping a Tree Trail
- Identifying a Tree
- Measuring a Tree
- Tree Structure and Function
- Benefits and Values of Trees
- Diversity of Species and Ecosystems
- Tree and Forest Health
- Tree History
- Urban Forestry Careers
- Completing a Student Service Leader Project

**Lesson Format**

Lesson modules are formatted in an easy to use, student-centered, instructional approach that is based on best practices and strategies. The instructional procedures follow the 5 E’s learning cycle (R.W. Bybee). The 5 E’s are excite, explore, explain, elaborate and evaluate.

The curriculum is aligned to fifth-grade Texas Essential Knowledge and Skills in reading, mathematics, science, social studies and technology application and to the State of Texas Assessments of Academic Readiness tests of science, mathematics and reading.

Mapping Application  www.treetrails.org
Teacher Lessons and Resources  http://tfsweb.tamu.edu/treetrails
One: Map a Tree Trail
   By understanding maps, students get a sense of where they are in relation to their home, school and neighborhood.
   Trees are often important landmarks along the way.
   Goal: Students will select a minimum of three trees for the Tree Trail.

Two: Tree Identification
   Tree identification is a critical first step towards an understanding of ‘diversity.’ By learning the names of trees, we
   come to appreciate them.
   Goal: Students will identify their Trail Trees and explain how identification relates to tree knowledge.

Three: Tree Measurement
   Tree measurement is fundamental to the practice of forestry. Foresters count trees and measure trees. With just a few
   basic measurements, we can assign values to trees and compare them to each other.
   Goal: Students will measure trees and explain how measurement is used to place value on trees and forests.

Four: Tree Structure and Function
   Trees are living organisms with many specialized structures – leaves, roots, wood, and the living cells that connect them.
   Understanding how trees are constructed and grow is essential to care for trees and calculate the benefits that trees
   provide.
   Goal: Students will explain the structure and function of tree parts.

Five: Benefits and Values of Trees
   Advances in the science of urban forestry allow us to assign monetary values to a wide range of benefits that trees in
   urban areas provide. As trees grow, these values rise – the only part of the built environment of our cities that does so!
   Goal: Students will determine the benefits of trees and calculate their value.

Six: Diversity of Species and Ecosystems
   Promoting ‘diversity’ is a basic principle of urban forestry. A diverse forest implies a more resilient forest, since disease
   or insect outbreaks likely won’t affect every tree all at once.
   Goal: Students will evaluate how the diversity of species affects the ecosystem.

Seven: Tree and Forest Health
   History has shown us the risk of planting too many of the same species in the urban forest. Cities and forests have lost
   many millions of trees to foreign or species-specific diseases and insect pests. Exotic tree species can sometimes invade
   our forest landscapes and crowd out native species.
   Goal: Students will demonstrate ways to keep trees and forests healthy.

Eight: Tree History
   Trees fascinate us because the oldest among them span many human generations. Trees can be a living link to our past,
   or may be planted by the current generation as memorials to important events or people in the community.
   Goal: Students will research the history of a tree(s) and make connections to the past.

Nine: Urban Forestry
   The trees around us – those that make up the ‘urban forest’ – are a reflection of the community itself. Cities often
   organize the protection, planting and care of trees in public spaces, through a Tree Board or other volunteer group.
   Tree City USA is one symbol of a community that cares about its trees.
   Goal: Students will create a Campus Tree Trail Care Plan.

Ten: Student Service Leader
   Arbor Day is the celebration of trees where we live, work, learn and play. Communities set aside one day each year to
   plant and care for trees, usually on public property, such as a school or park. Students can provide the leadership for a
   project to plant or care for trees – either on school grounds or in the surrounding community.
   Goal: Students will design and conduct a service learning project.
# Tree Trails Data Sheet

Name ____________________________

Group ____________________________

School / Organization ____________________________

Trail Name ____________________________

Trail Type

- [ ] School
- [ ] Nature Center
- [ ] Park
- [ ] Other

Hours Involved ____________________________

<table>
<thead>
<tr>
<th>Tree Order #</th>
<th>Latitude (decimal degrees)</th>
<th>Longitude (decimal degrees)</th>
<th>Tree Species</th>
<th>Circumference (inches)</th>
<th>Diameter (inches)</th>
<th>Height (feet)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Crown Spread (feet)  Condition Rating (Good Fair Poor) Comments

<table>
<thead>
<tr>
<th>Tree Order #</th>
<th>Latitude (decimal degrees)</th>
<th>Longitude (decimal degrees)</th>
<th>Tree Species</th>
<th>Circumference (inches)</th>
<th>Diameter (inches)</th>
<th>Height (feet)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Crown Spread (feet)  Condition Rating (Good Fair Poor) Comments

<table>
<thead>
<tr>
<th>Tree Order #</th>
<th>Latitude (decimal degrees)</th>
<th>Longitude (decimal degrees)</th>
<th>Tree Species</th>
<th>Circumference (inches)</th>
<th>Diameter (inches)</th>
<th>Height (feet)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Crown Spread (feet)  Condition Rating (Good Fair Poor) Comments
<table>
<thead>
<tr>
<th>Tree Order #</th>
<th>Latitude (decimal degrees)</th>
<th>Longitude (decimal degrees)</th>
<th>Tree Species</th>
<th>Circumference (inches)</th>
<th>Diameter (inches)</th>
<th>Height (feet)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Crown Spread (feet)</td>
<td>Condition Rating (Good Fair Poor)</td>
<td>Comments</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Tree Order #</td>
<td>Latitude (decimal degrees)</td>
<td>Longitude (decimal degrees)</td>
<td>Tree Species</td>
<td>Circumference (inches)</td>
<td>Diameter (inches)</td>
<td>Height (feet)</td>
</tr>
<tr>
<td>Crown Spread (feet)</td>
<td>Condition Rating (Good Fair Poor)</td>
<td>Comments</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Tree Order #</td>
<td>Latitude (decimal degrees)</td>
<td>Longitude (decimal degrees)</td>
<td>Tree Species</td>
<td>Circumference (inches)</td>
<td>Diameter (inches)</td>
<td>Height (feet)</td>
</tr>
<tr>
<td>Crown Spread (feet)</td>
<td>Condition Rating (Good Fair Poor)</td>
<td>Comments</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Tree Order #</td>
<td>Latitude (decimal degrees)</td>
<td>Longitude (decimal degrees)</td>
<td>Tree Species</td>
<td>Circumference (inches)</td>
<td>Diameter (inches)</td>
<td>Height (feet)</td>
</tr>
<tr>
<td>Crown Spread (feet)</td>
<td>Condition Rating (Good Fair Poor)</td>
<td>Comments</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Getting Started on Leaf Characteristics

**Tree Type**
Coniferous - a tree with needles or scales instead of leaves, bearing cones
Broadleaf - a tree with wide flat leaves

**Parts of a Leaf**
- Stem
- Petiole
- Blade
- Base
- Margin or Edge
- Primary Vein or Midrib
- Secondary or Lateral Veins
- Tip or Apex

**Simple & Compound Leaf**
- Bud
- Leaflets
- Simple Having one blade per leaf
- Compound Having more than one leaflet per leaf

**Leaf Arrangement**
- Opposite Leaves are attached opposite each other on the stem
- Alternate Leaves are attached alternately along the stem
- Whorled 3 or more leaves are attached at the same point on the stem

**Leaf Shapes**
- Lanceolate
- Deltoid
- Oval
- Star

**Leaf Margins**
- Entire Having a smooth edge
- Lobed Rounded segment not divided all the way to the midrib
- Dentate Having triangular, tooth-like teeth
- Serrate/Toothed Having sharp, saw-like teeth

**Leaf Apexes and Bases**
- Acuminate Long tapered point
- Bristle
- Rounded
- Acute
- Rounded
- Cuneate Wedge-shaped
- Inequalateral Not same on both sides
- Truncate Squared off

To find more Leaf Characteristics, visit the Trees of Texas website’s How to ID section: http://texastreeid.tamu.edu/content/howToID/

Illustrations copyright by Robert O’Brien
1. **Crown:** (head) part of the tree that consists of the leaves and the branches at the top of a tree.

2. **Leaves:** (fingers) food factories of the tree. The leaves contain chlorophyll which gives leaves their green color and is responsible for photosynthesis. During photosynthesis, leaves use solar energy from the sun to transform carbon dioxide from the atmosphere and water from the soil into sugar and oxygen producing a chemical change. The sugar (which is the tree’s food) is either used or stored in the branches, in the trunk, or in the roots. The oxygen is released into the atmosphere. Leaves clean the air and use energy from the sun to produce food for the tree.

3. **Branch, Twigs and Boughs:** (arms) A branch is a woody part of the tree connected to, but not part of the central trunk. Large branches are known as boughs and small branches are known as twigs.

4. **Flowers and Seeds:** Flowers produce seeds. Seeds are the primary way that trees produce new trees. Seeds vary greatly in size and shape.

5. **Trunk:** Provides support and is used as “pipes” to transport nutrients to the leaves and sugar from the leaves to the rest of the tree.

   Parts of the Trunk are
   
   a. **Bark:** (skin) protects the tree from injury by animals, diseases, fire, etc. and has a variety of characteristics such as thin, thick, spongy, rough, smooth.
   
   b. **Inner Bark or Phloem:** (arteries) inner bark that carries sap from leaves to rest of tree.
   
   c. **Cambium:** (veins or artery tissue) a thin layer of growing tissue between the xylem and phloem.
   
   d. **Sapwood or Xylem:** (veins) brings water and nutrients up from the tree roots.
   
   e. **Heartwood:** (skeleton) forms the core, is made of deadwood and provides strength.

6. **Roots:** (feet) holds the soil in place, anchor the tree in the ground and absorb water and nutrients from the ground. The roots include lateral roots, rootlets and root hairs.
Getting Started

Rounding Recorded Values

All recorded measurements should be rounded down to the nearest whole number. Rounding a number for tree measurement means to remove the decimal places or fractions of a number and only record the whole number.

Examples: 48.9 feet is recorded as 48 feet, 132 3/4 inches is recorded as 132 inches.

Foresters round down in tree measurements instead of rounding up, because the tree has not yet reached the higher measurement. They keep to whole numbers because of the relative accuracy of repeatability – roughed up bark and even relative humidity can make small differences, as can having the tape measure less than perfectly perpendicular to the centerline of the trunk.

Is It One Tree or Two (or More?)

Determine whether a tree has a single trunk or whether it represents two or more stems growing very close to one another. Trunks that have clear separation or include bark at or near the ground line should be considered separate trees; trunks of different species should also be considered separate trees, no matter how close together. When following the circumference rules below, if the point below the lowest fork places the measurement at the ground line, the stems should be considered separate.

Circumference

General Rule

Diameter at Breast Height (DBH) point is 4.5 feet up from the ground. (Example A)

First, find the DBH point. Then, find the smallest trunk circumference between the DBH point and the ground.

Measure and record, in inches, that smallest trunk circumference. If the tree forks, measure below the lowest fork. (Example B)

Also record the height above the ground, in inches, where the measurement was taken for your records.

Considerations for Determining DBH Point

Tree on Slope: Measure up 4.5 feet along the axis of the trunk on high and low sides; DBH point is midway between these two planes. (Example C)

Leaning Tree: Measure 4.5 feet along both the top and undersides of the trunk; DBH point is midway between these two planes. (Example D)

Low Branches: When determining where on the trunk to measure circumference, ignore portions that do not form part of the tree’s crown, such as dead branches or forks, and epicormic sprouts, which are ones that grow from the trunk or branches.

Obstruction at DBH: If there is a bump, burl, branch, or other obstruction at the DBH point, measure the circumference above and below the obstruction and record the smaller value. A buttress that forms between the trunk and root system as a natural feature of the species (e.g. baldcypress, water tupelo) should not be considered an obstruction.
Height

**General Rule**
Find the vertical distance between the ground line and the tallest part of the live crown. Record the measurement in feet. Also record the method used to determine this value.

Choices include: direct measurement [telescopig pole, climbing], clinometer, hypsometer, relascope, laser rangefinder [w/ or w/o internal clinometer], stick method, pencil method, comparison, or wild guess.

**Pencil Method to Measure Height**
One person stands near the trunk of the tree and the second person stands at a distance where both Person 1 and the top of the tree are visible.

Person 2 holds a ruler (or pencil) upright at arm’s length and (carefully!) walks forward or backward until the entire length of their ruler covers the tree from base to top. (Example E)

Still holding the ruler at arm’s length, Person 2 turns their wrist right or left so that the ruler is now horizontal, with one end even with the base of the tree.

Now Person 2 instructs Person 1 to move away from the trunk in the direction the ruler is pointed (at a 90 degree angle) until they are standing where the end of the ruler points. (Example F)

Person 1 is now standing roughly the same distance from the trunk as the tree is tall. Use a tape measure to record this distance, in feet.

Crown Spread

**General Rule**
Along the drip line of the tree, take two measurements of the crown width, in feet, at right angles, or perpendicular, to one another. Then, average the two perpendicular crown spread measurements.

Drip Line (Example G): the outline on the ground of the outermost leaves of the crown. Include only live portions of the crown.

Measurement 1 (Example H): find the widest crown spread, which is the greatest distance between any two points along the drip line and measure the length, in feet.

Measurement 2 (Example I): turn the measurement line 90 degrees, or perpendicular, from Measurement 1’s line, find the widest crown spread along this plane and measure the length, in feet.
**Stormwater Intercepted**

Trees reduce stormwater runoff and help regulate stream flows. Water runoff from surfaces like roadways and parking lots wash chemicals like oil or gasoline into streams, wetlands, rivers and oceans. These chemicals may harm drinking water, aquatic life and the ecosystem.

Find an interactive poster at http://www.arborday.org/trees/stormwater.cfm

**Air Quality**

Trees improve air quality. Leaves absorb air pollution that causes asthma, coughing and other health issues. Leaves also help remove dust and other matter from the air, then rain washes it to the ground.

**Carbon Dioxide**

Trees help reduce atmospheric carbon. They absorb carbon dioxide during photosynthesis. Trees store carbon dioxide in their roots, trunks and leaves while they grow.

**Energy Savings**

Trees alter climate and conserve energy use. Trees help buildings use less energy. In summer, trees shading east and west walls keep buildings cooler. In winter, allowing the sun to shine on the southern side of a building can warm inside spaces. Trees slow down winds around buildings and help decrease heat loss.

Find an animated model showing trees around a house at


**Property Value**

Trees in front of homes increase property value. Research has verified this by showing that homebuyers are willing to pay more for properties with more trees.

**Resources:**

- National Tree Benefit Calculator
  http://treebenefits.com/calculator/
- USDA Forest Service Center for Urban Forest Research
  http://www.fs.fed.us/psw/programs/uesd/uep/
- Arbor Day Foundation
  http://arborday.org/trees/index-benefits.cfm
- International Society of Arboriculture Consumer Information Program
  http://treesaregood.org/
Group _______

Try to find as many items on this list as you can. You may either find the item or a picture of it. You will have 10 minutes for the scavenger hunt. Items are divided into three levels of difficulty. Keep a tally because each level is worth a different amount.

If you can name what part of the tree the item comes from or what part is used in the product, you will get bonus points!

**Easy Items:** Find it = 1 point; What part of the tree does it come from = 2 points
- Chair _______________________
- Toilet tissue _______________________
- Apple _______________________
- Pecan _______________________
- Paper money _______________________
- Envelope _______________________
- Mulch _______________________   Easy Score _______

**Difficult Items:** Find it = 2 points; What part of the tree does it come from = 3 points
- Molasses (syrup) _______________________
- Toothbrush handle _______________________
- Cork _______________________
- Birdhouse _______________________
- Food packaging _______________________
- Chocolate _______________________
- Charcoal _______________________   Difficult Score _______

**Expert Items:** Find it = 3 points; What part of the tree does it come from = 4 points
- Aspirin _______________________
- Cinnamon _______________________
- Rayon cloth _______________________
- Hairspray _______________________
- Nail polish _______________________
- Ice cream _______________________
- Eyeglass frames _______________________

   Expert Score _______

Total Score _________

Module 5
Answer Sheet

**Easy Items:** Find it = 1 point; What part of the tree it comes from = 2 points
- Chair - solid wood (trunks and limbs)
- Toilet tissue - pulp
- Apple - fruit
- Pecan - nut
- Paper money - pulp
- Envelope - pulp
- Mulch - bark or the whole tree

**Difficult Items:** Find it = 2 points; What part of the tree it comes from = 3 points
- Molasses (syrup) - sap
- Toothbrush handle - pulp
- Cork - bark (mostly from cork oak tree)
- Birdhouse - solid wood (trunks and limbs)
- Food packaging - pulp
- Chocolate - nut (from cacao tree)
- Charcoal - wood

**Expert Items:** Find it = 3 points; What part of the tree it comes from = 4 points
- Aspirin - bark (of willow tree)
- Cinnamon - bark (of laurel tree)
- Rayon cloth - wood fibers
- Hairspray - contains wood resin
- Nail polish - contains chemicals (leftover from making paper, makes polish glossy)
- Ice cream - contains cellulose (makes it smooth and thick)
- Eyeglass frames - Cellulose (dissolved and forms a shape)

Wood is made of tiny fibers (cellulose) and the natural glue (lignin) that holds them together. When wood is turned into pulp, heat and chemicals dissolve the lignin and release the cellulose fibers.

Sap is the watery solution that circulates through the tree.

Resin is a clear or translucent substance that oozes from trees and other plants.
Navigating

Zoom and pan the map.

Navigation field

Enter an address or longitude/latitude in the navigation field.

Search By field

To find an individual trail or a grouping, select a category from the drop down list and type criteria.

Notes:
Trail Name will search for full or partial trail names.
Clear will remove selection criteria and zoom map out.
The criteria in the Search By field is collected for a trail group report.

Add a new trail

Navigate to your area on the map. Click the Add Trail button. Use your cursor to click from tree to tree. Each click will add a tree to the trail. Double click to end the trail.
Note: A trail must contain three or more trees.

To move the map when a trail covers a larger area, first click and release on your tree, then either:
- click and hold to move map screen to the next tree or
- enter an address or longitude/latitude in the navigation field and zoom in to select tree.

Edit a trail

Add trees to one end of a trail

Click on the Extend Trail button. Click on the map to add a tree, then use your cursor to drag a box around either the first or last tree on your trail.

Add a tree to the middle of a trail

Double click the green trail line. Click and drag a white toggle point between two existing trees to the location of the new tree on the map.

Move an existing tree

Double click the green trail line. Click and drag a grey toggle point on an existing tree to a new location on the map.
Generate a report

Individual trail
Click on the green trail line to view the trail information. Select Print Trail button.

Group of trails
Search By your chosen group. Select Print button.
Note: The report title will be what is entered as the Search By field criteria.

Calculate benefits
Benefits are automatically calculated based on your selection.
When the application starts, the benefits for all trails are displayed. When you select a trail, tree or Search By criteria, the benefits for that selection are displayed.
Note: Species and Latest Diameter fields must be complete to calculate benefits.

Display
Show trail types on map
Show trails on map: School Native Center Park Other
To filter which trails are displayed on the map, select one or more trail types.
Note: When printing a trail group report, the trail type display filter does not affect the report content. Only the criteria in the Search By field is collected for a trail group report.

Individual tree
Data is complete
Data is not complete

Tree layers
The Famous Tree and Champion Tree layers can be turned on and off by clicking on the tree icon below the map.

Top 10 most occurring species
The chart includes the top 10 most occurring species is for the selection – whether a single trail, group of trails or other category. When nothing is selected, it is for all trails.