TREE TRAILS

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

SECONDARY

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

★ Tree Trails Curriculum ★

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

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★ Secondary Lesson Modules ★

1-1: 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.

1-2: 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.

1-3: 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.

2-1: 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 how tree parts are structured to function for the tree.

2-2: Ecological Diversity and Native Species

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.

2-3: 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.

3: 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.

4: 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.

Internet Links

Tree Trails: http://tfsweb.tamu.edu/TreeTrails/
Tree Trails Map Application: www.treetrails.org
Texas A&M Forest Service: http://tfsweb.tamu.edu

Module 1-1 Map a Tree Trail

- Instructional Strategies: http://schools.spsd.sk.ca/curriculum/instructionalstrategies/
- Texas Forest Information Portal: http://texasforestinfo.tamu.edu/
- Quick Start Guide for map application: http://texasforestinfo.tamu.edu/treetrails/pdf/TreeTrailHelp.pdf
- Individual and Community Group Guide for creating a trail: http://tfsweb.tamu.edu/TreeTrails/Guide/
- Map My Property: http://tfsfrd.tamu.edu/MapMyProperty/
- Sample Tree Trail: http://texasforestinfo.tamu.edu/treetrails/
  Search By, Trail Name, enter: Heights HCBTR Trail
- Keep America Beautiful Student and Leader Learning Guides, The Social Blast lesson: https://www.kab.org/our-programs/education/student-and-leader-learning-guides

Module 1-2 Tree Identification

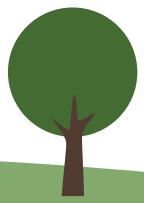
- Instructional Strategies, Think, Pair, Share, Venn Diagram: http://schools.spsd.sk.ca/curriculum/instructionalstrategies/
- Poem: https://www.poetryfoundation.org/poetrymagazine/poems/detail/33182#poem
- Trees of Texas, How to ID: http://texastreeid.tamu.edu/content/howToID/
- Trees of Texas, ID by Leaf: http://http://texastreeid.tamu.edu/content/idByLeaf/
- Trees of Texas, Leaf Collecting & Safety: http://texastreeid.tamu.edu/content/leafCollectingSafety/

Module 2-1 Tree Structure and Function

- Trees of Texas, How Trees Grow: http://texastreeid.tamu.edu/content/howTreesGrow/
- Keep America Beautiful Student and Leader Guides: The Social Blast lesson https://www.kab.org/our-programs/education/student-and-leader-learning-guides

Module 2-2 Ecological Diversity and Native Species

- Keep America Beautiful Leader Learning Guide, Community Greening article, Backyard Biodiversity: http://www.americanforests.org/magazine/article/backyard-biodiversity
- Keep America Beautiful Leader Learning Guide, Discover What Trees Do For Your Community: https://www.kab.org/our-programs/education/student-and-leader-learning-guides
- Firewise, Communities Compatible with Nature brochure: http://www.firewise.org/~/media/firewise/files/pdfs/booklets%20and%20brochures/brochurecommunitiescompatiblenature.pdf



Internet Links

Module 2-3 Tree and Forest Health

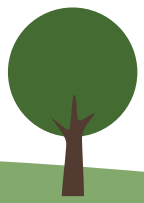
- Trees of Texas, How Trees Grow: http://texastreeid.tamu.edu/content/howTreesGrow/
- Texas A&M Forest Service, Forest Health: http://tfsweb.tamu.edu/foresthealth/
- The Nature Conservancy, The Benefits of Prescribed Fire Video: http://www.nature.org/ourinitiatives/habitats/forests/howwework/maintaining-fires-natural-role.xml
- Good Fires, Fighting Fire with Fire: http://goodfires.org/fire
- Texas A&M Forest Service Forest, Forest Health, Thinning Pine Plantations: Why, When and How?: http://texasforestservice.tamu.edu/uploadedFiles/TFSMain/Manage_Forest_and_Land/Forest_Health/Stewardship/ThinningWorkshopDecember2008.pdf
- U.S. Forest Service, Forest Insect & Disease Leaflets; http://bit.ly/2dw0ko1
- Arbor Day Foundation, Tree Health Guide: https://www.arborday.org/trees/health
- Southern Group of State Foresters, Forest Health: http://www.southernforests.org/rural/forest-health-1
- Western Forestry Leadership Coalition, Forest Health: http://wflccenter.org/priority-issues/forest-health
- Northeastern Area Association of State Foresters, Issues: http://www.northeasternforests.org/content/issues

Module 3 Benefits and Values

- Arbor Day Foundation, Benefits of Trees: https://www.arborday.org/trees/index-benefits.cfm
- Texas A&M Forest Service, Benefits of Trees:
  - Environmental, http://bit.ly/2e1LvuV
  - Social, http://bit.ly/2dEp5iY
  - Economic, http://bit.ly/2cT1Ux2
- i-Tree Design: https://www.itreetools.org/design.php
- i-Tree Lessons, 7 Tree Planting Design: http://www.itreelessons.com
- Create a WIKI page: http://bit.ly/2dJyO3H
- Create a Class Blog: http://wikihow.com/Start-a-Blog-on-Blogger
- Keep America Beautiful Student and Leader Learning Guides, Discover What Trees Do For Your Community: https://www.kab.org/our-programs/education/student-and-leader-learning-guides
- The Nature Conservancy, If Trees Could Sing: http://www.nature.org/iftreescouldsing

Module 4 Student Service Leader

- Careers in Forestry & Natural Resources: http://forestrycareers.org
- Natural Inquirer Scientist Card Series: http://www.naturalinquirer.org/Scientist-Card-Series-v-168.html
- Arbor Day Foundation: http://www.arborday.org
- Texas A&M Forest Service, Urban Forestry: http://tfsweb.tamu.edu/urbanforestry
- Texas Tree Planting Guide: http://texastreeplanting.tamu.edu/
- Keep America Beautiful Student and Leader Learning Guides, Community Service Learning: https://www.kab.org/our-programs/education/student-and- leader-learning-guides
- Keep America Beautiful, Submit Your Stories: http://blog.kab.org/
- Concordia University, Introduction to creating cross-curriculum comics and graphic novels: http://bit.ly/2dOdxGU
- ReadWriteThink, Comics and Graphic Novels lesson: http://bit.ly/2cVtVJ2



Tree Trails

1-1 Secondary

★ 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 other important landmarks along the way.

Goal and Objectives

Goal: Students will select a minimum of three trees for the Tree Trail.

Objectives: Students will

1. Select, order and plot a variety of trees for a class Tree Trail and publish on the Tree Trails application.
2. Explain how trees are important landmarks for their school, neighborhood and community environment.

Materials

General

- Tablet(s) or computer(s) with internet access
- Projector and screen
- GPS unit or phone/tablet with location application
- White board or chart paper and markers
- Tree Trails Portfolio, Student Learning Log/Journal

Handouts

- Tree Trails Data Sheet

Time and Internet Links

Instructional Time: 2-3 sessions, 45 minutes each

- Instructional Strategies
  http://schools.spsd.sk.ca/curriculum/instructionalstrategies
- Tree Trails
  www.treetrails.org
- Texas Forest Information Portal
  http://texasforestinfo.tamu.edu/
- Quick Start Guide for map application
  http://texasforestinfo.tamu.edu/treetrails/pdf/TreeTrailHelp.pdf
- Individual and Community Group Guide for creating a trail
  http://tfsweb.tamu.edu/TreeTrails/Guide/
- Map My Property
  http://tfsfrd.tamu.edu/MapMyProperty
- Sample Tree Trail
  www.treetrails.org
  Search By, Trail Name, enter: Heights HCBTR Trail
- Keep America Beautiful Student and Leader Learning Guides
  The Social Blast lesson
  https://www.kab.org/our-programs/education/student-and-leader-learning-guides

Instructional Procedures

I. Engage/Excite

1. Lead a discussion about the development of maps. Ask what it was like to discover the Americas, Artic, and Antarctic; i.e., ask if the early explorers have a plan to find new land? Did they have a map? Did they create a map? What was important to put on a map? When we create our map of trees, what will be important to put on it (size, identification, location, etc.)?
2. Extend the discussion about how maps relate to the landscape, school and community environment. Ask why a map of trees leads to greater understanding of our relationship to our school, community, its resources and landmarks/landscapes. Ask student to list answers in their Tree Trail Portfolio and/or create a class list. Have them include what they want to *Know* about mapping a tree trail.

II. Explore

1. Prompt a discussion about how technology is an important tool to make maps and record information about them. Show students a website where trees have been mapped and recorded by projecting the Tree Trails web application. Let them know this is the website where their class Tree Trail will be published. Show Tree Trails that have been mapped around the United States by clicking on the US map at the upper left side of the website.
2. Move students into small groups of two or three. Provide each group with a computer. Allow students to explore the Texas A&M Forest Service Information Portal and the different applications on this website, such as Forest Ecosystem Values, Forest Distribution, Map My Property and Tree Trails. Invite them to further investigate the Tree Trails application and its different tabs and sections. Encourage them to look at other group's trail and individual tree data.
3. Conduct a discussion about what they found and enjoyed.

III. Explain

1. Lead a discussion about the process of developing their trail map. List these steps on a chart or whiteboard: a. Decide on the location of the class Tree Trail, on campus or another landscape, such as a park; b. Name their class Tree Trail; c. Select trees for their trail; d. Order the trees on the trail; e. Map/plot the trees' trail on the website.
2. Tell students that each group will locate their tree(s) by recording longitude and latitude using a GPS unit or location app for phone or tablet that will be entered on the Tree Trails web application.

III. Explain continued

Provide each student with a Tree Trails Data Sheet. They will finish the data sheet as they develop their class Tree Trail.

Teacher Tip: An alternative method is to print a satellite view map to visually locate the trees. Use the Map My Property web application to find the address and print a copy for each group.

3. Lead student groups outside to select one or two trees each. Ask each group to record the location coordinates of their trees or if using a map, mark the locations. While outside, have the students work together to determine the order of the trees on the trail and assign each group the determined number. This order will be used to publish the class Tree Trail online.

IV. Extend/Elaborate

1. Lead a discussion about how Tree Trails are created and published on the Tree Trails web application. Review the order of the trees. Have a volunteer student mark the trees online as the groups give verbal directions to their tree on the map. They will complete the individual tree data in their small groups.

   Teacher Tip: Use the Quick Start Guide or the Individual and Community Group Guide for specific directions on publishing the class Tree Trail map. The digital trees can be moved or others added after the trail is added. Use the Quick Start Guide's Edit a trail *section for information on how to do that.*

2. Lead a discussion about their Tree Trail as part of the landscape. Ask how their trees form a reference point and help us relate to our landscape.

V. Evaluate

1. Move students into small groups and ask them to reflect over their learning experience and generate a list, on chart paper, of steps used in the development of their Tree Trail.
2. Ask each group to post their charts and share. Have students to analyze each group's synopsis. Conduct a "Challenge" debate session. Any group may challenge another about steps left out or in need further explanation. Close by asking students what they *Learned*. List responses.

VI. Extra Mileage/Attention

Extra Mileage: Regroup students using the expert model; i.e. allow student leader(s) to extend the discussion regarding how Tree Trail projects across the state could help increase awareness of

VI. Extra Mileage/Attention continued

values trees contribute to the landscape. They may create and post their ideas on a class Tree Trail blog and use Keep America Beautiful Leader Learning Guide's "The Social Blast" framework to plan a social media campaign to raise awareness about their Tree Trail as they learn more about their trees.

Extra Attention: Students work in pairs to retell the process of developing their class Tree Trail. Discuss what was easy and what was more difficult. Regroup students according to the different things they found difficult. Students enter their solutions for making the task easier and post solutions in their Portfolios.

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Tree Trails Data Sheet

Name ____________________

Group ____________________

School / Organization ____________________

Trail Name ____________________

Trail Type ☐ School ☐ Nature Center ☐ Park ☐ Other

Hours Involved ____________________

Tree Order #	Latitude (decimal degrees)	Longitude (decimal degrees)	Tree Species	Circumference (inches)	Diameter (inches)	Height (feet)

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

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

Learning Log

Use this Learning Log to write about your reflections, concerns, questions, responses, and just to add notes about your module experience. Each time you sign into your Learning Log, record the date and the Module number you are responding. If you have more than one entry for the same module, sign in again with a different time.

TREE TRAILS

Tree Trails

1-2 Secondary

★ 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 and Objectives

Goal: Students will identify their trail trees and explain how identification relates to tree knowledge.

Objectives: Students will

1. Choose a method to identify trees, determine the tree species of each tree, and enter the identification of their trees on the Tree Trail website.
2. Describe how the tree identification process develops observation skills basic to the scientific process.

Materials

General

- Tablet(s) or computer(s) with internet access
- Projector and screen
- GPS unit or phone/tablet with location application
- White board or chart paper and markers
- Tree Trails Portfolio, Student Learning Log/Journal

Handouts

- Tree Trails Data Sheet
- Getting Started on Leaf Characteristics
- Dichotomous Key Practice Activity

Activity Materials

- Variety of leaves to use for demonstration
- Plastic closure bags and markers (one bag and marker for each tree trail group)
- (Optional) Cameras or camera phones

Time and Internet Links

Instructional Time: 2-3 sessions, 45 minutes each

- Instructional Strategies, Think, Pair, Share, Venn Diagram
  http://schools.spsd.sk.ca/curriculum/instructionalstrategies/
- Poem
  https://www.poetryfoundation.org/poetrymagazine/poems/detail/33182#poem
- Trees of Texas, How to ID
  http://texastreeid.tamu.edu/content/howToID/
- Trees of Texas, ID by Leaf
  http://http://texastreeid.tamu.edu/content/idByLeaf/
- Trees of Texas, Leaf Collecting & Safety
  http://texastreeid.tamu.edu/content/leafCollectingSafety/
- Tree Trails
  www.treetrails.org

Instructional Procedures

I. Engage/Excite

1. Move students into their Tree Trail groups and have them choose a subject and write its description: a favorite personality, car, dress, animal, pet, etc. Ask the groups to keep the subject of their description a secret and exchange it with another group. Each group receiving the written descriptions should draw a picture of that description. Next, ask each group to return the drawing and its description to the groups who wrote it. Have the groups discuss what words helped with drawing. Let students determine what other words would have helped create a more complete picture.
2. Project the poem: "Learning the Trees" by Howard Nemerov. Have students follow along on their computers/laptops. Ask what the author meant when he referred to the "language of trees" used in this poem. Students should open their computers/tablets and go to the How to ID trees section to explore the vernacular of foresters.

II. Explore

1. Conduct a discussion about how foresters use words to create images of trees with vocabulary. Ask how and why scientists must use exact, accurate, specific language and images to identify all living and non-living things. Discuss how the observation skills used to identify trees applies to other scientific investigations. Identification is a first step in the scientific method and is used for discussing and learning about and protecting our world.
2. Continue the discussion by asking what traits they think foresters observe to identify trees. List what they *Know* on a chart/whiteboard or have them add to their Learning Logs.
3. Move students into their Tree Trails groups and to complete the Dichotomous Key Practice Activity. Provide each student with the Getting Started on Leaf Characteristics handout to use as a reference and keep in their Portfolio.

III. Explain

1. Project Trees of Texas How to ID section and/or have students follow on their computers/tablets. Lead students to observe the different identification techniques and all the other information available about identifying trees. Divide the class into three groups to read and report on Classification/Nomenclature, Identification Techniques and Leaves (not arrangement and other information about leaves). Provide chart paper and markers for each group. Each group should

III. Explain continued

choose a recorder and spokesperson and present their findings to the class.

2. Regroup students into their Tree Trail groups and have them use their computers/tablets and go to the next section of Trees of Texas and choose ID by Leaf.

   Teacher Tip: Students need to understand the vocabulary for leaf characteristics to use the key. Drawings are shown in each step of the key to illustrate the characteristics. The dictionary is also valuable for tree identification.

3. Exhibit a variety of leaves. Ask students to watch as you or student volunteers demonstrate how to determine identification using the leaf characteristics: leaf apexes and bases (heart shaped, rounded, tapered), leaf margins (serrated, lobed), leaf textures (hairy, smooth, thick, thin, rough, waxy), leaf structure (simple, compound) and leaf arrangements (opposite, alternate, whorled).
4. (Optional) Next let the students practice tree identification with real leaves by giving each group one or two leaf samples. Have each group create a list of characteristics and label a leaf sketch. Then identify the tree that matches the practice leaf characteristics using the Trees of Texas ID by Leaf key.

   Teacher Tip: Instead of using real leaves, demonstrate how to use the Trees of Texas ID by Leaf key by using the samples from the Dichotomous Key Practice Activity. This can show how using a larger key becomes more complicated and that recognizing and knowing leaf characteristics is important.

5. Next, discuss the need to develop a safety plan before collecting leaves from their tree trail trees. Have students go to the Trees of Texas Leaf Collecting & Safety section. Have students read the safety section and discuss cautions to take while collecting leaves. Develop a Safety Plan before going outside to collect, photograph and study leaves. Post the Safety Plan.

IV. Extend/Elaborate

1. Move the students into their Tree Trail groups. Provide each group with plastic closure bags and a marker, one per tree, to collect leaves from each of their trees. Instruct each pair to label the bags with their Group Name and the tree number/order on the trail. Go outside and collect their tree's leaves and/or photograph them. Remind the students to collect leaves from the ground and on a small branch if possible.

   Teacher Tip: If necessary, get permission to collect samples from the trees particularly if it is a park.

2. When the students return, have each group use a laptop or tablet and go to the Trees of Texas ID by Leaf section to determine the identification of their trees. Once each group has reviewed the information and verified their tree identification, they should write the common and scientific name on the collection bags.

IV. Extend/Elaborate continued

Another online tool for tree identification is the National Arbor Day Foundation What Tree is That?

Teacher Tip: Coniferous trees have needles or scales instead of leaves and are usually evergreen. Broadleaf trees have wide flat leaves rather than needlelike or scale like leaves.

3. Allow each group to display their leaves and photos with their collection bags to the whole class. After they have shared their trees, have them list the common name of trees on a whiteboard or chart. Next mark a tally for the 1st time the tree is identified. Then each student should enter the tree species in the Tree Name column their Tree Trail Data Sheet. The next group shares their trees and lists their trees with a tally mark for each new tree and a second tally for a tree that has already been listed. Then each student completes their Tree Trail Data Sheet name column. Continue until all groups have shared and listed their trees. Each group should go to their laptop to create a Bar Graph to chart their trees, showing the diversity of trees on their trail.
4. Project the Tree Trails mapping application. Demonstrate how to enter the tree name on the class tree trail and then have each group enter their tree name. Once all the tree species are entered, select the green trail line to redefine the program for the computer. The Top 10 Most Occurring Species graph below the map will repopulate showing their Tree Trail data. Have students compare to the graph they created.

V. Evaluate

1. Have each tree trail group create a dichotomous key for all the trail trees using leaf characteristics. Students would decide what characteristics to use at each level of the key and include enough levels to be able to identify to their individual tree species. Depending on the number of different trees, the key could end up with three levels or many more. Have students compare how the different groups accomplished the key. Then have the class work together to create one class key. After creating the key, have another class use it to identify the Tree Trail trees. Publish a print copy of the key or add a digital version to your school website.
2. Have students write, in their Learning Logs, a short list of ways: a) identification is an important scientific process and b) how the identification process contributes to their overall knowledge. Ask students to share in Think, Pair, Share groups of four. They may add to their lists new ideas they *Learned* during the tree identification activities.

VI. Extra Mileage/Attention

Extra Mileage: Have each Tree Trail group create a skit, video, or compose a poem about their tree's leaves - "The Road My Leaf Travels" - preferably sitting outside under their trail trees. This may be

VI. Extra Mileage/Attention continued

a group or individual project. Encourage them to use words that create imagery, feelings and distinguishes their tree. If they choose a poem, they may use different poem techniques like alliteration, onomatopoeia, Haiku, free verse, etc.

Extra Attention: Have students revisit the Tree Trails website to discover additional important characteristics of their Tree Trail trees. Construct a compare and contrast Venn diagram (two circles overlapping in the middle) to compare two different leaves collected. List like attributes in the overlapping section of the diagram and the different attributes for each leaf in circle one and two.

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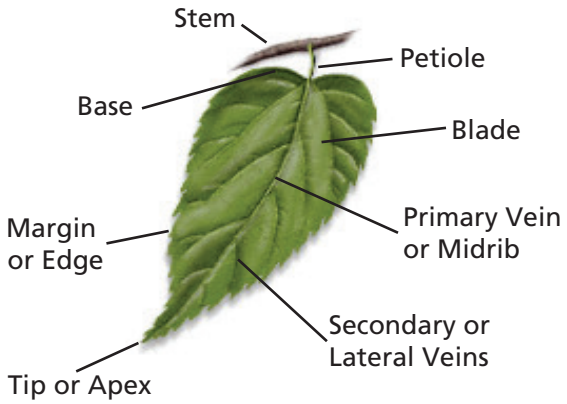
Getting Started on Leaf Characteristics

Tree Type

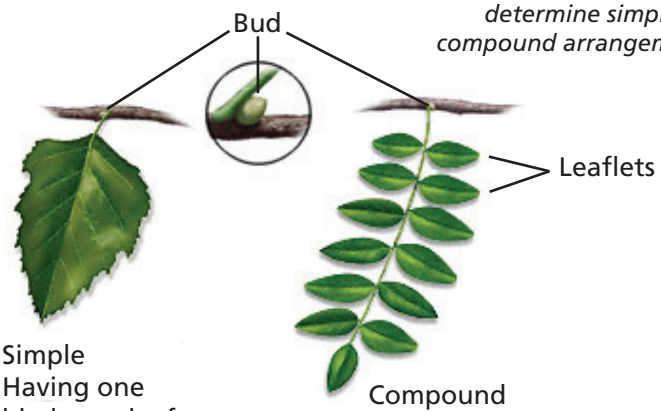
Coniferous - a tree with needles or scales instead of leaves, bearing cones
Broadleaf - a tree with wide flat leaves

Parts of a Leaf



Simple & Compound Leaf

Finding the bud will help determine simple or compound arrangement



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

Serrated/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/

TREE TRAILS

Tree Trails

1-3 Secondary

★ 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 and Objectives

Goal: Students will measure trees and explain how measurement is used to place value on trees and forests.

Objectives: Students will

1. Apply the forester's tree measurement process to measure a tree.
2. Determine the measurements and condition of their trail trees and enter on the Tree Trails website.
3. Construct the relationship between tree measurement and tree health and value.

Materials

General

- Tablet(s) or computer(s) with internet access
- Projector and screen
- GPS unit or phone/tablet with location application
- White board or chart paper and markers
- Tree Trails Portfolio, Student Learning Log/Journal

Handouts

- Tree Trails Data Sheet
- Tree Measurement Guidelines

Activity Materials

- Flexible tape measure
- Yard stick
- (Optional) Cameras or camera phones

Time and Internet Links

Instructional Time: 2-3 sessions, 45 minutes each

- Tree Trails
  www.treetrails.org

Instructional Procedures

I. Engage/Excite

1. Conduct a discussion about measurement. Ask students to name various professions that must use exact and precise measurement to assure their work is exercised without disastrous results. The list may include physicians, transportation engineers, construction workers, aircraft specialists, architects, petrochemical employees, etc. Expand the discussion to include different measurement standards used by different professions. Lead students to generalize that each profession depends on its particular type of measurement design.

   Teacher Tip: Share with students how people once used their bodies (hand and/or arm spans, body height) to measure. Students may have heard that horses may be measured by hand span.

2. (Optional) Students may have fun generating an illustration, a paragraph, a riddle, etc. about a person who used the wrong measurement for a project. Let students share.
3. Generate a conversation about what type of measurement they think professional foresters use and how they use these instruments for measuring trees. List what they *Know* on a chart/whiteboard or have them add to their Learning Logs.

II. Explore

1. Inform students that, like other professions, forester's measure trees using a standard process and they will use this same standard to measure their trail trees.
2. Provide each student with the Tree Measurement Guidelines handout. Project the guidelines and have them watch or follow along on their tablets/laptops.

   Teacher Tip: 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.

   Teacher Tip: It may be helpful to practice measuring a tree, circumference, diameter, height and crown spread, before presenting the guidelines to students.

3. Have students to read the guidelines and watch the demonstration videos on the Tree Trails website. Then follow with a question and answer session.

   Teacher Tip: Students may demonstrate circumference using a cylindrical object. Using the same object, demonstrate diameter and describe how the two measurements are related by the constant, pi.

III. Explain

1. Ask why foresters measure trees. List the responses. Coach students to provide as many reasons as possible. Ask students to check their responses to determine if their reasons included: a. tree size as it contributes to its value and benefits; b. continuous measurement over time allows foresters to monitor a tree's rate of growth; c. a tree's condition is an indicator of the tree's response to its environment; d. measurement is used to plan harvesting, make management decisions and calculate timber yield. Have students Include all the reasons why measurement is important in their Learning Logs.

IV. Extend/Elaborate

1. Have each student retrieve their Tree Trails Data Sheet from their Portfolio and locate the Circumference, Diameter, Crown Spread, Height, and Condition Rating columns. Move the students into their Tree Trail groups. Provide each group with measurements tools. Have students bring their Tree Trail Data Sheet and the Measurement Guidelines with them when they go outside to measure their trees.
2. Ask each group to measure their trail trees as specified in the guidelines and record the information in the appropriate column on their Tree Trail Data Sheet. Have students return to the classroom.
3. Provide the pairs with a laptop/tablet and have them follow along as each step is demonstrated on the projector. Once these steps are completed, closing the data window saves information for the tree.
4. Ask students to notice the left hand side of the screen which lists the annual benefits of the selected trail or tree, either the entire trail or individual trees. This is automatically calculated when the data is entered. Conduct a discussion about the value of their trees. Students may list responses in their Learning Logs.

   Teacher Tip: Module 3 further investigates the annual benefits of trees.

V. Evaluate

1. Have students use another method to measure height of a tree. Then compare this method to the first method.

   Teacher Tip: Find links to other methods on the Tree Trails Lesson page.
2. Conduct a discussion about what they found, *Learned* and enjoyed.

VI. Extra Mileage/Attention

Extra Mileage: Have students work in pairs to write a mathematical word problem related to two or three dimensions of their trail tree and give to another pair to solve. Ask student pairs to analyze how they answered the problem, what helped and what deterred them from getting the answer.

Extra Attention: Appoint peer students to accompany students while they take measurements of their trees with their hands and/or arms and let these students present their new measurements in terms of hand span and arm span measurements.

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

Tree Measurement Guidelines

Getting Started

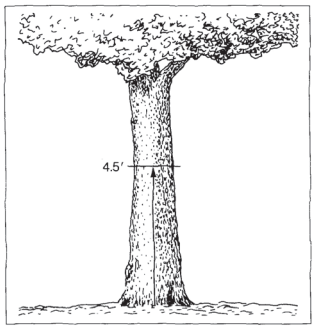
Rounding Recorded Values

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.



A

Circumference

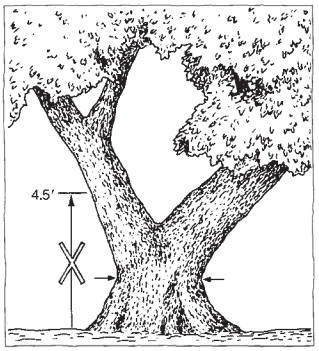
General Rule

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)

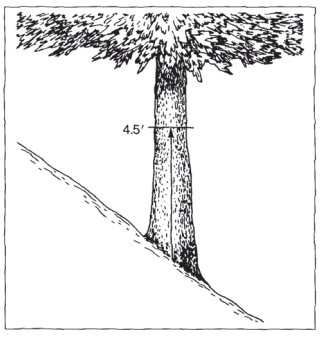
Also record the height above the ground, in inches, where the measurement was taken for your records.



B

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)

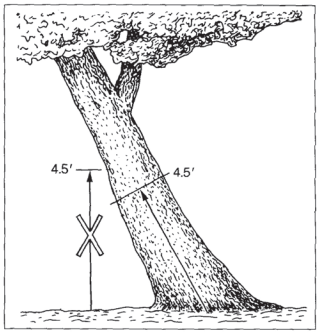


C

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.



D

Tree Measurement Guidelines

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 [telescoping 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.

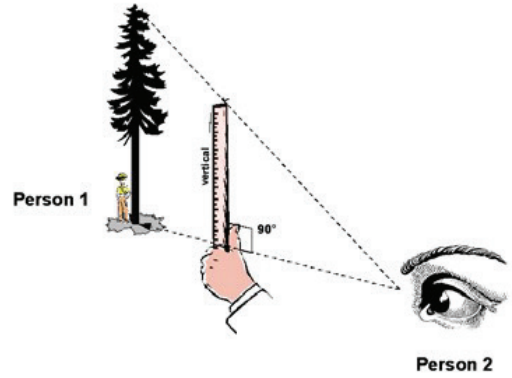
Person 2 holds a ruler (or pencil) upright at arm's length and (carefully!) walks forward or backward until the entire length of their ruler covers the tree from base to top. (Example E)

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.

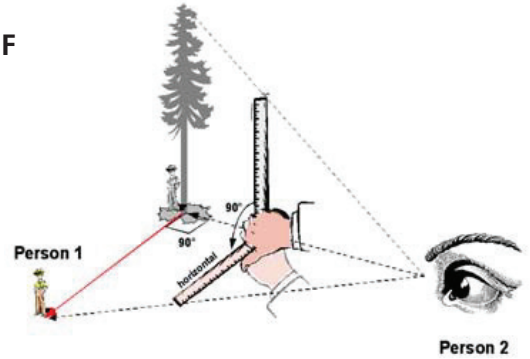
Now Person 2 instructs Person1 to move away from the trunk in the direction the ruler is pointed (at a 90 degree angle) until they are standing where the end of the ruler points. (Example F)

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.

E



F



Crown Spread

General Rule

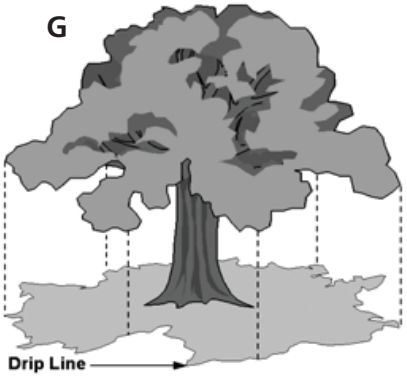
Along the drip line of the tree, take two measurements of the crown width, in feet, at right angles, or perpendicular, to one another. Then, average the two perpendicular crown spread measurements.

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

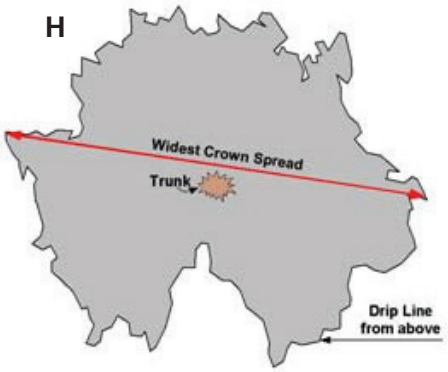
Measurement 1 (Example H): find the widest crown spread, which is the greatest distance between any two points along the drip line and measure the length, in feet.

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.

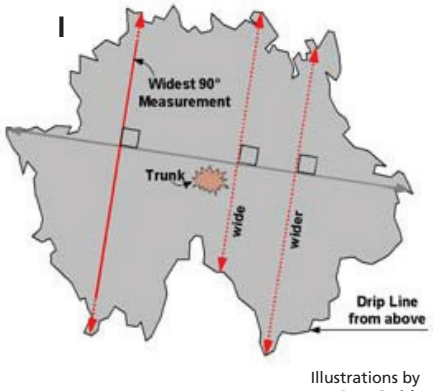
G



H



I



Illustrations by
Pete Smith

Tree Trails

2-1 SECONDARY

★ 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 and Objectives

Goal: Students will explain how tree parts are structured to function for the tree.

Objectives: Students will

1. Differentiate tree structure parts and explain their function.
2. Describe how a tree grows, produces food and distributes it.
3. Demonstrate how a tree grows, produces food and distributes it throughout the tree.

Materials

General

- Tablet(s) or computer(s) with internet access
- Projector and screen
- White board or chart paper and markers
- Tree Trails Portfolio, Student Learning Log/Journal

Handouts

- Tree Parts

Activity Materials

- Materials for video set construction
- Cameras or camera phones

Time and Internet Links

Instructional Time: 2-3 sessions, 45 minutes each

- Trees of Texas, How Trees Grow
  http://texastreeid.tamu.edu/content/howTreesGrow/
- Keep America Beautiful Student and Leader Guides
  The Social Blast lesson
  https://www.kab.org/our-programs/education/student-and-leader-learning-guides

Instructional Procedures

I. Engage/Excite

1. Provide students with the Tree Parts handout to take with them outside as they observe the parts of their trail tree; specifically observe the crown, leaves, branch, flowers/seeds, trunk, bark, and roots. They should take pictures and/or make drawings of their tree.
2. When they return to the class with their pictures, drawings and notes, they should label the parts and discuss their specific Tree Trail tree functions.
3. Ask students what they Want to know about tree parts and list on a whiteboard/chart or in their journal.

II. Explore

1. Select student volunteers to draw a large tree outline on bulletin board paper. Divide the "tree" into sections: a. crown, b. leaves, c. branches, d. flowers/seeds, e. trunk, f. bark, g. roots including lateral roots and root hairs.
2. As a mnemonic device, students may give alternate names to their trees parts; i.e., its hands, its hair, its feet, its shoes, etc.

III. Explain

1. Divide the class into seven groups to expand their research of the seven sections of the tree drawing. They may use the Trees of Texas website and click on How Trees Grow to research their assigned part. They will need to pay particular attention to the underlined words and definitions.
2. Then each group should present their findings. Each group should develop and include an assessment to check other students understanding of their research. It may be a question and answer session, a checklist, a fill in the blank, etc.

IV. Extend/Elaborate

1. To extend their research, students will produce a video skit or another media genre found in the Keep America Beautiful Leader Learning Guide lesson "The Social Blast."
2. Ask students what positions of responsibility are needed to produce a video skit or other media genre. List their responses and ask for volunteers to assume the responsibilities. For the skit, prompt

IV. Extend/Elaborate continued

them to include these kinds of roles: 1. Skit writers, 2. Rap or song writers for lyrics and music, 3. Set designers, 4. Prop constructionist, 5. Materials assemblers, 6. Producer and Director, 7. Video Recorders, etc. Develop a similar list for other media genres.

3. Write the skit and song about what each part does. The skit should be the performance of the part while the students are singing their song. The music and lyric composition of the song may be determined by the students.
4. Have students present the video skit and invite guests as deemed appropriate.

V. Evaluate

1. Have tree trail groups ask questions to the rest of the class about their tree's part and its function such as: "Can you name my part that carries water from the roots? Can you tell how I make food?" Other groups can chime in with additional or corrective responses.
2. Ask students to draw a tree, label the parts and name the function of the different parts. Have students share in pairs or triads and add or correct the drawing. Have students save their drawings and descriptions in their portfolio and/or learning logs.
3. Ask students what they Learned and list on the whiteboard/chart or in their journal.

VI. Extra Mileage/Attention

Extra Mileage: Have students draw a tree, label the part they would want to be and write a paragraph about why they want to be the part.

Extra Attention: Have students work in small groups to compare a tree to a factory, such as an auto manufacturing facility, and list the likenesses and differences.

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

TEXAS A&M FOREST SERVICE

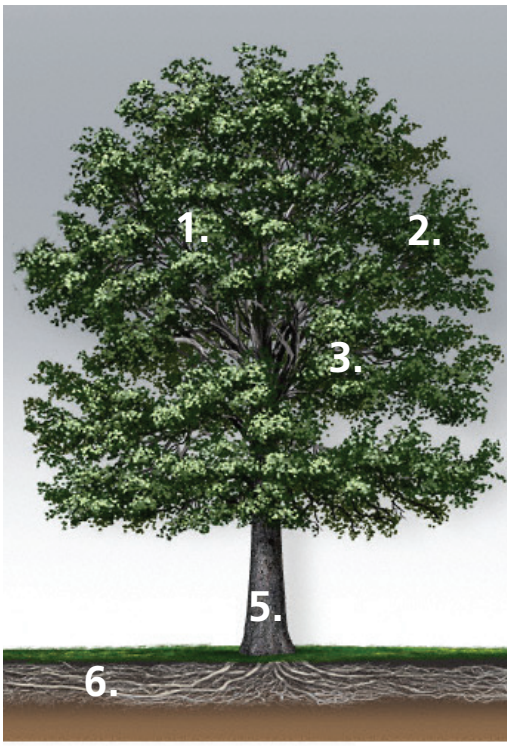
TEXAS URBAN FORESTRY COUNCIL

KEEP AMERICA BEAUTIFUL

Tree Parts

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.



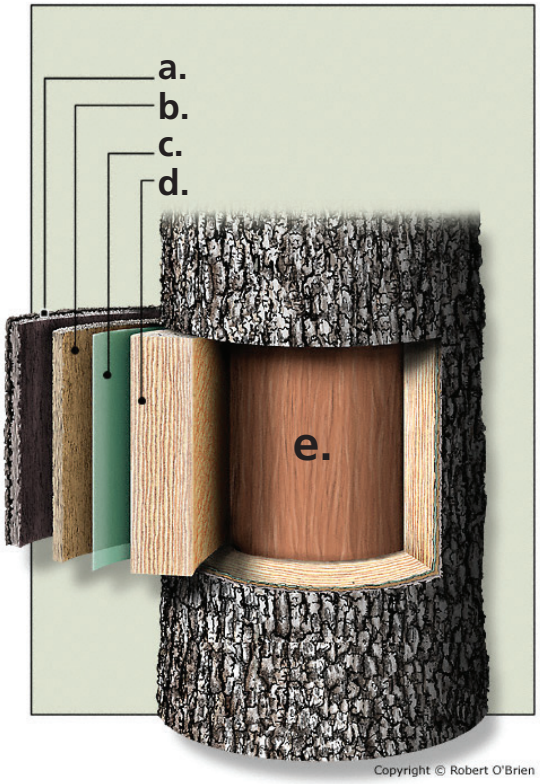
3. Branch, Twigs and Boughs: (arms) A branch is a woody part of the tree connected to, but not part of the central trunk. Large branches are known as boughs and small branches are known as twigs.

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.

Ecological Diversity and Native Species

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 and Objectives

Goal: Students will evaluate how the diversity of species affects the ecosystem.

Objectives: Students will

1. Investigate and define qualities related to ecological diversity.
2. Present a plan to create a diverse ecosystem that includes native species.
3. Evaluate an ideal diverse forest community.

Materials

General

- Tablet(s) or computer(s) with internet access
- Projector and screen
- White board or chart paper and markers
- Tree Trails Portfolio, Student Learning Log/Journal

Handouts

- Diverse Ecosystem Rubric

Activity Materials

- Cameras or camera phones

Time and Internet Links

Instructional Time: 2-3 sessions, 45 minutes each

- Keep America Beautiful Leader Learning Guide
  Community Greening article, Backyard Biodiversity
  http://www.americanforests.org/magazine/article/backyard-biodiversity
- Keep America Beautiful Leader Learning Guide
  Discover What Trees Do For Your Community
  https://www.kab.org/our-programs/education/student-and-leader-learning-guides
- Firewise, Communities Compatible with Nature brochure
  http://bit.ly/2e6qoal

Instructional Procedures

I. Engage/Excite

1. Lead a discussion about how the diversity of trees, the biodiversity of forests and animals and its ecosystems are important to our community and world.
2. Develop a chart with three columns to compare the concepts: Diversity, Biodiversity and Ecosystem. Ask students what they might already know about these terms and list on a chart.

*Teacher Tip: **Diversity** is the difference in a set of like species, such as trees. **Biodiversity** means the diversity, or variety, of plants, trees, animals and other living things in a particular area or region. An **ecosystem** is a complex set of relationships among the living and non-living resources, habitats, and the community of residents of the area. This includes plants, trees, animals, birds, fish, microorganisms, water, soil and people interacting as a system. Everything that lives in an ecosystem is dependent on the other species and elements. The balance of an ecosystem is delicate and a disruption, such as the introduction of a new element, can damage or interrupt the balance.*

II. Explore

1. Ask the students if they have noticed different kinds of trees around their school and/or neighborhood. Move students into groups of three or four. Take students out to walk around the school grounds or neighborhood. Assign each group a specific area to investigate, but assign only one group to an area that has a limited diversity of plants or trees, such as only grass or only one type of plant or tree.
2. Ask each group to investigate their assigned section for a number and variety of living plants, animals, insects and trees. Each group should take notes and/or photographs and save these to assist them with documenting the findings of their observations.
3. Return to class and discuss options for documenting their investigation, such as charting a graph depicting their finds (number of each category) and/or make posters showing a map of what they observe. They may use symbols to represent trees, plants, animals, insects, etc. They should post their maps or graphs in the classroom, halls or where other groups can observe.
4. Each group should present their chart or map to the class and discuss their findings.

III. Explain

1. Their findings should lead into a discussion about the diversity, biodiversity and ecosystem they found and what improvements might be investigated.
2. Provide the group with a laptop/tablet to research an ideal diverse ecosystem for their community.

III. Explain continued

They should go online to determine what native plants are best for their environment. They may consider other strategic ecosystem plans as a model.

3. Have students use their research as a plan to find ways to improve the diversity and ecosystem of their school grounds, neighborhood and/or community.
4. Provide each group with the Diverse Ecosystem Rubric to assist them with defining some of the characteristics of a more diverse landscape.

IV. Extend/Elaborate

1. Have each group develop a presentation of an ideal landscape plan for a particular area in their community. Their plan should outline what native plants, animals, organisms and trees will work best together for their environment.
2. Each group should give their presentation to the class.

V. Evaluate

1. Ask each group to evaluate other group's ideal plan. Ask students to combine their best ideas to create one plan for the school, neighborhood and/or community. They may present the plan to the principal, school board and/or the city council.
2. Then make a new map or revise the one they created earlier. Graphs may be used to enhance their plan.
3. Ask students what they *Learned* about Diversity, Biodiversity, & Ecosystems and list on a chart.

VI. Extra Mileage/Attention

Extra Mileage: Have students go online to locate a different ideal forest ecosystem (in another area of the world, state, community, etc.). Compare and contrast that to their local ecosystem. Ask these students to present their findings to the rest of the class.

Extra Attention: Have "expert" peers work with students to analyze and/or revise the Diverse Ecosystem Rubric.

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

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Diverse Ecosystem Rubric

Directions:
Use this rubric to assist you in designing a diverse ecosystem.
After you have developed a plan, score it according to the rubric, then revise your plan to make it better.

	1 Point	2 Points	3 Points	4 Points
Tree Qualities	Little or no trees	Few of same trees	Diverse number of trees	Diversity of trees planted in ideal locations
Plant Qualities	Little or no plants	Few of same plants	Diverse number of plants	Diversity of plants planted in ideal locations
Animal Qualities	Little or no animals	Few of same animals	Diverse number of animals	Diversity of useful animals on landscape
Insect Qualities	Little or no insects	Few of same insects	Diverse number of insects	Helpful insects found in landscape

Tree Qualities _____

Plant Qualities _____

Animal Qualities _____

Insect Qualities _____

Total _____

Score Review:

0-3 = Poor Plan, You need more variety, consider adding items for each Quality.

4-8 = Average Plan, You're on your way, consider adding items for each Quality.

9-13 = Good Plan, Well done, your plan shows some diversity.

14-16 = Excellent Plan, Diversity in your ecosystem shows a healthy system.

Tree Trails

2-3 Secondary

★ 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 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 and Objectives

Goal: Students will demonstrate ways to keep trees and forests healthy.

Objectives: Students will

1. Specify the causes of the major disruptions to a healthy forest.
2. Conduct a research investigation on forest health; complete a report and present conclusions to the class.
3. Evaluate the health of the campus landscape and name ways to maintain its health.

Materials

General

- Tablet(s) or computer(s) with internet access
- Projector and screen
- White board or chart paper and markers
- Tree Trails Portfolio, Student Learning Log/Journal

Handouts

- Tree Cross Sections
- Signs of Unhealthy Trees Guide
- Investigative Report Outline
- Investigative Procedures
- Research Topics
- (Optional) Media Presentation Instructions

Activity Materials

- Cameras or camera phones

Time and Internet Links

Instructional Time: 3 sessions, 45 minutes each

- Trees of Texas, How Trees Grow
  http://texastreeid.tamu.edu/content/howTreesGrow/
- Texas A&M Forest Service, Forest Health
  http://tfsweb.tamu.edu/foresthealth/
- The Nature Conservancy, The Benefits of Prescribed Fire Video
  http://www.nature.org/ourinitiatives/habitats/forests/howwework/maintaining-fires-natural-role.xml
- Good Fires, Fighting Fire with Fire
  http://goodfires.org/fire
- Texas A&M Forest Service Forest, Forest Health
  Thinning Pine Plantations: Why, When and How?
  http://bit.ly/2dWW00N
- U.S. Forest Service, Forest Insect & Disease Leaflets
  http://bit.ly/2dw0ko1
- Arbor Day Foundation, Tree Health Guide
  https://www.arborday.org/trees/health
- Southern Group of State Foresters, Forest Health
  http://www.southernforests.org/rural/forest-health-1
- Western Forestry Leadership Coalition, Forest Health
  http://wflccenter.org/priority-issues/forest-health
- Northeastern Area Association of State Foresters, Issues
  http://www.northeasternforests.org/content/issues

Instructional Procedures

I. Engage/Excite

1. Ask the students to imagine their life as a growing tree. Ask what they *Know* that may determine tree growth and its life; i.e., what affects the health of a tree, what makes it grow fast or slow. List their responses on a chart/whiteboard or in their journal.
2. Tell students that foresters use cross sections of a tree to help determine a tree's health, age and to find other important information related to a trees health and the health of the forest where it is growing.
3. Provide students with Tree Cross Sections handout and actual Tree Cookies, if available. The handout contains signs about a tree's health and its life. Tree rings tell if the tree had sufficient food, water, if it was crowded, if there was an insect invasion, disease, or fire, etc. Ask students to notice the different tree rings sizes and markings on the handout.
4. Have students read the information about each tree cross section and the information to estimate the age of a tree.

II. Explore

1. Activate "Team Forest Investigators" to investigate Forest Health. Divide students into small groups of four or five to create an investigative documentary entitled "Who are the Real Culprits of a Sick Forest."
2. Provide all students with a Signs of Unhealthy Trees handout. Before they begin their online investigation, take the students outside with their handout to explore the health of the trees on school grounds. Students should take photos and/or make drawings of their findings.

   Teacher Tip: Invite an arborist to visit the campus grounds with the class or take a field trip with an arborist to discuss and view community urban or rural forest health issues.
3. Have the students return to the classroom and lead a discussion of their findings. Tell students to keep their notes in their Portfolios to include in their scientific research investigation.

III. Explain

1. Provide each group with a topic to investigate. Each topic will be a Chapter in the Documentary. You or the class may choose a list of topics or use the Research Topics handout which includes corresponding internet resources.

III. Explain continued

2. Provide each group with a list of Investigative Procedures and Report Guidelines handout and explain each step.
3. Have the students go online to research their topic or chapter of the report. Provide each group with a Report Outline format to use as a guideline to compile their report.

IV. Extend/Elaborate

1. Instruct student groups to develop a "stage" for each group to present their Chapter of "Who are the Real Culprits of the Forest." Have each group present their Chapter. Have students display their visuals, audios and their completed report. They may conduct a question and answer session after the presentation.
2. (Optional) During their presentations, the students may role play a healthy tree becoming unhealthy due to their specific type of disruption. One or two student(s) play(s) the tree, one or two student(s) play(s) the culprit or disrupter and one student narrates the event. Students may make and use props for their roles. For example, tree with brown paper trunk and green hair, disrupter with paper plate face of bug/disease/invasive species and narrator with microphone.
3. After the presentations, have students respond by generating conclusions about healthy and unhealthy trees and the disruptions. List their conclusions on a chart/whiteboard.
4. (Optional) Explain to students how to make a media production out of the investigative documentary report. Let students know you will help facilitate the production but they will be the directors, producers, writers and performers. Have each group assign roles for their members. Provide the Media Presentation Instructions and discuss the directions. Have students record the presentation.

V. Evaluate

1. Discuss how the class can use their ideas to develop a class plan or list of ways to maintain and/or improve the forest health around their school or neighborhood. Have the students make a poster or bulletin of their plan to improve the forest health around their school or community and display it in the room, hall or on the school's website.
2. Ask students what they *Learned* about tree health and list on a whiteboard/chart or their journal.

VI. Extra Mileage/Attention

Extra Mileage: Have students pose a hypothesis to investigate a question of interest. Have them conduct their research and present it at a convenient time for extra credit, a prize, a privilege, etc.

Extra Attention: Have students brainstorm ideas about their part of the report that they liked the most and why and the part they did not like, why and what they may do to change their dislikes.

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

Tree Cross Sections

1.
The study of tree rings is called dendrochronology. Each year, a tree adds a spring and summer ring, a light colored ring in the spring and a dark colored ring in the summer.

The rings can tell dendrochronologists about the growth of that tree. Narrow rings could mean slower growth, possibly from not enough water, sunlight, space or nutrients.

2.
This tree shows scars where branches have died or fallen off and the tree has grown around and over them.

TREE TRAILS

3.
Wide rings could mean the available water, sunlight, space or nutrients allowed the tree to grow vigorously.

Narrower rings toward the outer edge could mean that the younger trees are starting to crowd each other.

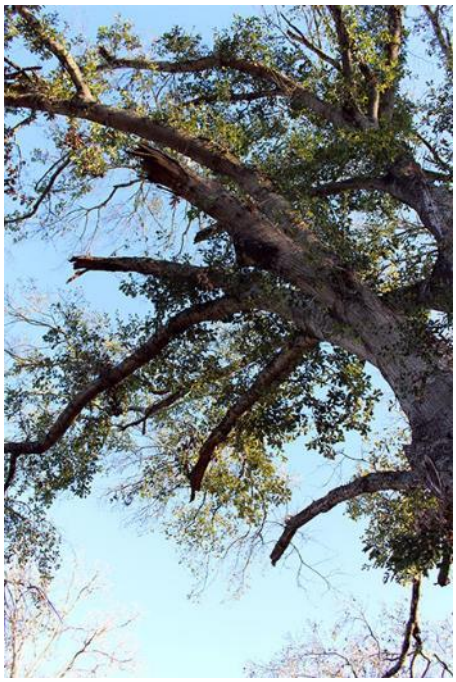
4.
This tree shows the difference in color of the heartwood and sapwood.

Blue stain fungus is also evident in the sapwood. The fungus is carried by bark beetles and quickens the tree's death after attack by the beetles.

Signs of Unhealthy Trees

Cavities in trunks or branches

Many broken branches or severe topping

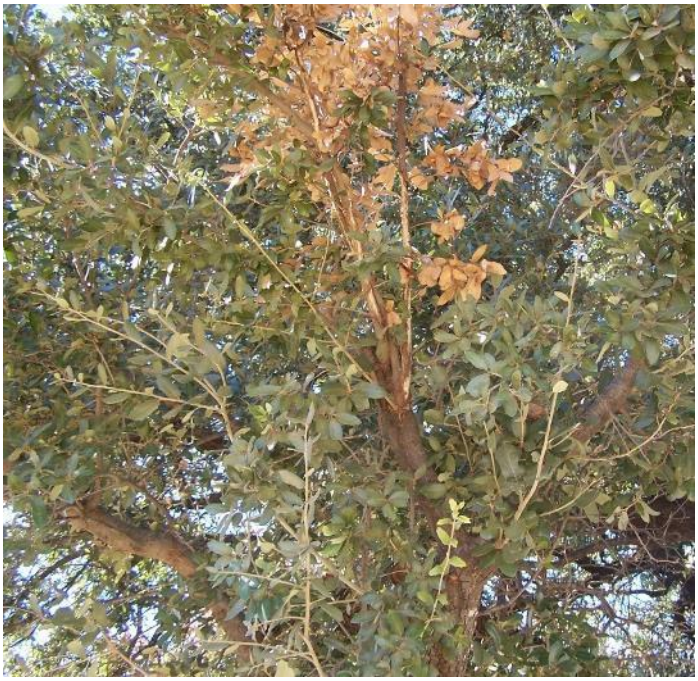


TREE TRAILS

Signs of Unhealthy Trees

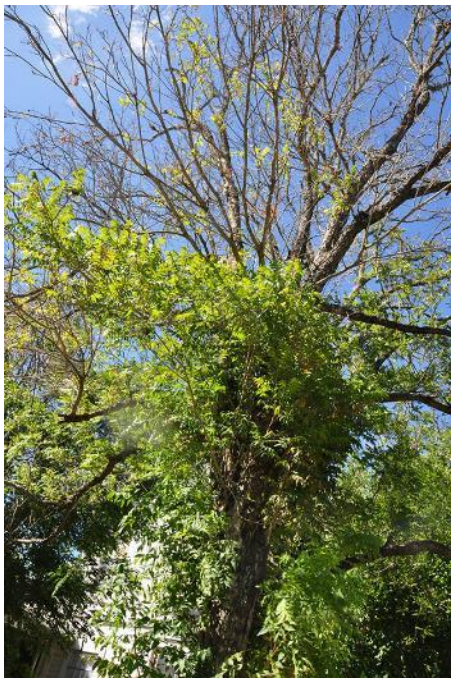
Unusual leaf shapes or colors

Pine attacked by engraver beetles



Squirrel damage

Numerous branches without leaves



TREE TRAILS

Signs of Unhealthy Trees

Damage from carvings or lawn equipment

Insect presence or evidence such as leaf chewing and rolling, holes in the bark, sawdust, etc.

Soapberry borer infestation

Engraver beetle galleries in loblolly pine bark

Caterpillars feeding

Boring dust in cedar elm

TREE TRAILS

Signs of Unhealthy Trees

Slime oozing from trunk or branches

Mushrooms or other fungi growing from trunk, branches or roots

Mushrooms on trunk

Brown fungus is Hypoxylon canker

Hypoxylon canker

TREE TRAILS

Investigative Report Outline

Title: Investigative Documentary on the Real Culprit of Sick Forests

Chapter: Name of Investigation

Section I. Purpose of investigation

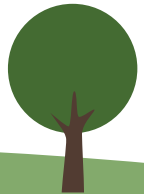
Section II. Hypothesis predicting the results

Section III. Research procedures

Section IV. Findings to include possible causes for the disruption (drought, etc.)

Section V. Conclusions

Investigators: Names of students



Investigative Procedures

a. You will be responsible for a chapter of the investigative documentary and present it to the class. You will use your laptops/tablets and go online to generate your report.

b. You should read the narrative provided by Texas A&M Forest Service Forest Health sections, which reports factors contributing to forest health such as heat, drought, flooding, lightning, animal damage, construction damage, soil compaction, wildfire, etc.

c. You will be given a list of online resources to use for your specific chapter.

d. You will write a synopsis of your findings to develop your chapter. You may incorporate any resources into your report. You may include photos, graphs or other graphics as supporting evidence for your conclusions. The chapter should include evidence found on your investigative campus trip.

Report Guidelines

Title: Investigative Documentary on the Real Culprit of Sick Forests

Chapter: Name of Investigation

Section I. Purpose of investigation

Section II. Hypothesis predicting the results

Section III. Research procedures

Section IV. Findings to include possible causes for the disruption (drought, etc.)

Section V. Conclusions

Investigators: Names of students

(find a fillable worksheet for the Report in the Tree Trails Resources section online)

Research Topics

1. Overcrowded, Make Room

Read and report on management techniques beneficial to forested ecosystems such as thinning or fire.

2. Insects: the Good and the Ugly

Compare and report on "Useful and Ugly Insects" such as Barklice and "Ugly Insects" that are not harmful such as the Hickory Horned Devil and Giant Walkingsticks.

3. Insects: the Bad and the Ugly

Read and report on "Harmful and Ugly Insects" to certain trees such as Pine Regeneration Weevils.

4. Difficult Diseases

Carefully read and report the information about how diseases occur and how to prevent them and keep the forest healthy. Examples of the conditions contributing to these diseases are found in particular disease sections: Oak Wilt, Root Rot, etc.

5. Invasive Awfuls

Report why invasive species are harmful to our forests. Select a pest and a plant to highlight.

Internet Resources

- Texas A&M Forest Service, Forest Health
  http://tfsweb.tamu.edu/foresthealth/
- Texas A&M Forest Service Forest, Forest Health, Thinning Pine Plantations: Why, When and How?
  http://bit.ly/2dWW00N
- Good Fires, Fighting Fire with Fire
  http://goodfires.org/fire
- The Nature Conservancy, The Benefits of Prescribed Fire video
  http://www.nature.org/ourinitiatives/habitats/forests/howwework/maintaining-fires-natural-role.xml
- U.S. Forest Service, Forest Insect & Disease Leaflets
  http://bit.ly/2dw0ko1
- Arbor Day Foundation, Tree Health Guide
  https://www.arborday.org/trees/health
- Southern Group of State Foresters, Forest Health
  http://www.southernforests.org/rural/forest-health-1
- Western Forestry Leadership Coalition, Forest Health
  http://wflccenter.org/priority-issues/forest-health
- Northeastern Area Association of State Foresters, Issues
  http://www.northeasternforests.org/content/issues

Media Presentation Instructions

Each group will appoint a:

1. ***Director*** *to introduce the Chapter Question, coordinate the performers and close the presentation.*

   Group Member _____

2. ***Producer*** *to coordinate the research, produce the order/sequence of the presentation and present the first section of the chapter.*

   Group Member _____

3. ***Writer*** *to gather and compile the information, record the script and present the second section of the chapter.*

   Group Member _____

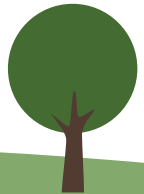
4. ***Assistant Producer and Writer*** *to help with the script, the production and conclude the presentation.*

   Group Member _____

5. ***Performers****: This is a suggestion for the performers but the group may decide a different order. All students in the group should have an individual role.*

   Group Members _____

   _____



Tree Trails

3 Secondary

★ Benefits and Values ★

Advances in the science of urban forestry allow us to assign monetary values to a wide range of benefits that trees provide. As trees grow, these values rise. This is the only part of the built environment of our cities that does so!

Goal and Objectives

Goal: Students will determine the benefits of trees and calculate their value.

Objectives: Students will

1. Use technology to calculate the value of their trail trees.
2. Analyze a wide range of benefits that trees provide.
3. Evaluate which trail tree(s) offers the most benefits and value.
4. Develop a plan to maintain and improve the value of trees on their Tree Trail.

Materials

General

- Tablet(s) or computer(s) with internet access
- Projector and screen
- White board or chart paper and markers
- Tree Trails Portfolio, Student Learning Log/Journal

Handouts

- Tree Scavenger Hunt and Answer Sheet
- Annual Benefits Breakdown
- Campus Care and Greening Plan

Time and Internet Links

Instructional Time: 3 sessions, 45 minutes each

- Arbor Day Foundation, Benefits of Trees
  https://www.arborday.org/trees/index-benefits.cfm
- Texas A&M Forest Service, Benefits of Trees
  - o Environmental, http://bit.ly/2e1LvuV
  - o Social, http://bit.ly/2dEp5iY
  - o Economic, http://bit.ly/2cT1Ux2
- i-Tree Design
  https://www.itreetools.org/design.php
- i-Tree Lessons, 7 Tree Planting Design
  http://www.itreelessons.com
- Create a WIKI page
  http://bit.ly/2dJyO3H
- Create a Class Blog
  http://wikihow.com/Start-a-Blog-on-Blogger
- Keep America Beautiful Student and Leader Learning Guides
  Discover What Trees Do For Your Community
  https://www.kab.org/our-programs/education/student-and-leader-learning-guides
- The Nature Conservancy, If Trees Could Sing
  http://www.nature.org/iftreescouldsing

Instructional Procedures

I. Engage/Excite

1. Engage students in a conversation about the benefits and values of trees and ask students what they would like to know. List their responses on a whiteboard/chart. Create a Class Blog where every student reflects on their experience.
2. To get started in learning about values and benefits of trees, students will participate in a Tree Scavenger Hunt. Divide the class into four groups and give them the Tree Scavenger Hunt Handout with a list of items in three levels of difficulty to find the item or a picture of it. Give each team approximately 10 minutes to find the items. Appoint a score keeper. Points are earned according to difficulty level.
3. Give the students the Scavenger Hunt answer sheet handout and let them total their scores. Each group should report their findings and scores. Check the items and scores and declare a winner.
4. Conclude with a discussion about the benefits and value these items mean to our community and the world. Use their responses to introduce the next activity.

II. Explore

1. On a chart/whiteboard use a graphic organizer to illustrate the relationship between three concepts of "Growth, Benefits and Value." Write the word "Growth" in the first box, next draw an arrow to a second box with the word "Benefits" in it, then draw another arrow from the "Benefits" box to the last box with the word "Value" in it.
2. Move students into small groups. Have each group brainstorm what growth means to them. Have students record their responses using their laptops/tablets or chart paper labeled "Growth." Have each group share their lists/charts with the class. If they used the laptop, have them print out the list. Place each group's list under the "Growth" box on the class chart.

   Teacher Tip: Before continuing the activity about Benefits, review the forestry definitions of Benefits and Value: benefits are a list of items and value is a dollar calculation. (Optional: Use a Compare and Contrast graphic organizer to further explain the definitions of benefits and value.)
3. Repeat the activity for the "Benefits" box to capture what benefits trees and forests provide. Remind students to use some of the items they found in the Scavenger Hunt. Remind them of other benefits such as lumber, wildlife habitat, recreation and air quality. Discuss how growth relates to benefits. Ask each group to share their lists/charts with the class. Place each groups list under the "Benefits" box.
4. Repeat the small group activity for the "Value" box. Discuss how benefits relate to value. Their list should include ways trees contribute economic dollar value.

II. Explore continued

5. When all groups have shared all three concepts, ask students to check to see if they would like to add other ideas they have learned about the benefits and values the ecosystem contributes.

   Teacher Tip: Forests provide a wide range of ecosystem services. In addition to providing food, fuel and fiber, forests clean the air, filter water supplies, control floods and erosion, sustain biodiversity, genetic resources, and provide opportunities for recreation, education, and cultural enrichment. Many other social and economic benefits exist, find more information on the Arbor Day Foundation and Texas A&M Forest Service websites.

III. Explain

1. Provide students with the Annual Benefits Breakdown handout. Ask students to notice the types of benefits: stormwater intercepted, air quality, carbon dioxide, energy savings, and property value. Conduct a question and answer session to check on understanding of the terms.
2. Project the Tree Trails map. Ask students to follow on their tablet/laptop as projected. Open the Tree Trails application and search by the school Tree Trail name. After selecting the green trail line, they should see the name of their trail under the "Annual Benefits" column heading. The dollar values shown are for all the trees on the entire trail. Discuss the benefits and value that the entire trail provides for the school. Print the trail report to display in the class.
3. To find the benefits and dollar value of each tree, have students move into their Tree Trail groups. Using their laptop/tablet, find their trail on the map. Select their tree to view the benefits in the Annual Benefits column. They should see their tree's species listed above the pie chart. Have each group conduct a discussion about the benefits their tree provides. Ask students to determine what type of benefit has the highest percent and dollar value. Have each group record their tree's values in their Learning Logs.

IV. Extend/Elaborate

1. Have students calculate the benefits of their tree(s) for current and future years using a future/forecasting model. Have students go online to i-Tree Design. Enter the address of the school or other location. Follow the instructions and outline the building/house, then add tree data and place the trees. Choose the number of years in the estimate benefits tab to calculate benefits. Tree benefit results include estimates for the current year, the specified future year, projected totals across that future timespan, and the total benefits provided to date. Have students ask for any number of years and look at the pie and line graphs. Discuss the results. Have students print out this report.

IV. Extend/Elaborate continued

2. After the investigation(s) ask each group to discuss their reports and the overall results of their research. They should save the results to use for planning a Campus Care and Greening Plan.
3. (Optional) Inform students that resources are available to assist them with developing a Campus Care and Greening Plan. They have become the school leaders as student urban foresters on campus. They will take their leadership as a Student Tree Board to establish a Campus Care and Greening Plan to ensure their Tree Trail and other trees on campus will be maintained in the future for all to enjoy. Use the handout for further instructional procedures.
4. (Optional) Have groups create a podcast or video about their trail tree and its benefits to themselves and the community. Encourage groups to vary the roles from the Lesson 2-1 video skit. Plan, record, produce and present the video. Inspiration can be found from The Nature Conservancy's If Trees Could Sing videos.

V. Evaluate

1. Have each Tree Trail group collaborate and draw a picture of the new landscape design, including their school's Tree Trail. They may use symbols and a legend. Then indicate on the drawing the trees and other plants that will increase the benefits to the school's environment.
2. Ask students to label what types of benefits they displayed.
3. Have student groups share their drawings, ask for input and make changes accordingly.
4. (Optional) Establish benchmarks for summative and formative evaluation of the Campus Care and Greening Plan, if created, and make changes as appropriate.

VI. Extra Mileage/Attention

Extra Mileage: Have each student develop a personal home/apartment greening design based on the benefits and value it would provide.

Extra Attention: Provide small groups with chart paper and markers. Ask them to draw a picture of a home without landscaping. Have the groups exchange drawings and ask each group to add trees to the drawing. Lead a discussion about increased value to the home and what benefits the trees provided.

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

Tree Scavenger Hunt

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 talley 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 _____

TREE TRAILS

Tree Scavenger Hunt

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

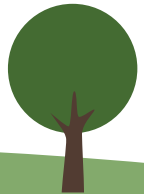
Expert Items: Find it = 3 points; What part of the tree it comes from = 4 points

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.



TREE TRAILS

Annual Benefits Breakdown

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

Tree 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

1. http://texastreeplanting.tamu.edu/energy_efficiency.html
2. http://www.arborday.org/globalwarming/summerShade.cfm

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/

Every year,
1 large tree

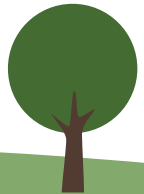
Retains
1000 gallons
of rainwater

Absorbs the carbon dioxide of a car driven
500 miles

Generates
260 pounds
of oxygen

Saves $32 in summertime air conditioning

Provides a home for
1-3 species of wildlife



TREE TRAILS

Campus Care and Greening Plan

Instructional Procedures

1. Inform students that resources are available to assist them with developing a Campus Care and Greening Plan. They have become the school leaders as student urban foresters on campus. They will take their leadership as a Student Tree Board to establish a Campus Care and Greening Plan to ensure their Tree Trail and other trees on campus will be maintained in the future for all to enjoy.
2. Move students into small groups and have students follow on their laptops/tables and project the Community Forestry Resources website to review some of the resources they may use. Other resources are: Arbor Day Foundation, Tree City USA, Tree Campus USA, Keep America Beautiful, U. S. Forest Service, Forestry Associations, Garden Clubs, or Nursery & Landscape Associations.
3. Discuss ways they can use these resources to create their Campus Care and Greening Plan. These resources would be easier to use if these were compiled in one list: a Tree Trail Resource List.
4. Have each group research and develop a list of resources on their laptops/tablets. Have the groups share and consolidate the list. As feasible, find a volunteer to assemble the Tree Trail Resource List. Post it on the school website, WIKI page and/or print it as a booklet. Acknowledge the list as valuable contribution to their school, class and community.
5. Take the class outside to revisit their Tree Trail. Ask how the Tree Trail benefits the school and community. Ask what they can do to maintain the benefits their Tree Trail provides. Ask how they can expand these types of benefits and values to the campus landscape. Ask them to think how a Campus Care and Greening Plan could not only maintain their Tree Trail but improve benefits to the total school landscape. Brainstorm ideas for the plan.
6. Form five student committees to develop and carry out the plan. Refer to the Keep America Beautiful Leader Guide's Community Greening section for more planning tools.

Groups

a. **WHY**: Information Taskforce to inform classmates and the community the benefits and values trees, native and indigenous plants provide and why they need care and maintenance to thrive.

b. **WHAT**: Action Taskforce to define and sequence what actions are needed to develop and maintain improvements to the school landscape.

c. **HOW**: Design Taskforce to design the plan that includes at least five different tree species based on their investigation which concludes which trees provide the most benefits and represent the ability to adapt to the climate of the local area.

d. **WHO**: Resource Taskforce to identify resources to help with steps in the plan.

e. **WHEN**: Ways and Means Taskforce to create a how-to plan to carry out, develop checkpoints and evaluate the implementation of the Campus Care and Greening Plan overall plan.

Instructional Procedures continued

7. Ask each committee to incorporate resources they found to assist with their part of the plan.
8. Present the Campus Care and Greening Plan to other classes, parents, school administrators, community leaders. Recognize all who assisted with the project.
9. Post the Plan on a school WIKI page as well as in the school and create a Class Blog where every student reflects on their learning experience and what they have Learned.

Resources

U.S. Forest Service Urban and Community Forestry Program
http://www.fs.fed.us/managing-land/urban-forests/ucf

Texas A&M Forest Service, Urban and Community Forestry
http://txforestservice.tamu.edu/abouturbanandcommunityforestry

National Arbor Day Foundation
https://www.arborday.org/programs/

Keep America Beautiful Student and Leader Learning Guides, Community Service Learning
https://www.kab.org/our-programs/education/student-and- leader-learning-guides

Tree Trails

4 Secondary

★ 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, care for or celebrate trees – either on school grounds or in the surrounding community.

Goal and Objectives

Goal: Students will design and conduct a service learning project.

Objectives: Students will

1. Conduct an informal or formal needs assessment for services for the class or community.
2. Research forestry organizations and resources that can assist with implementing and evaluating their service learning project
3. Design, develop and conduct a tree or forest related service learning project for the class, and/or parents, school administrators and/or the community.
4. Apply knowledge gained from the Tree Trails modules to the service project
5. Develop, administer and analyze an evaluation of the Student Service Learning Project.

Materials

General

- Tablet(s) or computer(s) with internet access
- Projector and screen
- White board or chart paper and markers
- Tree Trails Portfolio, Student Learning Log/Journal

Handouts

- Sample Needs Assessment Format
- Service Learning Sample Projects
- Student Service Learning Project Invitation Sample
- Tree Tag template
- Certificate of Achievement template
- Career Charades
- Campus Care and Greening Plan

Time and Internet Links

Instructional Time: 3 sessions, 45 minutes each
Project Presentation: 1-2 hours

- Careers in Forestry & Natural Resources, http://forestrycareers.org
- Natural Inquirer Scientist Card Series
  http://www.naturalinquirer.org/Scientist-Card-Series-v-168.html
- Arbor Day Foundation, http://www.arborday.org
- Texas A&M Forest Service, Urban Forestry
  http://tfsweb.tamu.edu/urbanforestry
- Texas Tree Planting Guide, http://texastreeplanting.tamu.edu/
- Keep America Beautiful Student and Leader Learning Guides
  Community Service Learning
  https://www.kab.org/our-programs/education/student-and-leader-learning-guides
- Keep America Beautiful, Submit Your Stories
  http://blog.kab.org/
- Concordia University
  Introduction to creating cross-curriculum comics and graphic novels
  http://bit.ly/2dOdxGU
- ReadWriteThink, Comics and Graphic Novels lesson
  http://bit.ly/2cVtVJ2

Instructional Procedures

I. Engage/Excite

1. Conduct a review of the tree and forest topics students have learned. Ask students if they can name careers related to the topics. For example, tree identification careers may comprise of foresters, biologists, landscape architects and/or arborists.
2. Move students into small groups to explore the forestry career websites. Have them review a variety of careers and take notes on the components that are of interest. Additionally, you may consider having students play Career Charades.
3. Ask students to think about which career they might choose or if there is a different related career they would prefer. Discuss activities each career might perform. Tell students they will have fun creating a project that uses some of the skills these careers require. Have students write in their Learning Logs/Portfolios their first choice of a career and name activities the job might require.

II. Explore

1. Lead a discussion about the importance of student to be leaders who can inform their school and community about the virtues of trees and forests, their beauty and the enormous benefits and values we receive from them. Tree Trail students have a special opportunity few schools have experienced; an in-depth study of trees and forests that opens the door to all fields of study. Now they can share their knowledge as student leaders by providing their services to the school and community.
2. Explore services that students could provide for their class, school or community related to the Tree Trail modules, such as exploring careers portrayed in Charades or leaders who provide information about how trees and forests improve our way of life. Record their ideas on a chart/whiteboard.
3. Let students know that the total service project and activities may be performed by an individual, teams or as one class project. It is the decision of the teacher and students which student service leader projects to provide and the students involved. However, every student must play a role.

   Teacher Tip: The following list of ways students can become service leaders is provided as a suggestion for the class to consider. To review the basics of a service learning project and find templates for organizing a project, review the Keep America Beautiful Leader Guide Service Learning section.
4. If deemed appropriate, display on a chart/whiteboard the following sample learning services as possible choices. While Arbor Day is listed as a separate project, most Arbor Day activities can be incorporated into any service learning project. It is up to the class and teacher to decide the most appropriate learning service.

II. Explore continued

Suggestions:

a. Plan and host an Arbor Day event
Coordinate dates, (school calendar, state Arbor Day and National Arbor Day), brainstorm activity ideas, create a schedule of events, select hosts or docents, assign tasks, and plan an evaluation for participants.

b. Plant a tree
Research where trees are needed, what trees are best for the site, who will fund the tree(s), what materials are needed and who will plant the tree, who will water the tree, plan dedication of the tree and develop and conduct an evaluation of the activity.

c. Install signage for the Tree Trail
Prepare and install signage for the Tree Trail, one for each trail tree. A template is provided to develop a marker for each tree. Possible items to include on a tree sign: tree outline, tree number, common and scientific name, measurement, date entered as a trail tree, etc. Place signs in holders and on stakes, decide where to place in ground and install the signage.

d. Host a Tree Trail tour
Invite other classrooms, administrators, parents, and guests. Prepare a Tree Trail Tour Outline that includes objectives for the tour, route of tour, schedule. Develop a narrative at each stop, evaluate tourist and create a brochure for the Tree Trail Tour. Include audio or visuals as needed.

e. Create a video or podcast tour
If not already created, develop videos or podcasts that can be uploaded on the school website. Prepare an outline for the script, develop the goal, purpose and objective statements, write a narrative for each tree. Include benefits, tree history or biology, future plans for the Tree Trail and develop an evaluation of the project.

f. Create a Campus Care and Greening Plan
If not already created, develop a plan that will contribute toward maintaining their Tree Trail and improve benefits to the total school landscape. Consult local experts, develop a resource list, write a plan. Share with the school and community groups.

5. Have students use all ideas and suggestions to develop, conduct and analyze a needs assessment to determine the best service project for the class, school and community. Survey other classes, teachers, administrators and parents using informal or formal assessment questions. Once the needs assessment results are tallied, the class will decide on specific student service leadership to provide.
6. Divide the class into small groups to develop the needs assessment. See the Sample Needs Assessment Format handout or the Keep America Beautiful's Student Learning Guide.

II. Explore continued

7. Conduct the needs assessment. Remember to involve as many school personnel, such as other teachers and students, administrators, maintenance staff, etc. as possible.
8. Project the results of the needs assessment to review. Allow students to use the results to decide on the service project they want to perform. Organize the students to work on their services. Students may be assigned individual or group tasks. If the class chooses one service, assign individuals to a task for that service.

III. Explain

1. As appropriate, assist students by providing a planning guide such as in the Keep America Beautiful Leader and Youth Learning Guides. Discuss the components their project should contain. Develop a schedule for students to work on their project. Include a project timeline and have students check progress toward completion or have the students make their own project timeline to share or post.
2. Provide the materials needed and plan the activities to complete the project within the preferred time period. Encourage students to plan on taking pictures and/or use a variety of media during their project and its development.
3. Remind students to develop an evaluation form for the service project chosen. It may look like the elementary module evaluations but it may have as few as four to five questions.
4. Inform students that they need to develop an invitation for guests to attend the dedication of the project. Provide a sample invitation and get feedback from the students. Then develop the chosen invitation format.

IV. Extend/Elaborate

1. Provide time for students to work on their Service Learning Project(s). Periodically check on their progress. Post a notice and/or a list of the statuses as they are completed.
2. Have students complete invitations for the guests they wish to invite, including the principal, other classes and special guests such as public officials, the local newspaper and television/media journalists. Provide students with the number of invitations needed for their family and guests and have them complete the invitations and deliver these.

   Teacher Tip: Discuss the event with administrators and faculty and decide on a time and location for the project dedication and include on the invitation.
3. Celebrate the Tree Trails Student Learning Project(s) by conducting the Dedication. Present the Student Service Leadership Certificates to the students. Record the presentation, if possible.
4. Remind the students that all visitors or anyone involved in the project should complete an

IV. Extend/Elaborate continued

evaluation form. Have students inform the audience where to leave their completed evaluation.

5. Post the projects on the school website or class WIKI page. If you are working with a Keep America Beautiful affiliate, share your project on their Submit Your Stories website.

V. Evaluate

1. Have students tally the evaluations and summarize the results. Conduct a discussion of the results of the evaluations of the project.
2. Have each student or team share their learning experience with the class by presenting a short synopsis what they did for the project. They may download their pictures and share with the classroom.
3. Have each student self-evaluate how they feel about the effectiveness of their project. Record in their journals. In addition, have students enter their reflections on the Class Blog.

VI. Extra Mileage/Attention

Extra Mileage: Produce a video of the before and after the Student Service Learning Project(s).

Extra Attention: Have students draw and/or describe their favorite part of the Student Service Learning Project. Specifically, students can create a cartoon, comic or short graphic novel to depict an aspect of their Tree Trail experiences, learning, service, etc.

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

Sample Needs Assessment Format

Tree Trails Service Learning Project

Name of Survey Participant:_____ Date:_____

Introduction and Purpose of the project:

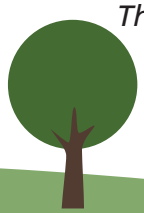
Deadline to return survey:

List of possible projects, please rank the most to least important (1 being most important):

Suggest other important projects not found in the above list:

Comments and recommendations:

Thank you for taking the time to add your valuable input and assist with our needs assessment.



Service Leader Sample Projects

Plan and host an Arbor Day event

Coordinate dates, (school calendar, state Arbor Day and National Arbor Day), brainstorm activity ideas, create a schedule of events, select hosts or docents, assign tasks, and plan an evaluation for participants.

Plant a tree

Research where trees are needed, what trees are best for the site, who will fund the tree(s), what materials are needed and who will plant the tree, who will water the tree, plan dedication of the tree and develop and conduct an evaluation of the activity.

Install signage for the Tree Trail

Prepare and install signage for the Tree Trail, one for each trail tree. A template is provided to develop a marker for each tree. Possible items to include on a tree sign: tree outline, tree number, common and scientific name, measurement, date entered as a trail tree, etc. Place signs in holders and on stakes, decide where to place in ground and install the signage.

Host a Tree Trail tour

Invite other classrooms, administrators, parents, and guests. Prepare a Tree Trail Tour Outline that includes objectives for the tour, route of tour, schedule. Develop a narrative for each stop and an evaluation for visitors. Create a brochure for the Tree Trail Tour. Include audio or visuals as needed.

Create a video or podcast tour

If not already created, develop videos or podcasts that can be uploaded on the school website. Prepare an outline for the script, develop the goal, purpose and objective statements, write a narrative for each tree. Include benefits, tree history or biology, future plans for the Tree Trail and develop an evaluation of the project.

Create a Campus Care and Greening Plan

If not already created, develop a plan that will contribute toward maintaining their Tree Trail and improve benefits to the total school landscape. Consult local experts, develop a resource list, write a plan. Share with the school and community groups.

Celebrate Arbor Day!

Mr. Carya's class will host a dedication event and tree planting at the Oak Street High School

Meet us at our campus Tree Trail
Friday November 4, 2016 at 10:00am

Please RSVP to 123-456-7890

Take a Tour

Come on a tree adventure with Mr. Carya's class!

Meet us at our campus Tree Trail
Friday November 4, 2016 between 9-10:00am

Sample Tree Tag

TREE TRAILS

I am a _____
Tree species

on _____ trail.
Tree Trail name

I provide ecological benefits like increased property value, improved air quality, stormwater interception, and energy savings valued at

$ _____

Find our trail online at www.treetrails.org

Certificate of Achievement

awarded to

_____

for their service leadership
in the Tree Trails program at

_____

_____ _____

Date Teacher

TREE TRAILS

Career Charades

Directions

Ask students if they can name careers related to the modules they have experienced. Start with a review of the module topics and careers associated with them. For example, tree identification is important to foresters, biologists, landscapers and nurserymen. Tell them they are going to play a game of Charades to identify related careers. Discuss the directions/rules for playing Charades and demonstrate or select students to demonstrate the pantomime actions.

Students can either use the cards within this handout, or create their own set using website resources.

After the activity, ask students to think about which career they might choose or if there is a different related career they would prefer. Discuss activities each career might perform.

Websites

Careers in Forestry & Natural Resources, http://forestrycareers.org

Natural Inquirer Scientist Card Series, http://www.naturalinquirer.org/Scientist-Card-Series-v-168.html

Accountant

a person who keeps the financial records of a business or person

Arborist

a person who is trained in properly planting and taking care of individual trees, such as pruning, fertilizing, or controlling disease.

Archeologist

a person that deals with past human life and activities by studying the bones, tools, etc., of ancient people

Christmas Tree Farmer

a person who grows and shapes trees for the winter holiday season

Career Charades

Engineer

a person that designs and creates new systems or structures

Entomologist or Insect Scientist

a person that studies insects

Forester

a person who takes care of forests by planting trees, cutting down trees, etc.

Hydrologist or Water Scientist

a person who studies how water moves through the Earth, the water quality, and water supply.

Landscape Architect

a person who plans and creates large outdoor spaces such as gardens, parks, etc.

Law Enforcement Officer

a person who enforces the law

Mechanic

a person who repairs machines (such as car engines) and keeps them running properly

Career Charades

Nurseryman

a person who owns or works in a place where trees and shrubs are grown and sold

Soil Scientist

a person that deals with the methods used by farmers to raise crops like trees and care for the soil

Teacher

a person who teaches students about certain subjects

Technology or Computer Specialist

a person that uses computers to create and maintain data and maps

Wildland Firefighter

a person puts out a fire that occurs in a wildland area

Wildlife Biologist

a person that manages, protects, and enhances habitat for wildlife

Writer

a person who writes books, poems, stories, news articles etc.

Campus Care and Greening Plan

Instructional Procedures

1. Inform students that resources are available to assist them with developing a Campus Care and Greening Plan. They have become the school leaders as student urban foresters on campus. They will take their leadership as a Student Tree Board to establish a Campus Care and Greening Plan to ensure their Tree Trail and other trees on campus will be maintained in the future for all to enjoy.
2. Move students into small groups and have students follow on their laptops/tables and project the Community Forestry Resources website to review some of the resources they may use. Other resources are: Arbor Day Foundation, Tree City USA, Tree Campus USA, Keep America Beautiful, U. S. Forest Service, Forestry Associations, Garden Clubs, or Nursery & Landscape Associations.
3. Discuss ways they can use these resources to create their Campus Care and Greening Plan. These resources would be easier to use if these were compiled in one list: a Tree Trail Resource List.
4. Have each group research and develop a list of resources on their laptops/tablets. Have the groups share and consolidate the list. As feasible, find a volunteer to assemble the Tree Trail Resource List. Post it on the school website, WIKI page and/or print it as a booklet. Acknowledge the list as valuable contribution to their school, class and community.
5. Take the class outside to revisit their Tree Trail. Ask how the Tree Trail benefits the school and community. Ask what they can do to maintain the benefits their Tree Trail provides. Ask how they can expand these types of benefits and values to the campus landscape. Ask them to think how a Campus Care and Greening Plan could not only maintain their Tree Trail but improve benefits to the total school landscape. Brainstorm ideas for the plan.
6. Form five student committees to develop and carry out the plan. Refer to the Keep America Beautiful Leader Guide's Community Greening section for more planning tools.

Groups

a. **WHY**: Information Taskforce to inform classmates and the community the benefits and values trees, native and indigenous plants provide and why they need care and maintenance to thrive.

b. **WHAT**: Action Taskforce to define and sequence what actions are needed to develop and maintain improvements to the school landscape.

c. **HOW**: Design Taskforce to design the plan that includes at least five different tree species based on their investigation which concludes which trees provide the most benefits and represent the ability to adapt to the climate of the local area.

d. **WHO**: Resource Taskforce to identify resources to help with steps in the plan.

e. **WHEN**: Ways and Means Taskforce to create a how-to plan to carry out, develop checkpoints and evaluate the implementation of the Campus Care and Greening Plan overall plan.

Instructional Procedures continued

7. Ask each committee to incorporate resources they found to assist with their part of the plan.
8. Present the Campus Care and Greening Plan to other classes, parents, school administrators, community leaders. Recognize all who assisted with the project.
9. Post the Plan on a school WIKI page as well as in the school and create a Class Blog where every student reflects on their learning experience and what they have Learned.

Resources

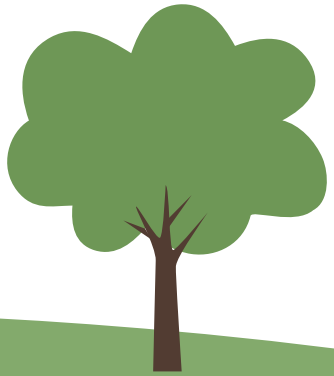
U.S. Forest Service Urban and Community Forestry Program
http://www.fs.fed.us/managing-land/urban-forests/ucf

Texas A&M Forest Service, Urban and Community Forestry
http://txforestservice.tamu.edu/abouturbanandcommunityforestry

National Arbor Day Foundation
https://www.arborday.org/programs/

Keep America Beautiful Student and Leader Learning Guides, Community Service Learning
https://www.kab.org/our-programs/education/student-and- leader-learning-guides

Notes



TREE TRAILS

TREE TRAILS

TEXAS A&M FOREST SERVICE

TEXAS URBAN FORESTRY COUNCIL

KEEP AMERICA BEAUTIFUL

www.treetrails.org