# The Forest Where We Live:
## A Six Part Series

# THE FOREST WHERE WE LIVE
## TEACHER RESOURCE GUIDE

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### REFERENCES AND RESOURCES:

U.S. Forest Service, *Investigating Your Environment*
U.S. Forest Service, *Urban Forestry Laboratory Exercises*
Project Learning Tree, *The Changing Forest: Forest Ecology*
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American Forests (www.amfor.org)
Forest Resource Environmental Education – F.R.E.E. (www.freenetwork.org)
Urban Forest Ecosystems Institute (http://www.urbanfor.cagr.calpoly.edu/)
National Urban and Community Forestry Advisory Council (www.treelink.org)
(www.treelink.org/connect/orgs/nucfac/index.htm)
Historic Germantown Inner-City Arboretum, Nashville, Tennessee (WAGould@aol.com)

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More Resources & Links, Page 70

### SOME GRANT OPPORTUNITIES:

Chevron Corporate Grants for Environmental Ed. (www.chevron.com/community/index.html)
GreenWorks!: **PLT** Community Action and Service Learning Program (www.plt.org/html/plt_in_action/grants)

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# Table of Contents

# THE FOREST WHERE WE LIVE

## Video Credits

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Lester Brown
Bureau of Parks, City of Atlanta
George Bush Presidential Library
Chicago Historical Society
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L. S. U. Libraries, Louisiana State University
Library of Congress-Prints & Photographs Division
Metropolitan Museum of Art
Muir Woods National Monument
Museum of the City of New York
National Agricultural Library
National Park Service
National Urban & Community Forestry Advisory Council
Nebraska State Historical Society
Office of U.S. Senator John Breaux
Prospect Park
Queens Botanical Gardens
Jeannie Frey Rhodes
Sacramento Archives & Museum Collection Center
Sacramento Parks & Recreation
Sacramento Tree Foundation
Scotlandville Magnet High School
Steve Shurtz
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Southern University Urban Forestry Unit
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The Roger Houston Ogden Collection
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Trees Atlanta
U.S. Environmental Protection Agency
U.S. Equities Realties Inc./John Hancock Center
Umlauf Sculpture Garden & Museum
Union Settlement Association
University of Maryland, Baltimore County
University of Wisconsin - Madison Archives
University Laboratory High School
US Bureau of Census
USDA Forest Service
US Geological Survey
Wilderness Society

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# This series is designed to help students

* Become more aware of the forest ecosystems of which they are a part

* Develop skills necessary to establish and maintain healthy urban landscapes

* Become acquainted with urban forestry-related careers, and

* Become stewards of their home environments.

## Resources

These resource materials include lesson plans for teachers and activities for students that accompany each of the six video lessons. Each lesson has an introduction, learning objectives, and the Teacher's Branch (background information, suggested directions for getting the lessons started and materials needed.) All activities are correlated to the National Science Education Standards.

In addition to these materials, two excellent on-line curricula from the U.S. Forest Service are listed below. Some of the activities included in this guide are taken from these resources. All can be downloaded and freely used as they are in the public domain.

1) Investigating *Your Environment*
(www.fsfed.us/outdoors/welcome.htm)
2) Urban *Forestry Laboratory Exercises*
(http://willow.ncfes.umn.edu/lab_exercises)

The Project Learning Tree secondary modules are also highly recommended as a resource. The PLT publication, *The Changing Forest: Forest Ecology,* is available through workshop participation. Contact Project Learning Tree at (www.plt.org) or call your state Forestry Department for additional information and workshop schedules.

## Note

Throughout the activities in this guide, students will be instructed to work in collaborative groups. Development of strong, cooperative teams is essential for successful completion not only of the unit activities, but also of the cumulative project. Rotation of job assignments and review of job descriptions may take extra time but will prove beneficial to team development.

## Assessment

A diverse variety of assessment opportunities and tools are included in ***The Forest Where We Live*** materials. While some assessment methods are suggested, the process of scoring student-generated explanations and products requires development of scoring rubrics. Rubrics define standards of performance for specific target populations. Scoring rubrics, therefore, should be developed by the classroom teacher and/or his or her students.

## The National Science Education Standards

**The National Science Education Standards:** ***The National Science Education Standards*** outline what students should know, understand, and be able to do in the natural sciences. ***The Forest Where We Live*** videos, materials, and investigations address these standards by promoting students' active construction of ideas and explanations. For example, these activities can be shown to:

- include investigations (some of which extend over several days) which incorporate the use of multiple process skills
- encourage student participation in small (cooperative) groups
- include the collection, analysis, and synthesis of data
- actively engage students in applying experimental results to scientific argument and explanation, and to elicit interchange of student ideas.

The videos, materials, and investigations address, reinforce, or support the following Content Standards:

**Unifying Concepts and Processes**
**Systems, Order, and Organization**
**Evidence, Models, and Explanations**
**Constancy, Change, and Measurement**
**Evolution and Equilibrium**
**Form and Function**

**A. Science As Inquiry**
**Ability to do Science Inquiry**
**Understanding About Scientific Inquiry**

**C. Life Science**
**Evolution (history/succession of the area)**
**Interdependence of Organisms**
**Matter, Energy, and Organization in Living Systems**
**Behavior of Organisms**

**F. Science in Personal and Social Perspectives**
**Population Growth**
**Natural Resources**
**Environmental Quality**
**Natural and Human-Induced Hazards**
**Science and Technology In Local, National and Global Challenges**

**G. History and Nature of Science**
**Science as a Human Endeavor**

## Safety

Science teachers must know and apply appropriate safety regulations in the storage, use, and care of materials. In addition, they should adhere to safety rules and guidelines established by both national organizations and state or local regulatory agencies and teach students how to safely engage in investigations inside and outside the classroom. Safety issues should be addressed before students participate in the activities incorporated in ***The Forest Where We Live***.

## References

National Research Council: National Science Education Standards: National Academy of Sciences: 1996

## Excellence in Environmental Education Guidelines

**Excellence in Environmental Education-Guidelines for Learning** (K-12) provides students, parents, educators, home schoolers, administrators, policy makers, and the public a set of common, voluntary guidelines for environmental education. The guidelines support state and local environmental education efforts by:

- Setting expectations for performance and achievement in fourth, eighth, and twelfth grades
- Suggesting a framework for effective and comprehensive environmental education programs and curricula
- Demonstrating how environmental education can be used to meet standards set by the traditional disciplines and to give students opportunities to synthesize knowledge and experience across disciplines
- Defining the aims of environmental education

These Guidelines set a standard for high-quality environmental education in schools and other learning settings across the country and draw on the best thinking in the field to outline the core ingredients for environmental education.

The Guidelines are organized into four strands, each of which represents a broad aspect of environmental education and its goal of environmental literacy. The strands are:

| | |
|---|---|
| **Strand 1:** | **Questioning and Analysis Skills** |
| **Strand 2:** | **Knowledge of Environmental Processes and Systems** |
| **Strand 3:** | **Skills for Understanding and Addressing Environmental Issues** |
| **Strand 4:** | **Personal and Civic Responsibility** |

The Guidelines offer a vision of environmental education that makes sense within the formal education system and promotes progress toward sustaining a healthy environment and quality of life. Guidelines are suggested for K-4, 5-8 and 9-12 grade levels. Each guideline focuses on one element of environmental literacy, describing a level of skill or knowledge appropriate to the grade level under which it appears. Sample performance measures illustrate how mastery of each guideline might be demonstrated.

## References

National Project for Excellence in Environmental Education: Environmental Education and Training Partnership: North American Association for Environmental Education: 1999

# INTRODUCTION TO THE VIDEO

**OVERVIEW:** Forests are often generalized as dense populations of trees covering many acres of rural landscapes, but for many urban youth, impressions of forests and their inhabitants are based upon fairy tales and the anthropomorphic representations on video and the silver screen. Forest ecosystem dynamics, forest management concepts, forestry-related careers (and frequently, even forest products) are foreign to young people, and therefore, lack value, if considered at all. However, trees surround urban Americans and have historically been an integral part of most American cities whether they were deliberately planted, arose as volunteer sprouts, or are survivors of previous forest cover. Trees line our avenues, shade our schoolyards, provide links to our heritage, contribute to economics and serve as a basis of urban ecosystems. They provide us with oxygen, help filter the air, reduce temperatures, buffer the effects of wind, and contribute to our sense of well being. And while not meeting the generalized definition of forests, city trees occupy approximately seventy million acres of our nation's landscape, a space they share with eighty percent of all Americans.

# The Video Series

## There are six videos in the series. They include:

Program 1

### Urban Forestry, What Is It?

In this basic introduction, viewers discover the field of urban forestry, which has risen in importance since the 1970s. They will learn the difference between rural and urban forests and hear from some of the key people working in the field: municipal foresters, scientists, government leaders, university professors teaching forestry issues and average citizens working in volunteer and nonprofit organizations.

Program 2

### The History of Urban Forestry

This program touches on the history of urban forests in America, from colonial days to the rise of an urban forest movement in the late 1970s. Viewers discover that a 19th century conservation movement arose over concerns about deforestation and led to the creation of city parks, wildlife refuges and the U. S. Park Service. The post-World War II period set the stage for a new environmental movement concerned with rapid urbanization, highway expansion, and the devastating impact of Dutch Elm disease. This period has seen the establishment of a body of knowledge, policies and practices aimed at protecting and fostering urban forests.

Program 3

### Deforestation In America

Viewers learn the dangers of not attending to urban forests. Urbanization is occurring at a breathtaking pace. Many local communities are failing to regulate land use. Uncoordinated development throughout the nation and the resulting deforestation have led to overheated cities, worsening air pollution, and flooding. The impact can be felt beyond city boundaries to encompass surrounding regions. Concerned citizens have called attention to urban forests and clamored for the establishment of an ethic of land use to benefit the entire community.

## The Science of Urban Forestry

**Program 4**

In this program viewers are exposed to new scientific research which reveals the importance and benefits of urban forests. These studies show how urban forests affect climate, energy savings, air pollution, the potential for cost benefits, and psychological health. Some of the most eminent foresters in America describe the first comprehensive studies ever to be done on municipal forests. Scientists studying problems of heat island effect and air pollution, and foresters in Wisconsin, Georgia, Texas and Louisiana, describe better ways to plan cities. Sociologists explain the psychological importance of trees in reducing stress and promoting harmony within inner city environments.

## And Who Shall Lead the Way?

**Program 5**

Viewers explore the debate over how to care for urban forests and who should assume the lead: government or nonprofit and private organizations? With cutbacks in municipal, state, and federal budgets, governments have steadily relinquished care for the nation's urban forests, citing the need to address more vital concerns. This has increasingly left the task to non-profits and private organizations. Viewers meet leaders of nonprofit organizations in Baton Rouge, Atlanta, New York, Sacramento, and Los Angeles as they work to protect urban forests. Forestry experts warn of the need for more government support (given the impact of rapid urbanization), the need for more scientific research, and the dangers of losing a vital resource to deforestation.

## A Natural World

**Program 6**

This program demonstrates how young people and communities can be drawn together through model programs that beautify urban areas, such as the Chicago "River Rats," which began as a camping program for inner city youth. After cleaning up a blighted river area, they expanded their efforts to build trails and a wildlife habitat. Viewers meet citizens throughout the country—foresters, researchers, professors, and private citizens— who affirm the vital importance trees play in preserving quality of life and a sense of community. Healthy urban forests moderate temperature, reduce air pollution and flooding, and allow people living in urban areas – representing 80% of the nation – to live calmer, less stressful lives. Viewers learn that our environment is part of who we are.

# Urban Forestry, What Is It?

# Program I

**Video Description**: In this basic introduction, viewers discover the field of urban forestry, which has risen in importance since the 1970s. They will learn the difference between rural and urban forests and hear from some of the key people working in the field: municipal foresters, scientists, government leaders, university professors teaching forestry issues, and average citizens working in volunteer and nonprofit organizations.

## Learning Objectives

After participating in the activities, the student will be able to:

1. describe and discuss the general anatomy and physiology of a normal, healthy tree
2. identify and describe the functions of the structural components of the roots, trunk, crown, flowers, and leaves
3. define the term "urban forest" and list characteristics of urban forests
4. briefly discuss several problems facing urban forests today
5. briefly discuss both government efforts and public efforts toward the development of urban forestry over the last thirty years
6. describe at least 5 careers related to the field of urban forestry

## Teacher's Branch

An introduction or review of basic tree biology should precede the introduction of the video and activities of **The Forest Where We Live** materials to help students prepare for further, more detailed study. Learning objectives 1-3 outline the information to be reviewed. Most life science and biology texts should have basic tree biology units. Other good resources include your state forestry agency and the Cooperative Extension Service. Both have publications that specialize in trees which are part of the ecosystem where you live. (In Louisiana, Extension Service publication 2631, Guide to Successful Trees, could serve as the text or as a reference for an urban forestry unit.) For those teachers who have had Project Learning Tree training, the "Nature of Plants" unit from Project Learning Tree's secondary module, The Changing Forest, provides a concise unit of study and includes investigative activities.

The *Urban Forestry Lab Exercises* publication includes an excellent glossary which defines most of the forestry terms which might be unfamiliar to teachers or students. (See Appendix).

After giving students a pre-test to determine their previous knowledge of tree biology (learning objectives. 1-3), review concepts as necessary. Group development of concept maps is suggested as a follow-up. Many communities have an urban forester. Contact your local government agency for information specific to your particular area.

The **"Close Encounters With A Tree"** activity is designed to be used both as a hands-on experience and as an authentic assessment of student learning. This activity, found on page 16, is well suited for both individual or small groups.

## Introduction to the Video

Before viewing the video, have students:

1. define the term "forest"
2. describe or draw a forest ecosystem
3. list and describe at least three tree species growing in their neighborhoods and describe the role each plays in their lives
4. list and discuss at least five forestry-related careers

After students have shared their answers with the class, distribute copies of learning objectives 4-6 and review these with the students.

Students should then view the video and discuss and complete objectives 4-6. Utilize botany text books, the *Urban Forestry Lab Exercises* glossary, and forestry publications in your class work.

After viewing the video, students should discuss their answers to the objectives and brainstorm a list of urban forestry-related careers. **"Who is Minding Our Urban Forests?"** (See below) provides a partial list. Students should develop a list that includes others, as well.

## Who is Minding Our Urban Forests?

Some career opportunities related to urban forestry:

urban forester
soil specialist
arborist
chemist
plant geneticist
professor
computer specialist
park ranger
utility company tree trimmer
utility company management hydrologist
tree service specialist
insect or plant disease specialist
heavy machine operator
wood carver
garden supply store owner
horticulturist
landscape designer
landscape architect
wildlife biologist
Extension Service Agent
school teacher
water service provider


Working individually or in small groups, students should research urban forestry-related careers. Personal interviews and internet research should be encouraged. Original student presentations should include: job description, pay scale, necessary education and professional development, chances for advancement, working conditions, and description of a typical day or week. Presentations may include guest speakers or videotaped interviews.

# Close Encounters With A Tree

(Modified from LA PLT Tree Observation Synthesis)

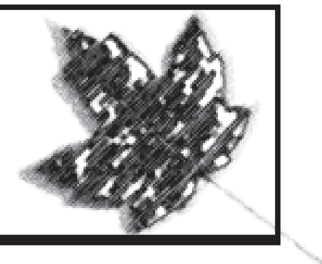
Find a tree that looks interesting, unusual or pleasing in some way. On a large piece of newsprint or in your nature journal:

1. Sketch the tree using charcoal. Using natural materials, color the sketch.
2. Estimate the tree's height. Describe what methods you used to make this estimation. Compare the height of the tree to the crown diameter. Is there any relationship between the two?
3. Measure the circumference at various heights from the ground and record these. How do you think people did this before the advent of rulers? Use that method!
4. Do a chalk or crayon rubbing of the bark pattern. Is the bark thick or is it thin? Describe interesting patterns of characteristics of the bark (they may help you identify the tree).
5. Do a chalk or crayon leaf rubbing. Indicate the type of aspice, base venation, leaf shape, and margin.
6. Describe any leaf adaptations which are typical of this tree.
7. Look for flowers, fruit, or cones. Sketch these (or if possible, dry and press some.) Indicate if the flower is perfect or imperfect and if the tree is monoecious or dioecious.
8. Columnar plants have root systems extending three times the dripline, and plants with broad-spreading crowns are likely to have roots extending one and a half to two times the branch spread. Estimate the circumference of your tree's root system.
9. Describe or sketch root adaptations seen and infer their functions. Describe any exposed roots and speculate why or how they were exposed. Does this exposure seem to have negative effects upon this tree? Explain your reasoning.
10. List ten to fifteen adjectives which describe your tree. Weave these into a poem or story about your tree.

**Be careful not to damage the environment when getting your materials!**

## Materials

- large sheets of newsprint (or students' nature journals)
- charcoal sticks (one per student or group)
- crayons (two or three per student or group)
- chalk (optional – one or two sticks per student or group)
- pencils (one per student or group)



## Connections to the Standards

### Part 1

**The activity found on page 16 aligns with the following "National Science Education Standards" and the "Excellence in EE-Guidelines for Learning"**

### Grades 5-8

Science Content Standard A: Science As Inquiry
- *Abilities necessary to do scientific inquiry*

Science Content Standard C: Life Sciences
*Structure and function of living systems*

Excellence in EE-Guidelines for Learning Strand 1:
Questioning and Analysis Skills
- *Questioning*
- *Collecting information*
- *Organizing information*

Excellence in EE-Guidelines for Learning Strand 2.2:
The Living Environment
- *Organisms, populations, and communities*

Excellence in EE- Guidelines for Learning Strand 2.4:
Environment and Society
- *Human/environment interaction*

### Grades 9-12

Science Content Standard A Science As Inquiry
- *Abilities necessary to do scientific inquiry*

Science Content Standard C: Life Sciences
- *Matter, energy, and organization in living systems*

Excellence in EE-Guidelines for Learning Strand 1:
Questioning and Analysis Skills
- *Questioning*
- *Collecting Information*
- *Developing proposed explanations*

Excellence in EE –Guidelines for Learning Strand 2.2:
The Living Environment
- *Organisms, populations, and communities*

Excellence in EE-Guidelines for Learning Strand 2.4:
Environment and Society
- *Human/environmental interactions*

# The History of Urban Forestry Program II

**Video Description**: This program touches on the history of urban forests in America, from colonial days to the rise of an urban forest movement in the late 1970s. Viewers discover that a 19th century conservation movement arose over concerns about deforestation and led to the creation of city parks, wildlife refuges and the U.S. Park Service. The post-World War II period set the stage for a new environmental movement concerned with rapid urbanization, highway expansion, and the devastating impact of Dutch Elm disease. This period has seen the establishment of a body of knowledge, policies and practices aimed at protecting and fostering urban forests.

## Learning Objectives

The student will be able to:

1. develop a presentation relating trees to the history of their family, school, neighborhood, or city
2. discuss current or historical urban forestry issues local to his/her home
3. discuss the history of Arbor Day in his/her state

## Teacher's Branch

The trees around our schools and homes are part of an historic legacy of nature in America. The responsibility for that legacy now falls on America's youth. Numerous resources are available to assist young people in meeting this challenge. The National Arbor Day Foundation (www.arborday.org) has numerous free or inexpensive educational publications, such as tree identification booklets and curricula, which include tree planting and maintenance activities and materials which promote environmental stewardship. Many state or local Farm Bureau offices, Cooperative Extension Service offices and historical societies have speakers who can relate urban forestry to the history of your particular area of the country. The District U.S. Forest Service and your state and local forestry offices have materials relevant to urban forestry issues. The Internet site, The Elm Research Institute (www.forelms.org) and "A Woodland Grows in Brooklyn," by Charles Siebert, (*Audubon*, Jan-Feb, 1997), tie history to problems and re-mediation of an urban forest ecosystem.

## Introduction to the Video

Before viewing the video, have students discuss what is meant by a "movement," and ask them to give some examples, such as an environmental movement, a religious movement, a political movement, etc.

After viewing the video, have each student group complete one of the following:

1. Develop a creative presentation relating trees and the history of their families, school, neighborhood, city, or some specific site such as a cemetery or park.
2. Contact state, local, or national organizations or agencies to research current or historical local urban forestry issues (such as Dutch Elm disease, Formosan termite infestations, or problems associated with exotic species, such as the Chinese Tallow tree). Students should also prepare a creative presentation of their work. Presentations might include skits or plays, videotapes, photographic essays, illustrated booklets, slide shows or power point presentations, or taped interviews with urban foresters, other experts or "old-timers." Choices are limited only by equipment and time restraints. Specific requirements, due dates and the amount of in-class time devoted to this project are to be determined by the teacher.
3. Research the history of Arbor Day in your state or community and plan an Arbor Day celebration for a local elementary school. A good contact is your state Office of Forestry. The plan should be based upon research and include tree and site selection, funding for the tree, fertilizer, tools, purchase of trees and other materials, instruction of younger children, program agenda, and long-term and summer watering and maintenance schedules.

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## Connections to the Standards
### Part 2

**The classroom discussions found on page 18 align with the following "National Science Education Standards" and the "Excellence in EE-Guidelines for Learning"**

### Grades 5-8

Science Content Standard A: Science As Inquiry
Understandings about scientific inquiry
Science Standard C: Life Sciences
- *Diversity and adaptations of organisms*

Excellence in EE-Guidelines for Learning Strand 1: Questioning and Analysis Skills
- *Questioning*
- *Collecting information*
- *Developing proposed explanations*

Excellence in EE-Guidelines for Learning Strand 2.3: Humans and Their Societies
- *Culture*

Excellence in EE-Guidelines for Learning Strand 2.4: Environment and Society
- *Places*

Excellence in EE-Guidelines for Learning Strand 3.1: Skills for Understanding and Addressing Environmental Issues
- *Identifying and investigating issues*

### Grades 9-12

Science Content Standard A Science As Inquiry
- *Understanding about scientific inquiry*

Science Content Standard G: History and Nature of Science Standards
- *Nature of Science*

Excellence in EE-Guidelines for Learning Strand 1: Questioning and Analysis Skills
- *Questioning*
- *Collecting information*
- *Developing proposed explanations*

Excellence in EE-Guidelines for Learning Strand 2.2: The Environment
- *Organisms, populations and communities*

Excellence in EE-Guidelines for Learning Strand 2.4: Environment and Society
- *Places*

Excellence in EE-Guidelines for Learning Strand 3.1: Skills for Understanding and Addressing Environmental Issues
- *Identifying and investigating issues*

# Deforestation in America
# Program III

## Learning Objectives

The student will be able to:

1. discuss some of the effects that one plant may have on other organisms in an urban setting
2. describe the importance of the interactions among trees, soil and humans in the urban environment
3. recognize that data accuracy is linked to accuracy of measuring devices
4. demonstrate the correct use of specific pieces of laboratory equipment, such as thermometers, sling psychrometers, pH meters (or pH paper) and balances, which are used to gather data.
5. analyze data, draw conclusions, and communicate results
6. relate several benefits that shade trees provide
7. calculate and compare the difference between soil temperature in the shade and soil temperature in the sun
8. relate other climatic conditions to the difference between soil temperature in the sun and soil temperature in the shade
9. discuss defoliation problems associated with gypsy moth infestation
10. formulate gypsy moth management plans and defend his/her group's specific management perspective

Losing trees means that there is potentially more carbon dioxide in the air. Carbon dioxide

**Video Description**: Viewers learn the dangers of not attending to urban forests. Urbanization is occurring at a breathtaking pace. Many local communities are failing to regulate land use. Uncoordinated development throughout the nation and the resulting deforestation have led to overheated cities, worsening air pollution, and flooding. The impact can be felt beyond city boundaries to encompass surrounding regions. Concerned citizens have called attention to urban forests and clamored for the establishment of an ethic of land use to benefit the entire community.

## Teacher's Branch

and other atmospheric gases, under certain conditions, can act like a thermal blanket and heat up the planet—the so called "greenhouse effect." The U.S. Forest Service *Urban Forestry Lab Exercises* "What Effects Do Trees Have on the Environment" and "Comparing Soil Temperatures in Sun and Shade" are to be considered lab activities for this unit.

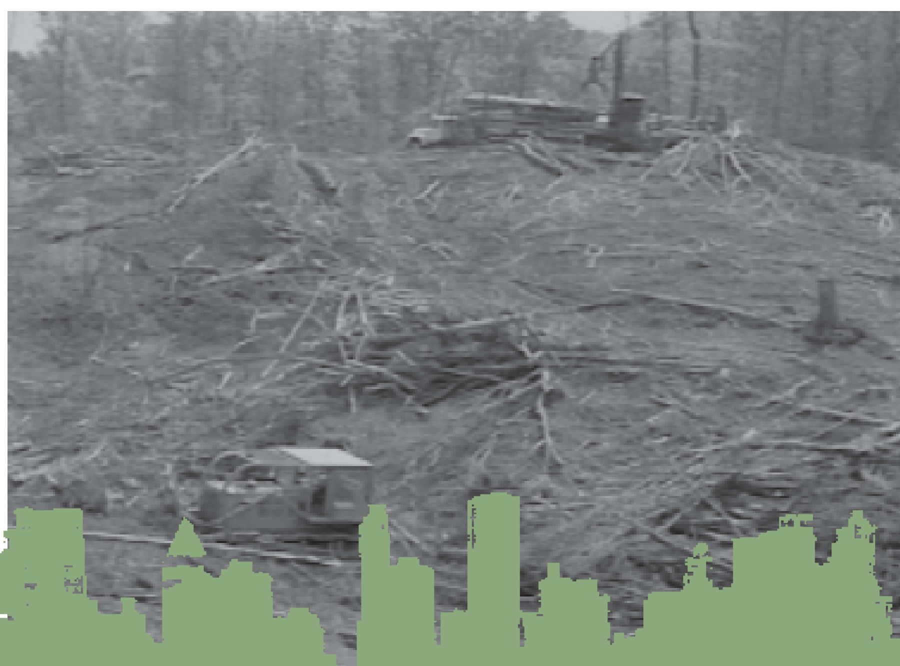
## Introduction to the Video

After viewing the video, students should discuss deforestation in general and then complete the lab exercise "What Effect Do Trees Have on the Environment?" This activity is designed to take three days. As this activity requires use of sling psychrometers and ph meters (or ph paper), the teacher may need to review use of these items prior to the activity and perhaps borrow equipment from a forester. Lab safety issues should also be addressed. "Comparing Soil Temperatures In Sun and Shade" takes only about 10 minutes per day to complete, but data should be collected daily over several weeks. Correct equipment use and lab safety issues should be addressed.

If internet access is available, have students visit the COOL COMMUNITIES website (www.amfor.org). This site promotes strategic urban tree planting, landscaping and use of light-colored surfaces to reduce heat island effect. This combination of activities should promote student understanding of the value of tree cover and assist them in inferring the dangers of deforestation.

Gypsy moths were first introduced to North America in 1869 in a misguided attempt to breed healthy silkworms. The gypsy moth caterpillar is now a serious defoliator of trees and shrubs in the U.S. and Canada. Resources appropriate for this topic can be found at the U.S. Forest Service web site, (http://fhpr8.srs.fs.fed.us/programs/sts/sts_bref.htm). *EE News: Environmental Education in Wisconsin*, Spring 1999 edition features a special insert on gypsy moths. For information, visit (www.dnr.state.wi.us/eek) or contact the publisher at (morganac@dnr.state.wi.us). Single free copies of A Gypsy Moth Poster (pub-FR-131) are available from Wisconsin DNR, Bureau of Forestry, P. O. Box 7921, Madison, WI 53707. Project Learning Tree: *The Changing Forests-Forest Ecology* "Saga of the Gypsy Moth" has students formulate management plans and assume responsibility for advocating their specific management perspective. To make it more relevant, this activity could be modified by the teacher (or students) to explore local urban deforestation concerns. For example, students could determine if any exotic or nonnative species are found in their area. The Project Learning Tree (www.plt.org) *The Changing Forest: Forest Ecology* activity "Home Sweet Home" (Part B and Enrichment #2) has students examine exotic species in their local forests.

The environment affects trees, but trees can also affect the environment. A tree needs water, minerals, carbon dioxide, and sunlight. The pH, moisture con-



# What Effects Do Trees Have On The Environment?

## Introduction

tent, type of soil, competition, and mankind all affect tree growth. This experiment is designed to help us understand how trees affect the environment around them.

Many other factors are now being investigated for trees the same way that they are for people. The forest is much different than an urban area. While taking measurements of these environmental factors, consider what other factors you could measure. Which of these factors do you think are important to a homeowner/forester?

## Question

1. Does the soil moisture, soil pH, soil temperature and humidity vary from tree to tree?

## Hypothesis

*Students are to write their own hypothesis before continuing.*

## Materials

| | | |
|---|---|---|
| Air thermometer | Soil thermometer | ***Possible Option:*** |
| Sling psychrometer | pH meter/pH paper | Balances/scales |
| Moisture meter | Meter sticks | Distilled water |
| 15 cm rulers | Plastic bags | |

## Procedure

1. Students will work in groups to prepare the appropriate data tables.
2. Take the first set of air and soil temperatures at the base (bole) of the tree, and the second set at the drip line (measure the distance from the trunk). The final set should be taken at least 5 meters from the tree in full sun.
3. The pH should be measured using the pH meter at the same distances as the temperatures. If pH is to be tested, collect a soil sample, place in a plastic bag, and return it to the laboratory. In the lab, add an equal amount of distilled water to the soil sample, and then in three to five minutes (when the soil has settled) use the pH paper.
4. Measure the soil moisture with the meter at the same locations.
5. Measure the humidity in the same approximate locations.

## Results

The data for your group's work should be checked with the teacher before it is entered in the class data table. Make sure of the units you are using and the number of places in your calculated results. The table should be labeled **Table A** with an appropriate key for any abbreviations.

The following abbreviations are used in data **Table B** to conserve space:

**AT** - ***air temperature***
**H** - ***humidity***
**SM** - ***soil moisture***
**ST** - ***soil temperature***
**pH** - ***acidity of soil***

Combine data from at least three other groups (or as your teacher directs) in the **Class Data Table B.**

## Table A: Student Group Data

TREE # ____________

SPECIES ___________________

| | Air Temp. | Soil Temp. | Humidity | pH | Soil Moisture |
|---|---|---|---|---|---|
| **Base** | | | | | |
| **Dripline** | | | | | |
| **Outside** | | | | | |

## Table B: Class Data

| Tree No. | Species | Base | Dripline | Outside |
|---|---|---|---|---|
| | | AT ST H pH SM | AT ST H pH SM | AT ST H pH SM |
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |

## Discussion Questions

1. Which tree had the greatest difference in temperature between the base and the area outside the tree? Which tree had the least difference? What was the difference?
2. Was the difference in humidity between the base of the tree and the open area outside surprising to you? Explain.
3. Which trees had the greatest soil moisture at the base? At the drip line? Is there a difference? Why?
4. Do you believe that the pH difference is due to the species of tree? Explain your answer.

## Conclusions

1. Does the data support your hypothesis? Why or why not?
2. What do the results of this experiment tell you about trees as a homeowner/forester?
3. What experiment could you design to learn more about the effects of trees on the environment?
4. How are the conditions under a tree different from the conditions beyond?

## Background Information

While the microenvironment required by an organism may not seem important to the untrained observer, the microenvironment above and below ground can have a tremendous impact on all organisms. In the last 30 years, the availability of more sophisticated techniques are increasing our awareness of the microenvironment. We have been manipulating the macro-environment without realizing how the microenvironment is also being altered.

The chemistry of the soil and the tree are now being studied intensively by scientists. Scientific journals are now available that specifically address the health and productivity of trees. The three factors chosen for this exercise can be measured and compared easily. Since trees live for many years, student data on the same tree can be compared over time. The trees we plant and take care of today can be here for many generations to come.

## Target Group

High school or middle school level

## Timeline

**Day 1 –** Students should discuss their ideas on the macro- or microenvironment of a tree. This should include how far away from a tree we can measure the effect of the tree. The students need to discuss what factors are needed in their data tables. The students should then make their hypothesis by group and this should be checked before going out in the field. Demonstration of the equipment and its proper use are needed for accurate data recording. The students' data table design should be checked, along with their equipment lists. The class data table should be a summary by groups.

**Day 2 –** Students should go out to their two trees and gather the data. When finished, have them return to the lab, assimilate the class data, and work on calculations and discussion questions.

**Day 3 –** Conduct a question and answer session after the class data has been collected and checked. Use a graphing program or have each group gather data from two other species of trees and make a graph for comparisons.

## Placement of Lab in Curriculum

This exercise is part of the unit on trees and can be done once the preliminary work of organizing the science class has been accomplished.

This exercise would fit in an environmental or higher plant unit. The exercises are more effective as a coordinated unit over a two to three week period.

## Student Learning Objectives

Students will be able to:

1. Recognize that one organism will have an effect on other plants in an urban setting.
2. Understand that the interaction among trees, soil and people is becoming increasingly important in the urban environment.
3. Understand that data reflects the accuracy of the measuring devices.
4. Apply quantitative observational methods to accumulate precise data about the trees at their site.
5. Analyze the results of the experiment.
6. Evaluate the interpretation of data collected during the experiment.

TIPS

## Preparation and Teaching Tips

The preparation for this experiment is the same as the preceding exercises in this unit. The need to prepare the area for the tree key exercise is the prelude to all the experiments. Once the field work of setting up the tree identification has been done by map or tree tag number, trees can be assigned to students. It is suggested that each group collect information on two trees. If there is time or need, additional trees can be assigned. ***Remember that too much data is as confusing as too little.***

Students should prepare a data table for the two trees they are going to study. The class data table should be the same format, so computer analysis can be done later.

The lab exercise can be done by one or two groups while other groups are doing the other labs in this packet. Plan ahead so that all the photocopied materials are prepared, and the students have prepared the proper tables and equipment lists for the exercise.

The data tables for the students are meant as an example that can either be used as is, or as a suggestion of how to set up a table. Since the organization of the data table used in the field is not important to the class, it may be prudent to let students design their own to gain experience with this process.

### Blowouts

***"Remember that too much data is as confusing as too little."***

1. Compare and contrast the north side to the south side of the tree and the east side to the west side.
2. Compare different tree species.
3. Compare trees of the same species which are different ages.
4. Compare trees that have been mulched extensively to those that are surrounded by grass, or are in median strips of parking lots.


1. ***Biology: Living Systems.*** Alexander, P., et al. Prentice Hall Inc. 1989.
2. ***Field Biology for Secondary Students.*** Voss, Burton, editor. Unpublished. University of Michigan Biological Station. 1987.
3. ***Tree Maintenance.*** Pirone, P.P., 5th edition, Oxford University Press, N.Y. 1989.


## References

## Discussion Questions Answers

To accurately answer these questions the students have to review all the class data and examine all the possibilities. The answers will vary for all the groups, and the work should be designed so it is done as a group. Any type of in-depth answer will suffice with the use of pictures or diagrams to support their position. A final report to the class on each experiment could enhance their motivation to examine one area in detail.

## Table B:

**Example 1**
**— °C —**

| Tree No. | Species | Base<br>AT ST H pH SM | Dripline<br>AT ST H pH SM | Outside<br>AT ST H pH SM |
|---|---|---|---|---|
| *1* | *Silver Maple* | *21 21 83 6.5 5* | *24 24 85 7.5 4* | *27 31 65 8.0 1* |
| *3* | *Pin Oak* | *20 20 85 6.0 5* | *24 22 80 7.0 3* | *26 30 62 8.0 1* |
| | | | | |

**Example 2**
**— °F —**

| Tree No. | Species | Base<br>AT ST H pH SM | Dripline<br>AT ST H pH SM | Outside<br>AT ST H pH SM |
|---|---|---|---|---|
| *1* | *Silver Maple* | *71 70 83 6.5 5* | *77 77 85 7.5 4* | *80 87 65 8.0 1* |
| *3* | *Pin Oak* | *69 69 85 6.0 5* | *77 74 80 7.0 3* | *80 86 63 8.0 1* |
| | | | | |

## Connections to the Standards

### Part 3A

**The activity found on page 21 aligns with the following "National Science Education Standards" and the "Excellence in EE-Guidelines for Learning"**

### Grades 5-8

Science Content Standard A: Science As Inquiry
- *Abilities necessary to do scientific inquiry*

Science Content Standard B: Physical Science
- *Transfer of energy*

Science Content Standard C Life Science
- *Diversity and adaptations of organisms*

Science Content Standard F: Science in Personal and Social Perspectives
- *Science and technology in society*

Excellence in EE-Guidelines for Learning Strand 1: Questioning and Analysis Skills
- *Collecting information*
- *Developing proposed explanations*

### Grades 9-12

Science Content Standard A: Science As Inquiry
- *Abilities necessary to do scientific inquiry*

Science Content Standard B: Physical Science
- *Structure and properties of matter*

Science Content Standard C: Life Science
- *Matter, energy, and organization in living systems*

Science Content Standard F: Science in Personal and Social Perspectives
- *Science and technology in local, national, and global challenges*

Excellence in EE-Guidelines for Learning Strand 1 Questioning and Analysis Skills
- *Collecting information*
- *Developing proposed explanations*

# Optional Laboratory:
# Comparing Soil Temperatures In Sun And Shade

## Introduction

Shade is one of the most recognizable characteristics of a tree. On a hot summer day, the outline of a shady area is probably more noticed than the tree itself. What are the effects of shade, other than cool comfort, as one escapes from the direct sun?

The shade from a forest tree creates a microclimate suitable for many species of plants and animals to survive and flourish. Many small plants have adapted to the understory of a forest, and need protection from the direct rays of the sun. The forest soil is cool and moist, which is good for plants. The moist forest soil is also a good place for microorganisms to survive. Many of these microorganisms, such as soil bacteria and fungi, are beneficial to forest plants.

Soil temperature is a critical part of the survival of organisms both big and small. Shade not only cools the subsurface, but also the air temperature above the ground which helps to stabilize the entire area. A city street lined with trees has sidewalks that are much cooler than a city street without trees. Many people suffer from heat related illnesses. People are more likely to show signs of heat stress in a city where there are few trees and shade. In this exercise, measuring soil temperature differences will illustrate the effects of shade from a tree.

### Question

1. You probably have guessed that there will be a difference in soil temperature between sun and shade, but will there be a difference of 10 degrees or more?

?

## Procedure

1. If a long range study is planned, the school grounds are a good place to locate two permanent sites so that daily readings can be made in a routine fashion.
2. The site in the sun should be well away from any structure because the structure might radiate heat onto the soil where the thermometer is located. The thermometer can be concealed and will not affect the reading because the tip of the probe is detecting the soil heat, not the round gauge on top of the probe.
3. The site in the shade should not be too close to a tree trunk.
4. Leave probes in the ground for at least a half hour to adjust to the soil temperature.

**(Optional: if time permits)**

5. Use thermometers to record air temperatures.
6. Use wind gauges to record wind velocity.
7. Use sling psychrometers to record humidity data.

### Hypothesis

*Students should make their own hypothesis before continuing.*

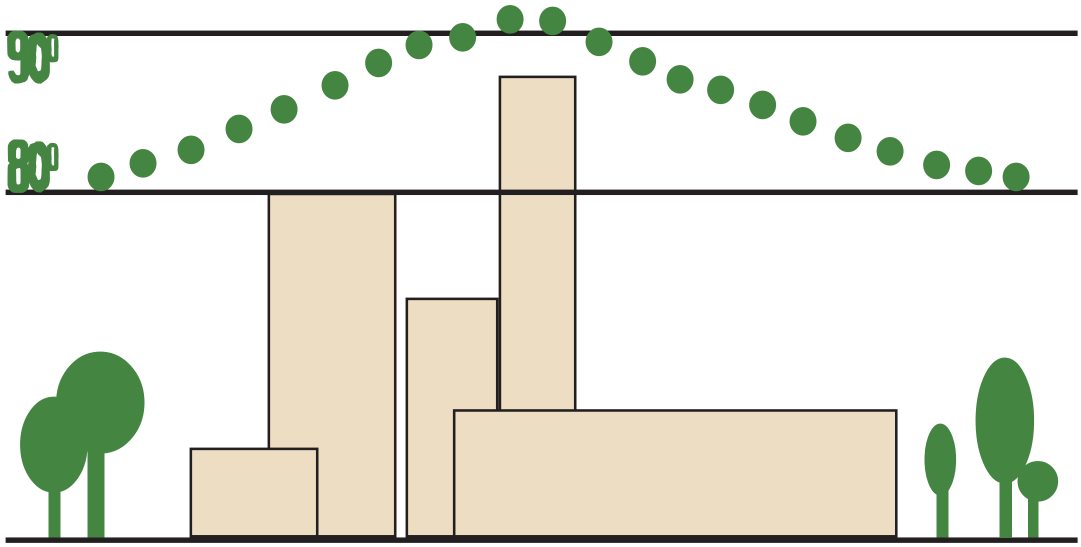
### Materials

Soil thermometers
Data sheet

## Blowouts

1. Urban heat islands are isolated pockets of increased temperatures located over urban areas. The heat pockets are greater because of the increased number of building structures and paved areas (Fig. 1). Structures and pavements absorb and reradiate direct solar radiation. Find two sunny sites to place the soil thermometer probes so that one is in the lawn and the other is next to a building wall. A south facing wall will provide the best results.

**Fig. 1.** A generalized cross-section of a simplified urban heat island.




### Soil Temperature Comparison: Sun / Shade

**NAME:** ______________________________

**Location of Soil Thermometers:** ______________________

| Day # | Air Temp. | Windy/Calm | % Humidity | Cloudy/Clear | Soil Temp. | |
|---|---|---|---|---|---|---|
| | | | | | Sun | Shade |
| | | | | | | |
| | | | | | | |
| | | | | | | |
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| | | | | | | |
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## Background Information

The quest for shade is one of the ultimate experiences in the summer. Escaping the direct rays of the sun is probably deeply rooted in our primal past, so that seeking shade has become a subconscious act. The shade tree in your backyard or your favorite park is a place of welcome shelter and enjoyment. The human benefit of shade is quite evident, but what about the more subtle attributes of forest trees and shade?

Shade helps to create a more favorable understory environment. Many herbs, shrubs and saplings require a cool environment to grow successfully. Shade also reduces the rate of soil moisture evaporation. Many animals, such as small insects and worms, depend on a high soil moisture content to survive. These small animals are food for other larger animals, which therefore become indirectly dependent upon the shade trees provide. Since shade promotes the growth of grasses, herbs and shrubs, shade can also then be linked to soil stabilization, because the roots of plants reduce soil erosion. One might look at a timber area and say that the tract is helping to control erosion. But if the understory vegetation is being grazed by livestock the forest tract is actually contributing to erosion. ***Too often in rural areas, livestock are allowed to graze in woodlands, particularly along watershed drainages. An estimated 66 percent of erosion occurs because of heavy grazing. The resulting disturbance of forest duff and understory increases erosion and sedimentation into adjacent waterways.*** [1]

Moderating solar radiation for a city or urban environment can have extensive benefits other than the immediate escape from the sun. A concept that forest researchers have used is that of urban heat islands. Urban areas are often warmed by the heat generated by sources of reradiation, such as paved parking lots, stone buildings and roads. It has been found that city parks within a community can be 2-6 degrees cooler than the rest of the urban heat island. Urban heat islands have also been blamed for increased health risks such as cardiovascular diseases and other heat-aggravated illnesses. Trees which are in city parks and trees which line urban streets have been credited with reducing air conditioning costs. The shade that trees provide is a complex, but often overlooked phenomenon when discussing the benefits of planting and maintaining trees.

## Timeline

## Target Group

Sixth through eighth grade.

This activity can be a daily reading of the soil thermometers which take only 10 minutes to read and record. (Acquiring additional data such as humidity and air temperature might require more time.) These can also be found in a newspaper, by calling a local weather recording, or they can be measured by onsite field measurement.

## Student Learning Objectives

The student will be able to:

1. Relate many of the benefits shade trees provide.
2. Read and record from a soil thermometer.
3. Calculate the difference between soil temperature in the shade and in the sun.
4. Relate other climatic conditions to the difference between soil temperature in the sun and shade.

## Procedure

Setting up this data comparison seems quite simple, and it is! However,

[1] ***A Long Range Plan for Illinois Forest Resources***. Illinois Council on Forestry Development, Sept 1990.

there are a number of interesting variations that could be used based upon imagination and time availability. This particular project is best suited for a long term study, so that interpretations can be made with reference to the other climatic conditions. However, the results from just one day of comparison can be very dramatic as the students see the big difference shade trees can make on soil temperature.

Select two spots on your grounds; one in the full sun and the other in the shade of a tree. One to two hours is enough time to take a reading and record a difference of 15 degrees. You can choose to install permanent thermometers for reading on the hour, or take them with you on your daily trips.

## Blowouts

Mulch placed around the base of a tree is designed to trap rain and moisture and insulate the soil immediately below from direct radiation. In the full sun, place one soil thermometer in the grass and another through the mulch around a tree. Read in an hour.

## Glossary

***Insulation:*** a barrier creating dead air space thereby reducing the tendency of cool or warm air to move from a high concentration to a low concentration (diffusion). Mulch is a type of insulation; so is a tree canopy.

## References

1. ***Chicago's Evolving Urban Forest***. McPhearson E. C., and Nowak. USDA Forest Service, North-eastern Forest Experiment Station. 1992.
2. ***A Long Range Plan for Illinois Forest Resources.*** Illinois Council on Forestry Development, Sept 1990.
3. ***Boundary Layer Climates.*** Oke, T.C. New York Methuen. p. 435. 1987.

## Connections to the Standards

### Part 3B

**The activity beginning on page 25 aligns with the following "National Science Education Standards" and the "Excellence in EE-Guidelines for Learning"**

### Grades 5-8

Science Content Standard A: Science As Inquiry
- *Abilities necessary to do scientific inquiry*

Science Content Standard B: Physical Science
- *Properties and changes of properties in matter*

Science Content Standard C: Life Sciences
- *Regulation and behavior*

Excellence in EE-Guidelines for Learning Strand 1: Questioning and Analysis Skills
- *Collecting information*
- *Developing proposed explanations*

### Grades 9-12

Science Content Standard A: Science As Inquiry
- *Abilities necessary to do scientific inquiry*

Science Content Standard B: Physical Science
- *Structure and properties of matter*

Science Content Standard C: Life Science
- *Behavior or organisms*

Excellence in EE-Guidelines for Learning Strand 1: Questioning and Analysis Skills
- *Collecting information*
- *Developing proposed explanations*

# The Science of Urban Forestry

# Program IV

## Learning Objectives

The student will be able to:

1. determine the distance between two points by counting the number of steps taken between the two points
2. compute the length of his/her average step and, given a pre-measured 100-foot distance, measure tree height
3. determine tree circumference
4. discuss interactions among trees, soil surface conditions, and subsurface soil characteristics
5. use soil sampling techniques and devices
6. use data collected to draw conclusions about the nature of soil at different sites
7. evaluate each site for future tree growth
8. determine the age of a tree

**Video Description**: In this program viewers are exposed to new scientific research which reveals the importance and benefits of urban forests. These studies show how urban forests affect climate, energy savings, air pollution, the potential for cost benefits, and psychological health. Some of the most eminent foresters in America describe the first comprehensive studies ever to be done on municipal forests. Scientists studying problems of heat island effect and air pollution, and foresters in Wisconsin, Georgia, Texas and Louisiana, describe better ways to plan cities. Sociologists explain the psychological importance of trees in reducing stress and promoting harmony within inner city environments.

## Teacher's Branch

The video should be used to introduce this unit.

The U.S. Forest Service *Urban Forestry Lab Exercises* "How Big is a Tree?" and "Measuring Tree Heights" introduce forestry measurement skills. Availability of a clinometer (see page 31) and the degree of slope of the surrounding area should be used by the teacher in selecting between "How Big Is A Tree?" and "Measuring Tree Heights." "Measuring Tree Heights" requires clinometers and its procedures include measuring trees growing on slopes. "How Big Is A Tree?" utilizes less sophisticated techniques, but includes measuring tree circumference. Instruction, practice, and lab completion will require at least 1 to 2 hours for either activity.

Tree growth and development are dependent upon the soil below. However, urban soils are exposed to or covered by chemicals, barriers, and structures, which make acquisition of necessary nutrients and specific soil conditions difficult. The *Urban Forestry Lab Exercise* "What's Happening Below the Surface?" familiarizes students with soil sampling techniques and has them correlate subsurface soil characteristics, tree species, and soil surface conditions. This activity includes equipment for which correct use and safety considerations should be reviewed. This activity requires about five one-hour class periods to complete. Once armed with these skills, students can complete the "Meet the Forest" activity or the Project Learning Tree activity "Cast of Thousands."

Instruction in drying leaves, use of taxonomic keys, and dendrochronology (such as reading the rings) are appropriate for this unit as well. Good resources include: *the Urban Forestry Lab Exercise* "How Old is This Tree?," the leaf drying activity (on page 31) and taxonomic keys. Free or inexpensive tree identification guides are available from state Cooperative Extension offices, state forestry departments, and the U.S. Forest Service. In Louisiana, two Cooperative Extension Service publications (*Trees of Louisiana* and *Leaf Key for Louisiana Trees)* are readily available. *Teachers Guide to Arbor Month, Minnesota Arbor Month Partnership* 1990 and 1993 offer activities appropriate for identification, dendrochronology, forest measurement skills and more.

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## Connections to the Standards

### Part 4A

**The activities found on page 32-33 align with the following "National Science Education Standards" and the "Excellence in EE-Guidelines for Learning"**

### Grades 5-8

Science Content Standard A Science As Inquiry
- *Abilities necessary to do scientific inquiry*

Science Content Standard C Life Science
- *Structure and function in living systems*

Content Standard F: Science in Personal and Social Perspectives
- *Populations, resources and environments*

Excellence in EE-Guidelines for Learning Strand 1: Questioning and Analysis Skills
- *Questioning*
- *Collecting information*

Excellence in EE – Guidelines for Learning Strand 2.1: The Earth as a Physical System
- *Processes that shape the Earth*
- *Changes in Matter*

Excellence in EE- Guidelines for Learning Strand 2.2: The Living Environment
- *Flow of matter and energy*

### Grades 9-12

Science Content Standard A Science As Inquiry
- *Abilities necessary to do scientific inquiry*

Science Content Standard B: Physical Science
- *Properties and changes of properties in matter*

Science Content Standard C: Life Sciences
- *Diversity and adaptations of organisms*

Science Content Standard F: Science in Personal and Social Perspectives
- *Populations, resources and environments*

Excellence in EE-Guidelines for Learning Strand 1: Questioning and Analysis Skills
- *Questioning*
- *Collecting information*

Excellence in EE – Guidelines for Learning Strand 2.1: The Earth as a Physical System
- *Processes that shape the Earth*
- *Changes in Matter*

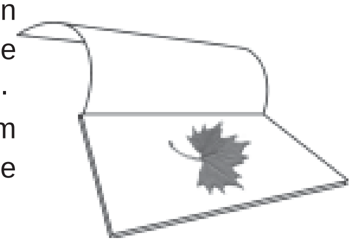
# Drying Leaves

In addition to traditional plant presses (which may be difficult to carry into the field or store in the classroom), pocket-size leaf presses can be constructed out of layers of cardboard, waxed paper, and newspaper bound together by large rubber bands. Create “sandwiches” with leaves at the center by first using paper towels, then waxed paper, and finally, cardboard layers above and below.

Back in the classroom or at home, students can dry their leaves in a microwave oven. This method requires little of the time or space needed when using plant presses. The only materials necessary, other than a microwave oven and leaves, are magazines or catalogs and paper towels. *Remember: don’t place magazines with staples in the microwave oven!*

## Procedure

1. Sandwich the leaves between paper towels and place each “sandwich” between pages of the magazine.
2. Place a paper towel in the bottom of the microwave oven to prevent the magazine from sticking to the bottom surface.
3. Place the magazine inside, set the microwave oven on high and set the timer.
4. Check the leaves every 3-5 minutes to prevent overdrying.
5. Once the leaves are dry, use caution in removing the magazine from the microwave oven as it gets very hot.
6. When the leaves are dry, allow them to stay in the magazine until they are cool. This prevents curling.



***NOTE:*** *Number of leaves being dried, thickness of leaves and variations in microwave ovens influence the drying time. If only 2 or 3 leaves (which are not very thick) are being dried, 2 minutes is probably long enough to result in dry, brittle leaves. More pages or drying leaves with thick, waxy cuticles may take 5-10 minutes.*

Thanks to Betty Jones, STAR Center, Alexandria, Louisiana
Use of a microwave oven in drying leaves is modified from “Drying Leaves Quickly” by Judith K. Wood and Carl E. Wood in *The Science Teacher*, February, 1989.

# A Simple Clinometer

A simple clinometer can be built using a protractor, a drinking straw, tape, some string and a small weight. Tape the straw across the flat edge of the protractor. Then tape one end of the string to the straw at the midpoint. Attach a small weight to the other end of the string. (Fig. 2)

Activity is adapted from *The Changing Forest: Forest Ecology,* page 38

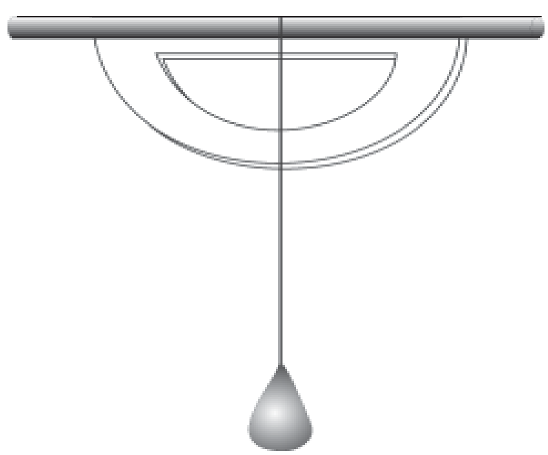


FIG. 2. Clinometer

# How Big Is A Tree?

## Introduction

One of the goals of the Urban Forestry program is to involve students in activities which require scientific research. Nearly all research is based upon data collection and analysis. If an appropriate off-site area is not available, concentrate on using your school site. As more and more schools participate in this study, we want to develop a network by which teachers from around the area can communicate and share ideas.

For this activity, we want participating schools to develop a data base which can be upgraded each year. To do this, you need to know the height and circumference of every tree on your school site, and then chart the growth of those trees over the years.

## Questions

1. How do we estimate the height of a tree?
2. How do we measure the circumference of trees?

## Procedures

1. As part of Lab #1 , you may have started to develop a map of the trees on your school site. If you did not, you will need to have some way to keep a record of all existing trees and any new ones you plant.
2. Designate groups of students to gather data on the height and circumference of every tree on your site and record this information.
3. There are several methods by which your students can estimate or measure the heights of the trees. If your math curriculum includes Geometry, you may want to incorporate some of your math lessons here. If not, here is probably the simplest way:
   A. Have students measure their own height (in cm).
   B. Student A stands under a tree while student B stands a distance away. (about 20 paces)
   C. Student B holds a pencil at arms length and covers part of the pencil so that the visible part is the same length as Students A's height.
   D. Student B now moves the pencil up the tree and measures how many times taller the tree is than Student A.
   E. Simply multiply this number times Student A's height and you have a good estimate of the tree's height. **Example:** Student A is 150 cm tall. Student B found that the tree is about four times taller than student A. So 150 cm x 4 = 600 cm. The tree is approximately 6 meters tall.
4. Find the circumference of the tree by simply measuring. Tree circumference is usually measured at about chest height. To insure accurate measurements from year to year, you may wish to make a mark with paint in the bark to designate the exact place where the measurement is made.

## Discussion Questions

1. What is the value of a "longitudinal" study?
2. Why is it necessary to study a tree for such a long time?

## Materials

Metric tape measures

## Results

Please record your data on the forms provided

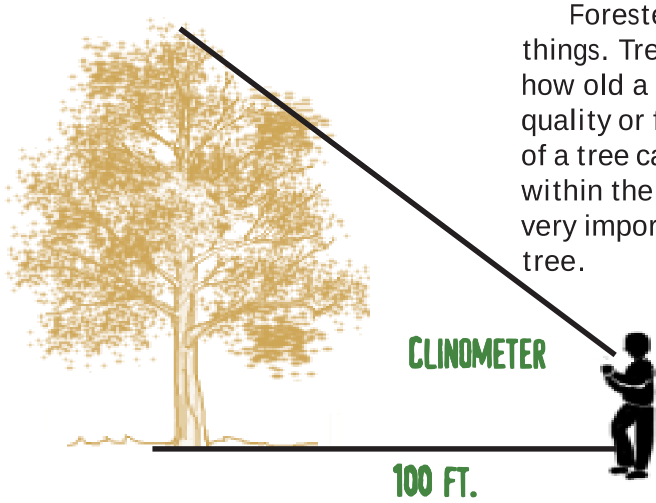
## Tree Height Data Table

| Tree No. | Species | Height (ft.) | Circumference (in.) | Site Observations |
|---|---|---|---|---|
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |

# Optional Laboratory: Measuring Tree Heights

## Introduction

Foresters use tree height for many things. Tree height can give a clue as to how old a tree is. It can also reflect the quality or fertility of the site. The height of a tree can indicate a trees' dominance within the forest canopy, and is used in a very important calculation of lumber per tree.




## Target Group

Sixth through eighth grade.

## Materials

Clinometer
100 foot tape
Pencil and paper

## Questions

1. How is the Pythagorean theorem used to determine tree heights?

## Hypothesis

*Students should make their own hypothesis before continuing.*

## Procedures

1. Draw a large tree on your paper. Draw a person to the same relative scale as the tree. Superimpose a right triangle on the tree and person. Relate the equation $\mathbf{A^2 + B^2 = C^2}$ to your drawing. A clinometer is based upon this equation.
2. One student should stand with the end of a 100 foot tape at the midsection of a tree to be measured. The other student should walk away from the tree on level ground, extending the tape. Mark the point 100 feet away.
3. Taking turns, students should look through the clinometer eyepiece towards the tree top and read the tree height on the right hand side of the clinometer. Record the measurement in the data table.
4. Practice on other trees.

| Tree No. | Species | Height (ft.) | Crown Class | Site Observations |
|---|---|---|---|---|
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |

Tree Height Data Table

## Background Information

Tree height is probably one of the two most important characteristics of a tree that a forester would need to know. Tree height gives clues as to how old the tree is, what kind of site the tree is growing on, and the crown class of the tree. Tree height is also used in calculating the amount of wood in a tree.

## Timeline

Thirty minutes of classroom, plus 45 minutes - 1 hour field time. The information, procedure and activity should be completed within 45 minutes to an hour. Additional time may be needed for practice.

## Student Learning Objectives

Students will be able to:

1. Use a clinometer correctly.
2. Locate the tree apex.
3. Develop a pacing stride for 50 or 100 feet.
4. Measure the tree height.

### Materials

100 foot tape
Clinometer

## Procedure

Choose a wooded area in which some large tree crowns are meshed into one another, and where there is a fairly distinct slope. Explain that a clinometer works on triangulation based on one of the sides of the triangle being 100 feet. Have a student hold the end of the 100 foot tape at the mid-section of a tree to be measured. Have another student run the tape out to 100 feet and mark the end of the tape. Make sure the second student did not go down slope or up slope from the tree. Make sure that the tree apex is discernible from the 100 foot mark. Have the student look through the clinometer eyepiece toward the tree apex. The student must keep both eyes open. One eye tracks the tree top while the other eye lines up the cross hair within the clinometer with the tree top. The student reads the measurements on the right-hand side of the clinometer. This is the tree height in feet. Groups of three to four students are recommended, so that measurements can be compared for accuracy.

## Crown Classes in Even-Aged Stands

In even-aged forests a simple classification has long been standard in this country. It involves the recognition of five crown classes based on their position in the canopy.

1. **Dominant trees.** The crowns of dominant trees rise somewhat above the general level of the canopy so that they enjoy full light from above and also laterally.
2. **Codominant trees.** These are not quite as tall as dominants. Their crowns receive overhead light but they may be hemmed to a certain degree laterally by dominants. They comprise the main canopy of the forest.
3. **Intermediate trees.** These crowns are definitely in a subordinate position, but may receive some direct overhead light through holes in the canopy.
4. **Suppressed trees (or overtopped).** These are definitely submerged members of the forest community having little free overhead light. They exist by virtue of the sunlight that filters through the canopy or the direct light that may be received through some chance break.
5. **Dead trees.**

Dominant trees    Codominant trees    Intermediate trees    Suppressed trees    Dead trees

From: ***Principles of Silviculture***. Baker, F.S., McGraw-Hill Book Co. New York. pgs. 72-73. 1950.

## Blowouts

1. Have students pace along a 100 foot section of trail or pavement. Students should count either every other pace, or every pace; whatever they choose, they should be consistent. Have students continue pacing until they become comfortable with a fairly consistent count. This technique of having a 'built-in' pace will permit the student to measure tree heights without having to use a tape measure and still be fairly accurate. This technique also allows a student to measure the tree height alone without the aid of another student.
2. Choose a tree on a slope. Have the student pace out 100 feet across the slope to measure the tree height. Now have the student pace out 100 feet from the same tree either up or down the slope. Have the student read the tree height and compare it to the height when read across the slope. If the student paced out down the slope, the reading will be higher. The reading will be lower if the student paced up the slope. Reinforce the idea of trying to choose an 'across slope' direction when pacing out from the tree. There are conversion tables available to correct for slope when it is impossible to pace across the slope.
3. Choose a tree on a flat terrain to pace out 100 feet to measure the height. Now have the student go out 50 feet from the tree (use a tape since the student has not developed a 'built-in' 100 foot pace yet) and measure the tree height. Ask the student to compare the two measurements. The 50 foot reading should be approximately twice the 100 foot reading.

## Glossary

***tree apex:*** the tallest, uppermost part of the tree crown.
***clinometer:*** a tool used to measure slope percentages and true heights
***crown class:*** a classification system used to determine a tree's position within a forest. Examples are **dominant** and **intermediate**.
***crown:*** the portion of the tree which is made up of main branches, intermediate branches, twigs and leaves. The portion of the tree which rests upon the main trunk of the tree.

## References


1. ***Manual Of Forest Mensuration***. Beers, T. and Miller, C., T & C Enterprises, West Lafayette, Indiana. 1973.
2. ***Earths Trees: Environmental Learning Series***. Earthwise. WP Press, Tucson, AZ. 1992.


**example data**

| Tree No. | Species | Height (ft.) | Crown Class | Site Observations |
|---|---|---|---|---|
| *1* | *White Oak* | *68* | *co-dominant* | *SE facing slope - 10° slope mowed understory* |
| *2* | *Shagbark Hickory* | *53* | *intermediate* | |
| *3* | *Bur Oak* | *75* | *dominant* | |
| *4* | *Basswood* | *48* | *intermediate* | |
| | | | | |

TREE HEIGHT DATA TABLE

# What's Happening Below The Surface?

## Introduction

Tree growth takes place not only above the ground, but also below it. The nutrients necessary for plant growth are available only under very specific conditions for each tree species. Trees have adjusted after great lengths of time to very specific environmental conditions that existed long before humankind came on the scene. When we place a tree in an urban setting, we need to see that its needs are met. The site in which a tree lives will be modified by the tree, if the environment is not hostile. Our intent here is to determine the soil conditions around trees that are already planted and growing.

Soils differ widely over even a small area. Good soil will be composed of 45% mineral and 5% organic matter with the other portion equally divided between air (25%) and water (25%). Large populations of microorganisms, insects and arthropods also occupy the soil and need air to survive.

Soils are generally composed of more than one layer or horizon. Soil color and composition distinguish these layers. Using the resources provided here or in your textbook, find out more about the structure of soil. Soil texture refers to the size of the particles that make up the soil. These five (from large to small) are large stones, gravel, sand, silt, and clay.

This exercise will familiarize you with the technique of soil sampling. Measuring different soil layers will aid in determining the soil composition in your area.

## Question

1. Is the soil beneath our trees all the same?

## Hypothesis

*Students should make their own hypothesis before continuing.*

## Materials

Plastic sample bags
Tape measure
Notebooks and pencils
Bucket with replacement soil
Field scale
Marking pen for bags
Small rulers (15 cm)
Flags (stakes)
Old newspaper & rolling pin
21" soil probe

## Procedure

### Day One

1. Before leaving the lab you should have prepared:
   A. the mass of each of the labeled samples.
   B. all the necessary data tables from examples below.
   C. all the necessary equipment.
2. When you arrive at each tree, stop and observe the tree, noting any special conditions to be entered in the data table. (ie. driveways, power lines, sidewalks, construction nearby, damage to the tree itself, etc.).
3. At each tree, first determine which are the north and south sides, and measure 0.5, 2, 4, 8, and 12 meters in each direction with the tape. (Note in the table wherever this is not possible).
4. At each spot, take a sample as deep as possible and then note the depth from the surface where the color changes. Record the maximum depth.
5. Collecting Samples:
   A. Draw and label a picture of each sample collected in your "logbook" (length, hori- zon, size of each section, color.)
   B. Pop the sample out of the tube and cut off the top 5 to 8 cm including the grass roots. Place all the samples from the same side of the tree in the same

bag marked with the tree number and direction of the samples (ex. Tree #25 - south). Make sure the sample is kept in the bag, tied with a twist tie. Record the mass when finished.

C. Weigh the bag with the moist soil inside.

6. Determining Soil Water Content:

A. Remove the sample from the bag and place it on newspaper to dry overnight.

B. The next day, place the material back in the bag to find the mass of the dried soil.

C. Calculate the % soil water content from Table B.

## DAY TWO

7. Determining Soil Constituents:

A. Crunch or roll out all the lumps of soil using a rolling pin or other large, clean metal object. All foreign matter (like leaves, twigs and roots) should be removed, with as little contact with your hands as possible.

B. Samples can be run through the soil sieves, if all the soil aggregates have been properly crushed.

C. Shake the sieves for about 10 minutes, then separate them, and determine the mass of the soil on each sieve. (Remember to mass the bag **before** you put soil into it to be massed. (*ex. total mass - bag mass = sample mass*)

(1.) Calculate the total mass and the percentage of each type of soil by dividing each mass by the total.

(2.) From Table E take the three parts (sand, silt, clay) that apply to the soil texture triangle and find the **textural class** of soil in each sample.

8. Record the final results in Table E.

## TABLE A: SOIL SAMPLE CORE FIELD DATA

Measure and record depth of color change and length total of sample

| Site No. | Depth / Distance from Tree / Color | | | | | | |
|---|---|---|---|---|---|---|---|
| | Tree No. | 0.5 m | 2 m | 4 m | 8 m | 12 m | Notes |
| | | | | | | | |
| | | | | | | | |
| | | | | | | | |
| | | | | | | | |

| Site Key |
|---|
| |

## TABLE B: SOIL FROM FIELD COLLECTION

**SOIL FROM FIELD COLLECTION**

Tree # ________ Side ______ Side Soil Sample Mass

DAY ONE

| | | | |
|---|---|---|---|
| A. Mass of bag | _______ g | _______ g | ________ g |
| B. Mass of bag & sample | _______ g | _______ g | ________ g |
| C. B-A=mass of sample | _______ g | _______ g | ________ g |

DAY TWO

| | | | |
|---|---|---|---|
| D. Mass of dried soil | _______ g | _______ g | ________ g |
| E. Difference of A-B=mass water | _______ g | _______ g | ________ g |
| F. % water =C/A x 100 | g | g | g |

## Table C: Mass of Separated Samples

(RECORDED IN GRAMS)

| Tree No. | side | rocks | gravel | sand | silt | clay | Total |
|---|---|---|---|---|---|---|---|
| | | | | | | | |
| | | | | | | | |
| | | | | | | | |

## Table D: Soil Structure by Percentage

(SIEVE SEPARATION TECHNIQUE / DATA FOR EACH TYPE).

| Tree No. | side | rocks | gravel | sand | silt | clay | Total |
|---|---|---|---|---|---|---|---|
| | | | | | | | |
| | | | | | | | |
| | | | | | | | |

**Analysis of Results**

## Table E: Summary Table

| Tree No. | side N/S/E/W | soil moisture | distance of first change | depth of color change | textural class | Tree name |
|---|---|---|---|---|---|---|
| | | | | | | |
| | | | | | | |
| | | | | | | |

## Discussion Questions

1. Did any of your trees have more layers of soil than others? Compared to your classmates? Which ones?
2. Is there a difference in the distance at which there is a color change? Between different sides of trees?
3. Do you think there is any correlation between soil layers and the type of tree you are sampling? Why?
4. Is there any difference in the sides of the trees and/or tree types?
5. Which tree has the most gravel and stones? What reason, using data, can you give for this?
6. Which tree had the most moisture in your group? In your class?
7. Does the data support your hypothesis? Why or why not?
   A. If your hypothesis is supported by the data what would you do next if you were a scientist/forester?
   B. If your hypothesis was not supported by the data what would you do next?
8. What have you learned from this exercise about trees and soil? (be as specific as possible)

## Background Information

Tree growth and development is dependent on the soil below. The structure, texture, color, and condition of the soil all lead to successful tree growth. Poorly drained clay soils, which are usually found in new urban areas, require a different planting procedure than the dark crumbly type soils of a forest or older neighborhood. To find the type of soil conditions trees require, consult the publications listed in the references.

Soils in most urban or recently developed suburban areas have been changed dramatically from what they were before towns were built. The original soil profile could have been anywhere from three to six feet and was most likely scraped off. Plants must grow in soils that are often less than adequate. Even if soils were not removed, the number of trucks or vehicles that moved across your property while your house was being built may have compacted the soils. Soils piled into big mounds until they can be spread over the landscape change chemically and biologically with the passage of time. Without the proper ratio of water and air in the soil, trees will not grow well.

As sidewalks, curbs and streets are installed, the gravel and chemicals used also cause changes in the soil conditions. Trees have to overcome these changes to survive. Limestone driveways raise the soil pH. Compaction of soil slows water infiltration. Water runs off some areas and puddles in others, like the large holes just dug for the trees. Landscapes are designed to move water away from foundations, and plants may need extra watering. Soils are important to tree survival and we can even see that some trees will change the soils.

Soils differ widely in their characteristics. Soil science is the study of soils. Most soil studies related to plant growth have been related to farming: grains in the midwest; citrus trees in Florida; cotton in the south; and fruit trees. Relatively few people have spent their entire careers working in Urban Forestry simply because this is such a new and evolving field.

A ringed or spiral notebook full of tree-related stories collected from magazines or newspapers should be kept yearly for class reference. The sources of information from the local daily newspaper will astound students. The local agricultural extension service, or city library, has books on trees and even more on gardening that can be useful resources. Landscape contractors in your area, or your city forester, can provide information for students. Hardware stores can also provide information if students look at resource books in the gardening sections. A wide variety of resources are available.

## Target Group

Ninth through twelfth grade students are the intended audience. Slight modifications can be made to increase the difficulty of data analysis, or simplify it for other groups.

## Timeline

The amount of time needed to accomplish this particular project will depend on the number of trees and the number of times you wish to have data for trees reported. This exercise is intended for five days of work; one day of preparation, two days of field work, and two days of laboratory data analysis.

With groups of four, this exercise can be done in conjunction with other projects in this unit. Students need one day to collect data and another to calculate and check on other student groups. The student data work-up and the conclusion should be checked by other groups for comparison. A one day field trip would be good as a culminating activity for all of these exercises.

## Placement of the Project in the Curriculum

This can be placed in the ecology or plant section of your units; but ideally the entire Urban Forestry unit should be used together.

## Student Learning Objectives

Students will be able to:

1. Understand the interaction among trees, soil and people.
2. Use equipment properly to gather data.
3. Accurately record gathered data.
4. Draw conclusions about the nature of soil at different sites for tree growth.
5. Evaluate each site for future tree growth.

## Preparation and Teaching Tips

1. The previous exercise on labeling and mapping of your school site should have been completed.
2. Trees and shrubs at your school site should be tagged with an inventory number.
3. Review procedures for how many trees to use, how the data is recorded, what units to use, what level of accuracy is required, and how each of the tools is to be used.
4. Check with a school maintenance official to see if there are any buried cables to avoid. (TV cable is usually shallow)
5. Realize that for each class, and each time you go outside, it is a different teaching situation.
6. Use a checklist of materials, so students can check out all of their equipment.
7. Make sure each group of students is prepared and has written its hypothesis(es).

## Results

Results will vary with sampling site. See attached class data table examples.

## Blowouts

1. Use a soil auger and take deep soil profiles for chemical analysis.
2. Dig a large soil pit 3' wide x 6' long x 5' deep so root structure and soil change is easily visible.
3. Measure the depths of soil horizons and compare to data for different types of natural environments, or with their own homes.

## Answers To Discussion Questions On Page 38

To accurately answer these questions the students will have to compare their results with other groups. A large classroom data table on butcher paper would open up many more avenues of discussion. There are no specific answers for these questions as they are all of higher order. The simple direct questions are on the pre- and post-quizzes.

1. Groups should have differences by specific types of trees.
2. The sample farthest away from an older tree should be more dramatic than for a newly planted tree in a field.
3. This question is asked if there is a field planted tree as compared to a group planted tree (forest) sample that was used.
4. There should be a difference between north and south.
5. The tree with the most gravel can tell about the construction techniques at your school site.
6. The same species of tree should show similarities.
7. Answers will vary. This is important to the development of scientific thinking in students.
8. Same as above only they must use their data to support analysis.

## References


1. ***Selecting & Planting Trees***. The Morton Arboretum, Lisle, IL. 1990.
2. ***Understanding Soils***. VAS (Vocational Agriculture Service) Bulletin 4052, College of Agriculture, University of Illinois.
3. ***Soil Structure***. VAS Bulletin 4028. College of Agriculture, University of Illinois.
4. ***Soil Color***. VAS Bulletin 4029. College of Agriculture, University of Illinois.
5. ***Soil Texture***. VAS Bulletin 4030. College of Agriculture, University of Illinois.
6. ***Oakfield Soil Samplers***. Instructions, 1990.
7. ***Screen Sieves.*** Bulletin 0008752. Hubbard Inc. 1991.
8. ***Field Biology for Secondary Students.*** Voss, B.E., editor, Unpublished UMBS. 1988.


## Connections to the Standards

### Part 4B

**The activity found on page 36 aligns with the following "National Science Education Standards" and the "Excellence in EE-Guidelines for Learning"**

### Grades 5-8

Science Content Standard A: Science As Inquiry
- *Understandings about scientific inquiry*

Science Standard C: Life Sciences
- *Diversity and adaptations of organisms*

Excellence in EE-Guidelines for Learning Strand 1: Questioning and Analysis Skills
- Questioning
- Collecting information

Excellence in EE – Guidelines for Learning Strand 2.1: The Earth as a Physical System
- Processes that shape the Earth
- Changes in Matter

### Grades 9-12

Science Content Standard A: Science As Inquiry
- *Understandings about scientific inquiry*

Science Standard C: Life Sciences
- *Diversity and adaptations of organisms*

Excellence in EE-Guidelines for Learning Strand 1: Questioning and Analysis Skills
- *Questioning*
- *Collecting information*

Excellence in EE – Guidelines for Learning Strand 2.1: The Earth as a Physical System
- *Processes that shape the Earth*
- *Changes in Matter*

# How Old Is A Tree?

## Introduction

Minerals, water and nutrients travel from the soil to other parts of a tree by way of small tube-like tissues called **xylem**. A similar type of tissue, called **phloem**, carries food substances down from the tree's leaves. In between xylem and phloem tissue is the tissue called **cambium**. Cambium is the growth tissue of the stem that produces new xylem and phloem cells. Each year, as a new layer of xylem cells grows, it wraps around the layer before it. Because each layer is one year's growth of xylem cells, these layers are called **annual rings**.

Most students already know that you can count the rings on a tree stump to get the age of a tree, but the annual rings contain more information and can be used by scientists to date old wooden structures, tell the weather, etc.

## Procedures

1. Give each group 2 plastic cups. Have students fill the cups about half full of water and add food coloring (two different colors). With the leaves still on the celery, cut a slit up the bottom of the stalk about half way up so that one half can be put in each of the two cups.
2. Let this experiment set overnight for best results.
3. Pass out the 'tree cookies' and let students practice counting the rings.
4. Complete the optional Lab-aids kit on dendrochronology. (Published by Lab-aids, Inc., not included in this guide.) Intermediate-aged students will probably need some guidance as they go through the worksheet. However, the activity does give them some interesting insights, especially into archeology and the early history of our country.
5. The next day, examine the celery experiment.

## Results

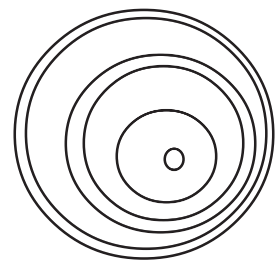
The leaves of the celery should show the two colors of the food coloring on their respective sides. Also, if you cut about a centimeter off the bottom of the celery, the colored xylem will show very well. Be sure that students see this.

## Questions

1. How can we demonstrate the function of xylem and phloem?
2. What do annual rings really tell us?

## Materials

Celery
Plastic cups
Food coloring
Knife
Lab-aids kit
Trunk cross-sections (tree cookies)



## Discussion Question

1. Why do the leaves turn the color of the food coloring?

## Conclusion

The xylem of the celery will transport water up to its leaves. Since the water is colored, the coloring will show up in the leaves.

## Connections to the Standards

### Part 4C

**The activity found on page 42 aligns with the following "National Science Education Standards" and the "Excellence in Ee-Guidelines for Learning."**

### Grades 5-8

Science Content Standard A: Science As Inquiry
- *Abilities necessary to do scientific inquiry*

Science Content Standard C: Life Sciences
*Structure and function of living systems*

Excellence in EE-Guidelines for Learning Strand 1: Questioning and Analysis Skills
- *Questioning*
- *Collecting information*
- *Organizing information*

Excellence in EE-Guidelines for Learning Strand 2.2: The Living Environment
- *Organisms, populations, and communities*

### Grades 9-12

Science Content Standard A Science As Inquiry
- *Abilities necessary to do scientific inquiry*

Science Content Standard C: Life Sciences
- *Matter, energy, and organization in living systems*

Excellence in EE-Guidelines for Learning Strand 1: Questioning and Analysis Skills
- *Questioning*
- *Collecting Information*
- *Developing proposed explanations*

Excellence in EE –Guidelines for Learning Strand 2.2: The Living Environment
- *Organisms, populations, and communities*

Excellence in EE-Guidelines for Learning Strand 2.4: Environment and Society
- *Human/environmental interactions*

# And Who Should Lead the Way?

# Program V

**Video Description**: Viewers explore the debate over how to care for urban forests and who should assume the lead: government or nonprofit and private organizations? With cutbacks in municipal, state, and federal budgets, governments have steadily relinquished care for the nation's urban forests, citing the need to address more vital concerns. This has increasingly left the task to non-profits and private organizations. Viewers meet leaders of non-profit organizations in Baton Rouge, Atlanta, New York, Sacramento, and Los Angeles as they work to protect urban forests. Forestry experts warn of the need for more government support (given the impact of rapid urbanization), the need for more scientific research, and the dangers of losing a vital resource to deforestation.

## Learning Objectives

The students will be able to:

1. demonstrate the effects of personal choices and actions on the natural environment
2. develop an awareness of personal responsibility as stewards of the local environment
3. demonstrate the ability to utilize the skills and concepts learned in previous units in addressing an environmental need or issue
4. plan and conduct a project designed to address a local environmental need or issue

# Teacher's Branch

The video should serve as an introduction for the activities.

The focus of these activities is to give students an opportunity to lead the way, by giving them the chance to design and implement their own urban forest stewardship programs. Suggested activities include having students team with a government or community environmental agency or a business to develop plans for a community or school forested area, to fund the project, and to carry out planting and maintenance. Students might also form a partnership with a local elementary school to plan an outdoor study area or a garden to enhance wildlife habitat. In either project, students would determine the best sites for planting and the best trees for their site. Their research investigations might include conducting soil analyses, considering water availability and needs, determining the optimum number and mix of trees, and selecting the right trees for desired benefits (fruit, wildlife habitat, shade, aesthetic value.) Site design and construction must be considered and well planned. Students could design a virtual site, view it in 3-D, watch as it matures before their eyes, identify potential problem areas, and make alterations in their plans.

•Costs for materials, labor and maintenance should also be considered, as well as potential funding sources.

•Local garden clubs, Master Gardener programs, parks, and volunteer agencies can help students develop their own projects. Students should develop a list of sites and projects that links with their lives and their interests.

•The U.S. Forest Service *Urban Forestry Lab Exercises*, "Planting a Tree and Helping It to Grow," "How Fast does This Tree Grow?" and "Establishing a School Arboretum or Tree Walk" provide background and skill development activities useful in this unit. Also visit the Forest Stewardship Council at www.goodwood.org/goodwood/goodwood_list/cert_agencies/fsc.html, the Arbor Day Foundation at www.arborday.org and the American Forest and Paper Association "Youth Take Action" site (http://205.197.9.134/) for activities and service-related projects. "Project Learning Tree in the City" involves traditionally underserved students in community action projects caroline_alston@plt.org. The COOL COMMUNITIES site www.amfor.org promotes strategic urban tree planting, landscaping, and reduction of urban heat island effect.

•"Investigating a Built Community" provides students with an easy to follow process to use in identifying parts of a human-built community, looking at land use patterns, constructing a process to investigate a part of the community, and developing an action plan. This lesson plan, if done in its entirety, requires 8 to 10 hours and includes field investigations (one 3 hour and one 1 hour). Implementation of the plan will require additional time.

# Connections to the Standards

## Part 5A

**The activity found on page 45 aligns with the following "National Science Education Standards" and the "Excellence in EE-Guidelines for Learning"**

### Grades 5-8

Science Content Standard A: Science As Inquiry
- *Abilities necessary to do scientific inquiry*
- *Understandings about scientific inquiry*

Science Content Standard C: Life Science
- *Regulation and behavior*

Excellence in EE-Guidelines for Learning Strand 1: Questioning and Analysis Skills
- *Collecting information*
- *Developing proposed explanations*
- *Evaluating accuracy and reliability*
- *Organizing information*
- *Developing proposed explanations*

Excellence in EE-Guidelines for Learning Strand 2.2: The Living Environment
- *Systems and connections*

Excellence in EE – Guidelines for Learning Strand 2.4: Environment and Society
- *Places*

### Grades 9-12

Science Content Standard A: Science As Inquiry
- *Abilities necessary to do scientific inquiry*
- *Understandings about scientific inquiry*

Science Content Standard C: Life Science
- *Matter, energy and organization in living systems*

Excellence in EE-Guidelines for Learning Strand 1: Questioning and Analysis Skills
- *Collecting information*
- *Developing proposed explanations*
- *Evaluating accuracy and reliability*
- *Organizing information*
- *Developing proposed explanations*

Excellence in EE-Guidelines for Learning Strand 2.2: The Living Environment
- *Systems and connections*

Excellence in EE – Guidelines for Learning Strand 2.4: Environment and Society
- *Places*

# How Fast Does This Tree Grow?

## Introduction

The process of knowing the trees in your neighborhood began the first time you walked outside and noticed the trees in bloom. Recognizing fall leaf color may have inspired you to make a collection. Not knowing exactly what to do with the leaves, they soon became dry and brittle.

With age comes a greater appreciation for trees. Trees give us shade in the summer, a wind break in the winter, and a place for many types of small animals to live. We realize trees grow slowly, but live a long time. Many a poet has written about trees, and you can find innumerable passages in literature about them. Now with the ever changing urban habitat we need to learn even more about trees to find the ones that will serve us best.

With the tools of a forester, and even some you can find in hardware stores, you can determine if a tree is growing well. Other tools are used by foresters only in a heavily wooded site as compared to the urban forest we are examining. We start with simple measurements of **height, diameter at breast height, and twig growth**.

There are several different ways to evaluate the health of trees. The methods we are going to use here are just a few of the ways that growth data can be gathered.

## Question

?

1. How does the data collected about trees tell us more than just height, width or growth pattern?

## Hypothesis

*Students should make their own hypothesis before continuing.*

## Materials

Metric ruler
Clinometer
Stool
100 ft. tape
Tree identification key
Diameter tape
Journals (logbook)
Data tables

## Procedure

1. The student group should practice using all the tools before going outside.
2. Each member of the group should calculate how many steps it takes to pace 100 ft. Each student should practice pacing several times to get an average. Make a small data table with this information.
3. Make sure you know how to use the clinometer before going outside. This data goes in Table B.
4. Each group should prepare a checklist of materials and a data table. A simple pocket calculator can be used to calculate the averages.
5. Each student should be able to identify terminal bud scars, since these are the points that must be used to measure twig growth. This data goes in Table A. Add data from other groups.
6. Either a compass or a map with directions on it should be used to determine the directions for gathering data as accurately as possible. This data goes in Table A.

### Table A: Tree Twig Length

| | | | TWIG GROWTH | | | | | |
|---|---|---|---|---|---|---|---|---|
| Tree No. | Tree Species | Directions N/S/E/W | 20__ | 20__ | 20__ | 20__ | 20__ | Average |
| | | | | | | | | |
| | | | | | | | | |
| | | | | | | | | |
| | | | | | | | | |
| | | | | | | | | |
| | | | | | | | | |

## Table B: Tree Data

| Tree No. | Tree Species | Tree Height | Tree Diameter |
|---|---|---|---|
| | | | |
| | | | |
| | | | |
| | | | |
| | | | |
| | | | |
| | | | |
| | | | |

## Discussion Questions

1. Which tree species had the greatest twig growth last year? Which tree species had the greatest average twig growth over the last five years? Why?
2. Is there a pattern to the data? What is the pattern that your group sees? Give three reasons for it.
3. Were any of your trees planted in the last five years? Which ones? Why?
4. What are two other methods or instruments that could be used for this exercise? Give the reasons you chose them.

## Conclusions

1. If you were to do this exercise again, what technique would you change and why?
2. What other data would you need to make an accurate estimate of the health condition of the trees you used for this exercise?

## Blowouts

1. Do the trees in urban areas follow typical growth patterns?
2. What problems does the urban forest have to contend with in order to survive?

High school. Designed for 50 minute sections, but can be used at lower levels, if the amount of data gathering is adjusted.

## Timeline:

## Background Information

Trees are living organisms. Tree growth is easy to quantify, since trees don't move at a fast pace. The data gathered in this exercise must be gathered over long periods of time (3 or more years) in order to draw conclusions. Long-term data gathering is not unusual. NutraSweet took 10 years of research before it was released into the market. The FDA requires much time and many studies before allowing a new drug on the market. Trees have now become a renewed area of study, as scientists search for chemicals that may be useful to humankind, such as taxol. Taxol comes from the bark of the Pacific Yew tree, which for years was considered waste by the forest industry. Time is a key ingredient in science and this is a study which will help students appreciate patience and persistence. Lumber companies and many state forestry departments publish information about tree programs that can be valuable in demonstrating the long-term commitment to trees.

Science does not happen in one hour of class time, nor does a tree grow thirty feet tall in one year. The old adage that 'speed kills' is very true in plants. The faster the tree grows, the shorter its life expectancy. In urban areas we plant fast growing trees to get shade quickly, but then in 10 years the trees are too large for the spot they are in and often must be removed. Tree growth can point this out dramatically and provide useful information for future plantings.

## Target Group:

**DAY 1**—Discuss the proper use of the tools to be employed. This will be a class data collection project and if proper use of the tools is not stressed, the data will not be valid. It would probably be useful to have some of the tree cross sections out for practice. An object that is 100 feet from the class window could be measured for height and then used as practice. Prepare data tables, vocabulary and complete work in student 'Logbooks.'

**DAY 2**—Students will take prepared data tables to the assigned sites for making measurements. Students will work in groups and everyone should collect data to check each other's work.

**DAY 3**—Students will work on the data in the classroom, gathering data from two other groups. Conclusions can then be drawn for completion of the experiment.

## PLACEMENT OF LAB IN CURRICULUM

This is part of the Forestry Unit and will fit in with any unit on tree or plant growth. This is also a good measurement lab, where students will develop data tables for organizing information that others will check.

## STUDENT LEARNING OBJECTIVES

Students will be able to:

1. Evaluate data collected on trees.
2. Replicate the results of another student's experiment.
3. Demonstrate that data reflects the accuracy of the measuring devices used.
4. Apply quantitative observational methods to accumulate precise data about trees.
5. Evaluate the interpretation of data collected during each experiment.

## PREPARATION AND TEACHING TIPS

Once the trees have been tagged, assign trees (by number or site) to students for collecting data. Stress that this will be part of the school's permanent record on tree growth. If students are using maps with numbers, make sure that they all know where they are going and which tools should be with them. If each student prepared his/her own checklist for the equipment needed for this assignment, it would foster responsibility on the student's part.

## BLOWOUTS

1. Students can enter the data onto a computer spread sheet for the entire class. Then each group can display the data graphically in different ways to make comparisons of how well the trees are growing.
2. Students can look up the expected growth rate of the species they are examining and develop a hypothesis to explain differences in the data they accumulated.
3. Students can determine the year the tree was transplanted, or if it was always on the site.

## REFERENCES


1. ***Project Wild***. Western Regional Environmental Education Council. 1986.
2. ***Project Learning Tree***. EEAI.
3. ***Field Biology for Secondary Students***. Burton Voss. University of Michigan Biology Station. 1988.


**example table:**

### TABLE A: TREE TWIG LENGTH

## PLANTING A TREE AND HELPING IT TO

| | | | TWIG GROWTH | | | | | |
|---|---|---|---|---|---|---|---|---|
| **Tree No.** | **Tree Species** | **Direction N/S/E/W** | **1993** | **1992** | **1991** | **1990** | **1989** | **AVG** |
| *1* | *Red Maple* | *N* | *10 cm* | *7.5 cm* | *12.5 cm* | *10 cm* | *10 cm* | *10 cm* |
| | | | | | | | | |

# Grow

## Introduction:

Trees are very much a permanent part of the landscape and you must select the type of tree to plant very carefully. When the decision has been made to plant a tree, you must then do your homework and find out what types of trees will be suited for your site. Some of the information that you need to know about the tree is: how large will it get, how fast will it grow, how much sunlight does it need, and what type of soil conditions does it like? Once you have chosen that perfect tree for your school, park, or home, more information must be obtained about the site where the tree will grow.

In an urban environment, selecting the proper tree is as important as selecting the proper location. Drawing a map of the selected area is a good first step. Don't forget to include the direction and dimensions of all problems above and below the ground that you might encounter. Information you may have already gathered by doing the soils lab ("What's Happening Below the Surface?") will be of great help in determining what must be done to allow the tree to thrive. Many books on tree selection are available. A resource list should be developed by the class.

### Materials

| | | |
|---|---|---|
| Shovels | Mulch | Water |
| Pruners | Rakes | String |
| Ruler | Stakes | Tree tag |
| Composted material | | Tree wrap |
| Old hose sections | | |

### Questions

1. How do we prepare for planting trees?
2. What is the currently accepted method for successful tree planting?

### Hypothesis

Students should prepare their own hypothesis before continuing.

## Procedure

### Site Selection

1. Using specific information about the conditions required for the tree to grow and a map of the site, choose 3 possible planting sites. Take soil core samples to determine what lies below the surface.
2. After developing a data table format for soil moisture, soil temperature, and pH readings at each site, gather the data. Map the area including measurements of the distance from buildings, sidewalk, power lines and shrubs that could affect the growth of the tree.
3. Bring this data into the classroom and place it on the board or overhead projector, so all students can make a case for each of the sites.
4. Choose the site that is most compatible with your tree.

### Planting

5. With a location determined, decide:
   A. How large the hole needs to be. (3x rootball diameter)
   B. How much organic matter should be placed in the hole with the tree.
   C. How much mulch should be placed over the soil around the tree. (to a depth of 4 inches)
6. Tree wrap should be applied to the tree, if needed, starting at the bottom and working up.
7. Bring this data into the classroom and place it on the board or overhead projector, so all students can make a case for each of the sites.
8. Watering is the **single most important** task of the planting procedure and must be carefully accomplished. When you plant the tree, add soil and water at the same time. Simply return the soil that was dug out. Adding topsoil, humous, or organic matter my  be helpful.
9. Water the entire mulched area daily for the first week, then at least 3 times per week for the next month. Approximately 3-5 minutes of water from a hose will be sufficient.
10. Check the soil moisture in the rootball by using a soil probe or large piece of wire. Resistance to penetration indicates that the rootball is drying out.

## Terminology

***define these words and phrases***

bud
bare root
roots
balled and burlaped
growth rate
amending soil
power lines
size of hole
cultivar
container plants
rootball
mulching
compacted soil
backfilling the hole
light requirements
leaves
pruning
fertilizing
watering
clay soil
drainage
longevity

## Results

Using the data table and map of the area, each student group should respond as to how they would adapt the planting technique described above if the tree were placed:

1. Along a narrow parkway.
2. Underneath a much larger and older tree.
3. Underneath power lines.
4. Next to the school building.

## Discussion Questions

1. Where would you plant a tree that has thorns?
2. How would you use a shrub you are told will never get larger than 4 or 5 feet?
3. If the school objected to the choice of tree (Crabapple), what could you do to make them understand that your choice is the right one?

## Conclusions

•Why do we need to plant trees in the urban areas of our country?
•Why do you put woodchips underneath a tree?
•If you were to plant a tree at your house, explain how you would change the procedure we used.

## Background Information

Planting a tree and/or shrub on your school grounds can become an overwhelming event. The components must be well defined; map drawings, note taking, and picture sketching of how the planting procedure was accomplished. Every student will want to dig the hole. You must insist that the job must be done correctly, and students should do only those tasks assigned. You should try to get help from the public to purchase materials by advertising this event.

Realize that the work to be done can be accomplished by many people in a short time if everyone works together. Task cards for each group can be used for assessment. If the task will take more than one class period, each hour of the day can have a few students working on each part of the task. Have students write questions for other classes to discuss, covering what has been done and how the job could have been done more efficiently. Explanations to questions raised by the students can generally be answered by anyone who has read a tree planting reference.

## Target Group

Elementary through high school.

## Blowout

***Examples:***

1. Determine the proper place to plant a tree.
2. Plant a tree correctly.
3. Demonstrate what must be done after planting the tree.

## Timeline

**Pre-Lab** preparation is accomplished for the most part, by completing the previous lab exercises in this unit. Gathering materials should begin early in the year. Check with the janitorial service about the possibility of borrowing equipment. Call the city or park district several weeks before the planting to make sure woodchips are available.

**Day 1** —Student groups make all the site measurements and take soil cores to examine the characteristics of each site. Discussion back in the classroom as to which site is the best. What are the criteria for selection of a site?

**Day 2** —If the site can be marked with a stake, do so. If not, then spray paint on the ground can mark the area. Decide if a pre-digging day is necessary to complete the task with available tools, or if the hole will have to be dug outside of class time.

**Day 3** —Have the assigned groups gather their materials and head out to the planting site, where everyone performs their assigned tasks. If multiple classes are involved, break down the work into parts and discuss proper techniques that everyone can observe while work is being done.

**Day 4** —Check the site to determine the soil moisture, and whether the plant has settled. Discuss the kind of long term care required. Have students check their hypothesis to see how well they accomplished all their tasks.

***Tasks can include:***

*A. bringing assigned tools*
*B. lining out the site after school*
*C. mapping of the area*
*D. preparing a maintenance schedule*
*E. collecting 5 gal buckets for watering / moving mulch*
*F. testing the soil before planting the tree*
*G. acquiring plastic to put under the soil that is removed from the hole*

## Placement of this Lab in the Curriculum

This exercise is the summative experience for the entire Urban Forestry curriculum package.

This lab can be done anytime after the teacher has covered safety and procedures in a classroom, but it is better placed after the class has completed the other exercises. This is a culminating activity that should be used as a growth experience for the students, and not as a strictly graded exercise. Planting the tree should become an aesthetic and recreational activity along with educational. Point out to the students that these trees, if maintained, could live for over 100 years. Typical urban trees live 7-40 years, depending on the site.

***The field work for this lab can be done at any point in the year, but the tree should be planted in the spring, not too close to the end of the school year, so that students can learn about maintaining the tree. Be sure to arrange for watering during the summer.***

## Student Learning Objectives

The students will be able to:

1. Understand the interaction among trees, soil, and people by participating in planting a tree.
2. Develop questions to be answered as part of the planting activity.
3. Explain the relationship between the new plantings and other organisms in the immediate area.
4. Evaluate the map and data to determine an appropriate planting site.

## Evaluation

1. The on-time completion of assigned tasks with all the data can be the easiest method of assessment.
2. The pre- and post-test can measure increases in the student's understanding of the process.
3. A written response, including answers to the student discussion and conclusion questions, will provide some insight into the student's understanding of the planting process.

## Preparation and Teaching Tips

A large amount of planning is necessary for this lab to be successful. The following committees will be needed:

1. A *site committee* to rope off the area and prepare it for the planting.
2. A *digging committee* responsible for measuring and staking the site, and digging the hole. Accurate measurements should be taken and noted in journals.
3. A *tree committee* responsible for the removal of the rope and burlap once the tree is situated properly in the hole. If the tree is in a container, the group must decide what method to use to remove the container.
4. A *mulching committee* responsible for gathering and moving the proper amount of mulch. City street crews or the park districts usually have mulch available and will drop it off at school.
5. A *tool committee* responsible for gathering and cleaning all the equipment. This includes shovels, rakes, buckets, hose, and stakes.
6. A *data committee* to measure the hole, the tree, and the rootball for inclusion in the data bank for future reference.

## Answers To Discussion Questions

1-3. The answers to all of these are based on all previous work and your specific site requirements. Helping the students with hints may be necessary.

1-3. The answers will vary. These are also based on the previous readings and laboratory work accomplished by the students.

## Blowouts

1. Students can go to local greenhouses to inquire about donations of other materials for planting at the school for beautification.
2. Students could raise small trees from seeds they collect in the fall and sell them to raise money for more plantings. These seedlings could also be planted in a nursery to be used in future years, or to give away to smaller children or shut-ins.

## References


1. ***Selecting and Planting Trees***, The Morton Arboretum, Lisle, IL. 1990.
2. ***Manual of Woody Plants***, Michael A. Dirr. Stipes Publishing Co., Champaign, IL. 1983.
3. ***The Right Tree in the Right Place***, Commonwealth Edison.
4. ***Tree and Shrub Planting in Illinois***, Planting Shade Trees, Tree Care, Guide to Illinois Big Tree, Plant Illinois, Illinois Dept. of Conservation.
5. ***Benefits of Trees***, *Trees and Turf*, *Tree Selection*, USDA Forest Service.
6. ***Transplanting Trees***, Vocational Agricultural Service Bulletin 5002a.


## Connections to the Standards

### Part 5B

**The activity found on page 48 aligns with the following "National Science Education Standards" and the "Excellence in EE-Guidelines for Learning"**

### Grades 5-8

Science Content Standard A: Science As Inquiry
- *Abilities necessary to do scientific inquiry*
- *Understandings about scientific inquiry*

Science Content Standard C: Life Science
- *Populations and ecosystems*
- *Regulation and behavior*

Excellence in EE-Guidelines for Learning Strand 1: Questioning and Analysis Skills
- *Collecting information*
- *Developing proposed explanations*
- *Evaluating accuracy and reliability*
- *Organizing information*
- *Developing proposed explanations*

Excellence in EE-Guidelines for Learning Strand 2.2: The Living Environment
- Systems and connections

Excellence in EE – Guidelines for Learning Strand 2.4: Environment and Society
- *Places*

### Grades 9-12

Science Content Standard A: Science As Inquiry
- *Abilities necessary to do scientific inquiry*
- *Understandings about scientific inquiry*

Science Content Standard C: Life Science
- *Matter, energy and organization in living systems*

Excellence in EE-Guidelines for Learning Strand 1: Questioning and Analysis Skills
- *Collecting information*
- *Developing proposed explanations*
- *Evaluating accuracy and reliability*
- *Organizing information*
- *Developing proposed explanations*

Excellence in EE-Guidelines for Learning Strand 2.2: The Living Environment
- *Systems and connections*

Excellence in EE – Guidelines for Learning Strand 2.4: Environment and Society
- *Places*

# Establishing A School Arboretum or Tree Walk

At your school site, you will need to identify a minimum of 20 trees or woody shrubs that can be used by your students for the experiments in this Urban Forestry Unit. If there is not enough woody plant material available at your site, then a tree walk of the neighborhood could be designed.

## Identifying all trees and shrubs on the premises

1. All students should use a tree identification guide to identify a number of plants selected by the teacher.
2. A set of labeled tree and leaf parts on laminated tag board should be used to brief students on the plant part names they would experience in the field.
3. Make a map of the grounds with all the trees marked and numbered. The trees should be labeled with matching numbered tags to assure that the students are using the correct trees for their experiments.
4. Once all the trees on your site are identified and verified, a special identification key just for your site could be developed.
5. Make an inventory of all the woody species on the school grounds, for use in a data base at a later date.

## Developing a School Arboretum

1. The school administration must agree to furnish an area on the grounds that can be developed into an arboretum.
2. New trees should be added each year. Donations from local arboreta or nurseries are often possible.
3. Your arboretum can serve as a community resource. Develop contacts in the community to work towards this goal.
4. Identify areas near the school that could be used for forestry activities in future years (fields, empty lots, community parks, cemeteries, churches, nurseries). Private firms or utility right-of-ways may also be used if proper approvals have been given,

If your school site is not suitable for establishing an arboretum, there may be a public park nearby that can be used, or you could develop a neighborhood tree walk.

## Use of Park Facilities:

1. Identify specific areas to be used.
2. Develop a list of short and long term benefits for the trees as a result of using the area.
3. Request permission for using the area.
4. Follow the same procedure as in the **Identifying All Trees and Shrubs on the Premises** section.

Working with your city forester or park district to increase the number of species growing in the park is a valuable school exercise.

1. Activities in which your class could participate:
   A. Arbor Day activities
   B. School/community activities on the site
   C. Earth Day planting or clean-up activities
   D. Others
2. Send students to local community groups to explain the project and what they hope to achieve by planting trees. The use of poetry or prose can be a way to encourage people.
3. Develop a list of trees suitable for the site to be planted.

## Tree Walk

## Blowouts

1. Construct a classification scheme just for the trees at your site.
2. Map out one area of the school with all the dimensions standardized. Indicate all obstructions to trees, and objects that would cause trouble for trees (i.e., power lines, sidewalks, streets, areas that are salted in winter, water retention areas, etc.).

***This exercise does not require a student guide.***

1. Map out a walk that students can take within an allotted school period. (15 to 25 trees are needed)
2. Check whether the trees are in the parkway or on front lawns.
   A. Check with the city forester before using parkway trees.
   B. Approach home owners to explain what the students will be doing, and how it will be part of the school's curriculum.
   C. Develop an inventory of the trees with their sites and addresses. The trees along the walk will involve the same experiments, so advance planning is very important.
3. Follow school rules governing students off campus.
   A. Specific instances may need to be discussed with the administrator in charge.
   B. Once a site has been selected for tree planting, it is necessary to check with the appropriate state and local agencies before digging to prevent damage to utility lines.
4. If a tree walk or park site is not a workable option, the development of the school arboretum with smaller habitat plants may be an option.

**SAFETY NOTE: GET AUTHORIZATION BEFORE YOU DIG!**

## PARKWAY TREE USE FORM

Dear Owner:

Please be advised that ____________________ School wishes to include the tree(s) on your parkway in a study of trees in our town. The students will take several sets of measurements on your tree(s) each year. The measurements will be used to develop a rating system for the quality and longevity of the tree(s). When combined with others, the data from your tree(s) will also help the students to develop a broad based set of data that can be used to develop possible courses of action for the future. The data will be made available to neighbors and city officials, to assist them in determining the condition of the trees.

The students of _________________ School promise not to cause damage to your tree(s), and to provide you with yearly updates on the condition of your tree(s). Please sign and date the authorization below. Without your signature your tree(s) cannot be used in this study. If you have any questions regarding the type of tests or measurements the students will perform,

please call - name: _____________________________

at phone: (___)________, during school hours.

Thank you.

.................................................................

(detach here)

owner: _______________________________________

date: _________________________________________

address: ______________________________________

city, state, and zip: ____________________________

## CONNECTIONS TO THE STANDARDS

### PART 5C

**The activity found on page 52 aligns with the following "National Science Education Standards" and the "Excellence in EE-Guidelines for Learning"**

### GRADES 5-8

Science Content Standard A: Science As Inquiry
- *Abilities necessary to do scientific inquiry*
- *Understandings about scientific inquiry*

Science Content Standard C: Life Science
- *Structure and function in living systems*

Excellence in EE-Guidelines for Learning Strand 1
Questioning and Analysis Skills
- *Collecting information*
- *Organizing information*

Excellence in EE – Guidelines for Learning Strand 4 Personal and Civic Responsibility
- *Accepting personal responsibility*

### GRADES 9-12

Science Content Standard A: Science As Inquiry
- *Abilities necessary to do scientific inquiry*
- *Understandings about scientific inquiry*

Science Content Standard C: Life Science
- *Matter, energy, and organization in living systems*

Excellence in EE-Guidelines for Learning Strand 1:
Questioning and Analysis Skills
- *Collecting information*
- *Organizing information*

Excellence in EE – Guidelines for Learning Strand 4:
Personal and Civic Responsibility
- *Accepting personal responsibility*

# Investigating a Built Community

## Introduction

"Investigating a Built Community" provides students with a clearly defined and easy-to-follow process to use when studying an urban or other human-built community. With rapid growth of urban and suburban areas, students need to look at patterns of land use and understand the critical importance of developing these lands wisely for future generations. In this session, students will identify parts of a human-built community, look at land-use patterns, and construct a process to investigate one part of the community. After data are collected and analyzed for different solutions, an action plan should be developed to implement one of the recommendations. Throughout, the emphasis is placed on the processes of planning and carrying out the investigations.

This lesson plan, if done in its entirety, will involve 8-10 hours of time, including 2 field investigations: one 3 hours long; one 1 hour long. The field investigations in a built community can be: the community around a school, a separate part of town, a farm complex, or a school building and the immediate area around it.

Because field investigations require small groups to work independently, adequate advance planning for supervision is important. This investigation is ideal for structuring a cooperative learning format. If direct supervision is required by your school, aides, parents, or other volunteers are possible sources of leadership.

## Activities

A complete correlation is impossible without first determining the issue and the direction of study. The depth of study and time spent on the investigations will also cause this correlation to vary. At a minimum level, and with almost any issue, the following goals and guidelines will most likely be involved:

## Steps And Components

### I. Preparing for the Investigation

A. Review on 8-step chart
B. Identify land-use areas and patterns.
C. Develop an overall view of the community.
D. Introduce a 3-stage data collecting chart.
E. Construct a 3-stage data collecting chart.
F. Use the 3-stage data collecting chart to analyze investigations.
G. Construct a data collecting and recording chart to use in the investigation.
H. Develop a procedure to test the investigation process.

### II. Conduct the Investigation and Report on It

A. Test out the investigation process.
B. Make modifications in the procedure, data collecting tools, etc.
C. Describe the process, procedures, and modifications made in the investigation.

### III. Analyzing Alternatives

A. List factors that contribute to current conditions and problems.
B. Brainstorm how changes would affect the situation.

### IV. Develop an Action Plan

A. Determine if the solution is feasible.
B. Develop a plan of action.

### V. Implement the Plan

A. Analyze each individual's role
B. Summarize process.

# STEP 1. PREPARE FOR THE INVESTIGATION

## CONCEPT

Change, Interaction, Cause/Effect, System

## PRINCIPLE

Built communities are where we spend most of our time. People should work with integrity and responsibility when developing environments for ourselves and future generations.

## OBJECTIVES

As a result of completing the activities in this process, students will be able to:

- Identify at least five different land-use categories in a built environment.
- Name and describe three themes often found in communities.
- Construct a data collecting and recording tool for some part of a built environment for data that is observable, collectable, and recordable.
- Describe a procedure to use in initiating an urban environmental investigation.

## MATERIALS

Maps of the urban area to be investigated (1 per small group)
Marking pens- various colors
Blackboard or easel board/pad
Newsprint, butcher paper, or easelpad
Paper, pencils
Masking tape
**Activity sheets-A; 3-Stage Chart**
Wall chart - samples included in lesson plan

## PROCESSES

Question
Hypothesize
Use numbers
Observe
Predict
Interpret data
Classify
Communicate
Infer

### 8 Steps to Investigating a Built Community

1. Become familiar with the community.
2. Identify and focus on land-use patterns and interrelationships.
3. Identify and analyze a specific topic.
4. Conduct the investigation.
5. Prepare and report on findings.
6. Analyze factors and alternatives to the present condition.
7. Develop an action plan.
8. Communicate feelings and values.

## TIME

2 Hours

## DOING THE ACTIVITY - **indoor**

### A. Set Stage

An urban or built environment is where most people spend the bulk of their time. The way a built environment is planned and managed affects how easily, safely, and pleasantly we spend a great part of our lives. Winston Churchill said, "We shape our cities, after that they shape us." Today we are going to investigate the built environment in this immediate area. We will do this by following a process which will allow us to develop our own investigations to collect and interpret information, and to make some suggestions for improving the area. We will spend some time here in the classroom first, then about three hours collecting information in the community, and then time back in the classroom reporting on our findings. Most of the work will be done in small groups.

### B. Procedure

1. Put up a wall chart.
2. Describe steps to students. Give them an opportunity to ask questions.
3. Ask the students: What are the major land-use categories found in most communities? (List examples on board)
4. Hand out community maps along with marking pens.
5. Have students locate and mark on the maps all the major land-use categories they come up with.

### C. Retrieve Data:

1. Have students share information.
2. Ask them if they came up with any new categories as they studied their maps.

## CLOSURE

Ask the students what conclusions they can draw about land uses in the community.

## TRANSITION

There are many ways of looking at a community, from a simple, overall look, like we just did, to a more in-depth look.

## A. SET STAGE

We want to find out more about different land-use categories in this area. One way to do this is with a 3 stage data collecting chart.

## B. PROCEDURE

1. Hand out **Activity Sheet A.**
2. Before we start our chart, let's look at an example of one.

***Note:*** *Pick a subject other than a land-use category listed on the board. Have a large wall chart prepared ahead of time, with headings made.*

3. Work through the 3-stage chart column by column.

## C. RETRIEVE DATA

After filling out the chart as an example, ask:

1. What might be the benefits of analyzing a land use in this way before doing an investigation about it? *(Easier to see all parts, community is broken into manageable parts, problems aren't as simple as they seem)*

### ACTIVITY A

**See Appendix Page 71**

| COLUMN 1<br>**What We Want to Find Out** | COLUMN 2<br>**How to Collect** | COLUMN 3<br>**How to Record** |
|---|---|---|
| Location of major arterials | Observe | Graphs |
| Kinds of transportation | Interview people | Statistics |
| Accessibility of terminals | Existing studies | Pictures |
| Land topography | Count # of cases at certain places | Film |
| Growth pattern | Count types of vehicles | Tape recorders |
| Traffic flow pattern | | Questionnaire |
| Peak traffic needs | | Map |
| Attitude of people | | Tables |
| What is needed? | | |
| How much is available? | | |
| Is It working? | | |
| What is being used now? | | |

## TRANSITION

Now that we have looked at a simple recording device, let's apply that to an area.

## A. Set Stage

**Describe** the specific area the group is going to investigate and have them locate it on the map.

***Note****: Some things to consider in identifying an area to investigate:*

- *it should be within walking distance in the time allotted (3 hours of investigation)*
- *it should have a variety of land use categories*
- *it should be interesting to study*

## B. Procedure

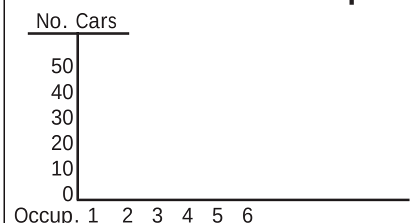
1. Split class into appropriate number of study teams (4-5 to a team).
2. Have each study team pick a land-use category.
3. Have study teams fill out column 1 in the 3-stage chart. Allow 10 minutes.
4. Have students identify, from Column 1 of their charts, one or two items that they want to find out more about from actual observations in the area to be investigated, and then construct a data-collecting and recording device to use in collecting and recording observations. The items must deal with data that is observable, collectable, and recordable in the area during the actual field investigation and within the time constraints. Filling out Columns 2 and 3 may help in their planning.

***Note****: Samples of data-collecting charts and recording charts may be helpful.*

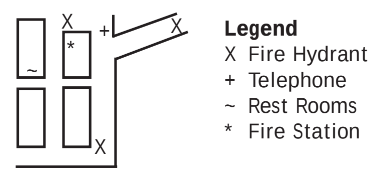
**Use of Parks By Age Groups**

| Age Group | Swim | Walk | Bike | Etc. |
|---|---|---|---|---|
| 0-6 | | | | |
| 7-12 | | | | |
| 13-21 | | | | |
| 21-30 | | | | |
| 30-40 | | | | |
| 40+ | | | | |

**No. People in Cars at Intersection- 4:00-4:15 p.m.**




**Location of Public Services**




5. When the students are about through making their data-collecting chart, tell them to develop a plan of action to investigate their part of the environment using data-collection and recording devices in the allotted field time. Consider dividing responsibilities for collecting and recording information: who goes where, other tools are needed, etc.
6. About 10 minutes into the planning, pick up and read the following sign:

> **Planning for an Investigation**
> Usually, the problems that people have are:
> **1**. Deciding what to do.
> **2**. Narrowing down the scope of the topic to something specific enough to actually investigate.
> **HAS YOUR GROUP EXPERIENCED THIS?**

### C. Retrieve Data

1. Before going out to do the investigation, have each group make a short presentation to describe the procedures, and display the recording devices to be used in the investigation. If you have a large class, have groups pair up and critique each other's plans instead of each small group presenting to the total group.
2. Just before dismissing the groups to do the field investigation, put up the following chart:

***This Session is All About Learning How to Prepare for an Investigation***

***Today the procedures are more important than the content. The idea is to try out your data-collecting and recording methods.***

**It may be necessary to modify your investigation procedures as you become involved in your task.**

### Closure

Explain that today, learning how to plan and carry out an investigation which involves collecting and interpreting data is more important than the actual content of the investigation.

## Step II: Conduct the Investigation

### Concept

Change, Interaction, Cause/Effect, System

### Principle

Built communities are where we spend most of our time. People should work with integrity and responsibility when developing environments for themselves and future generations.

### Objectives

The student will be able to:

- Test out the investigative process.
- Make modifications in the process.
- Adapt data collection tools to specific situations.
- Organize data into a report.
- Prepare a presentation, using the highlights of the data collected.

### Materials

More copies of **Activity A (optional).**
Wall chart— sample included in lesson plan.
Newsprint, butcher paper, or easel pad.
Masking tape.
Paper, pencils.
Marking pens— various colors.

### A. Set The Stage

1. Tell the group that they have 3 hours to do the field work.
2. When they return, they will have 1 hour to prepare a 5-minute report about the investigation. The instructions for the report should be posted for student viewing. (See below.)
3. Remind them of safety requirements and whatever supervision the students may need to have for your situation.
4. Send students out to conduct the investigation.
5. When students return, review the chart with them.

#### Instructions for the Presentation

1. **Describe your task.**
2. **Report on what you did, how you did it, and what it meant.**
3. **Describe how you modified your procedure, methods, recording devices, etc.**
4. **Use more than one individual as spokesperson.**
5. **Use visual display(s).**
6. **Limit report to 5 minutes.**
7. **This is a report about the investigation process and not the content or solutions to problems unless it relates to the process.**
8. **Do not report on all the minute details.**

### Processes

Observe
Predict
Infer
Communicate
Interpret Data
Use Numbers
Design Experiments

### Time

5 hours

### B. Procedure

Give each group I hour to develop its presentation.

### C. Retrieve Data

Have each group give its presentation. Make sure students stick to the time limits.

### Closure

Ask each group:

1. What problems did you encounter in your investigation?
2. What were the things that made you modify your procedures, etc.?
3. What are some things you'd consider if you did this step again?
4. How did you decide what to report on?
5. What else can we do with this information?

## Step III: Analyze Factors and Alternatives

### Concept

Change, Interaction, Cause/Effect, System

### Principle

Built communities are where we spend most of our time. People should work with integrity and responsibility when developing environments for themselves and future generations.

### Time

45 minutes

### Objective

The student will be able to:

- Analyze factors that contribute to a problem in the built environment.
- Identify change agents that can be used for the improved livability of the area.
- Develop alternatives to the present situation that would reduce or eliminate the factor that causes the problem.

### Materials

**Activity B: Analyze Factors and Alternatives. (See page 72)**
**Activity B: Example.(See page 73)**
Wall chart or overhead of Activity B.
Paper, pencils.

### Processes

Hypothesize
Formulate Models
Define Operationally
Question
Classify
Control Variables

### A. Set Stage

1. Remind each group that the process is the important thing here and not the content.
2. Ask them any of the following questions that will encourage the group to look at their area as a whole.

A. What are some of the characteristics of the area you studied?
- What does it look like?
- What land uses are present?
- What do people do there?

B. What are some of the needs of your area?
- Housing?
- Transportation?
- Services?

C. Give examples in your area that:
- illustrate the past
- typify the present
- indicate the future

D. What are some interrelationships, based on your observations? *(residential to business, business to transportation, etc.)*

E. How do the interrelationships affect the community? *(vacancies affect appearances, apartments affect community spirit, etc.)*

### B. Procedure

1. Hand out ***Activity Sheet B: Analyze Factors***
2. Put the chart up on the wall (or use overhead) and discuss with group.
3. Have individual teams select one issue, concern or problem, and fill out the activity sheet. Give them 25 minutes.

### C. Retrieve Data

This is not necessary; move on to step IV.

### Closure

This is not necessary, move on to step IV.

### Transition

Now that we've looked at some possible factors that affect your area and have brainstormed some alternative solutions, let's see if we can make one work.

**Activity B**
**See Appendix Page 72 (Example Page 73)**

**Activity C**
**See Appendix Page 74**

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## Step IV: Develop an Action Plan

### Concept

Change, Interaction, Cause/Effect, System

### Principle

Built communities are where we spend most of our time. People should employ integrity and responsibility when developing environments for themselves and future generations.

### Objectives

The student will be able to:

- Develop an action plan to implement an alternative.
- Analyze the feasibility of alternative solutions.

### Materials

**Activity C: Develop an Action Plan.**

### Processes

Interpret Data
Communicate
Formulate Models
Control Variables

### Time

45 minutes

### Doing the Activity

### A. Set Stage

Remind the group *again* that the emphasis in this lesson is on the *process.*

### B. Procedure

1. Hand out ***Activity Sheet C: Develop an Action Plan.***
2. Have group select one alternative from the activity sheet and:
   A. determine if it's feasible
   B. develop an action plan
3. Tell group they have 30 minutes to develop their action plan and give a 3 minute report on solutions and implementation steps only.

### C. Retrieve Data

1. Have each team give a 3-minute report.

### Closure

Ask group: If you were the planning commission, what guidelines would you develop for consideration of future developments in your area?

### Transition

Now that we think we have a solution, let's look at what we can do to help.

# STEP V: IMPLEMENT THE PLAN

## CONCEPT
Change, Interaction, Cause/Effect, System

## PRINCIPLE
Built communities are where we spend most of our time. People should employ integrity and responsibility when developing environments for ourselves and future generations.

## OBJECTIVE
The student will be able to:
- Describe what they can do to become involved in community action.
- Describe how you and the people of your community can become involved in affecting the local political decision-making process through investigations of a built environment.

**TIME**
45 minutes

**MATERIALS**
**Activity D: Implement the Plan.**

## PROCESSES
Communicate
Summarize

**ACTIVITY D**
**See Appendix**
**Page 75**

## DOING THE ACTIVITY

### A. SET STAGE
Say: Now that we have analyzed a built environment, let's switch gears a little and talk about how you feel about what you have just done.

### B. PROCEDURE
***Handout Activity D.***
Have students fill out the 3 parts.
Give them 20 minutes.

### C. RETRIEVE DATA
1. Ask individuals to share their thoughts.
2. Ask: What type of community action can be taken to motivate people to take informed action in situations such as we have been analyzing?

## CLOSURE
Ask the following (for entire lesson):
1. What procedure did we use about our investigations?
2. Can you think of other uses for this investigation process?
3. What did we find out about our environment in our study?
4. What are some things we learned as we went through this process?

# Connections to the Standards

## Part 5D

**The activity found on page 54 aligns with the following "National Science Education Standards" and the "Excellence in EE-Guidelines for Learning"**

### Grades 5–8

Science Content Standard A: Science As Inquiry
- *Abilities necessary to do scientific inquiry*
- *Understandings about scientific inquiry*

Science Content Standard C: Life Science
- *Populations and ecosystems*

Science Content Standard F: Science in Personal and Social Perspectives
- *Populations, resources and environments*

Excellence in EE: Guidelines for Learning Strand 1: Questioning and Analysis
- *Questioning*
- *Collecting information*
- *Evaluating accuracy and reliability*
- *Developing proposed explanations*

Excellence in EE: Guidelines for Learning Strand 2.2: The Living Environment
- *Organisms, populations, and communities*
- *Systems and connections*

Excellence in EE: Guidelines for Learning Strand 2.3: Humans and Their Societies
- *Political and economic systems*
- *Change and conflict*

Excellence in EE: Guidelines for Learning Strand 2.4: Environment and Society
- *Human/environment interactions*
- *Resources*
- *Environmental issues*

Excellence in EE: Guidelines for Learning Strand 3.1: Skills for Analyzing and Investigating Environmental Issues
- *Identifying and investigating issues*
- *Sorting out the consequences of issues*

Excellence in EE: Guidelines for Learning Strand 3.2: Decision-Making and Citizenship Skills
- *Planning and taking action*
- *Evaluating the results of actions*

Excellence in EE: Guidelines for Learning Strand 4: Personal and Civic Responsibility
- *Understanding societal values and principles*
- *Recognizing citizens' rights and responsibilities*

### Grades 9–12

Science Content A: Science As Inquiry
- *Abilities necessary to do scientific inquiry*
- *Understandings about scientific inquiry*

Science Content Standard C: Life Science
- *Matter, energy, and organization in living systems*

Science Content Standard F: Science in Personal and Social Perspectives
- *Environmental quality*

Excellence in EE: Guidelines for Learning Strand 1: Questioning and Analysis
- *Questioning*
- *Collecting information*
- *Evaluating accuracy and reliability*
- *Developing proposed explanations*

Excellence in EE: Guidelines for Learning Strand 2.2: The Living Environment
- *Organisms, populations, and communities*
- *Systems and connections*

Excellence in EE: Guidelines for Learning Strand 2.3: Humans and Their Societies
- *Political and economic systems*
- *Change and conflict*

Excellence in EE: Guidelines for Learning Strand 2.4: Environment and Society
- *Human/environment interactions*
- *Resources*
- *Environmental issues*

Excellence in EE: Guidelines for Learning Strand 3.1: Skills for Analyzing and Investigating Environmental Issues
- *Identifying and investigating issues*
- *Sorting out the consequences of issues*

Excellence in EE: Guidelines for Learning Strand 3.2: Decision-Making and Citizenship Skills
- *Planning and taking action*
- *Evaluating the results of actions*

Excellence in EE: Guidelines for Learning Strand 4: Personal and Civic Responsibility
- *Understanding societal values and principles*
- *Recognizing citizens' rights and responsibilities*

# A Natural World
# Program VI

## Learning Objectives

Working in small cooperative groups, the students will:

1. explore the variety of life in their selected sites and recognize/state the interrelationships among these living things
2. examine and state relationships between the organisms and their present-day physical (abiotic) environments
3. research the history of an area and determine the extent to which humans have had an impact on local wooded sites throughout history
4. develop comprehensive, creative ecological site studies which demonstrate their understanding of the values of and problems associated with urban forests (and the roles humans play in creating and solving these problems)

**Video Description**: This program demonstrates how young people and communities can be drawn together through model programs that beautify urban areas, such as the Chicago "River Rats," which began as a camping program for inner city youth. After cleaning up a blighted river area, they expanded their efforts to build trails and a wildlife habitat. Viewers meet citizens throughout the country—foresters, researchers, professors, and private citizens—who affirm the vital importance trees play in preserving quality of life and a sense of community. Healthy urban forests moderate temperature, reduce air pollution and flooding, and allow people living in urban areas – representing 80% of the nation – to live calmer, less stressful lives. Viewers learn that our environment is part of who we are.

## Teacher's Branch

During this unit, students should view and discuss the video, complete and present their "Meet Your Forest" (page 65) or Project Learning Tree's *The Changing Forest: Forest Ecology* "Cast of Thousands" projects. Additional suggested activities might include:

1. nature journal entries which incorporate several forms of written and visual expression,
2. nature journal entries which relay childhood memories of a special environmental/outdoor place or activity and discuss why this was special,
3. terrariums incorporating small pieces of broken branches. Lichens, mosses, resurrection fern, centipedes, slugs, fungi or insects living on and in these branches provide opportunities for students to experience succession and ecological interactions, and come to understand how rich the biodiversity of even such a small part of the urban forest ecosystem can be.

Good resources for journaling techniques include:

- *Urban Forestry Lab Exercise* "The Nature Journal"
- Project WILD "Nature Journaling"
- Project Learning Tree "Poet-a-tree"
- Project WET "Wet Words"

The following articles provide additional information:

- "Journalizing the Natural World" by Betty Lou Fegley, Keystone Conservationist, May-June, 1999
- "A Closer Look: Nature Journal" by Lyle Soniat and Jean May-Brett, Louisiana Conservationist, May-June, 1994
- Natural Journaling by Clare Walker Leslie and Charles E. Roth.

Terrarium building guidelines are available in Project Learning Tree *The Changing Forest: Forest Ecology,* and in most biology or environmental science lab manuals.

## Meet Your Forest Project

MEET YOUR FOREST is designed to provide students with a closer look at trees and their habitats by viewing them from a variety of perspectives, to provide opportunities for practical application of skills and concepts introduced throughout ***The Forest Where We Live***, and to have students communicate their findings in creative ways. Working in cooperative groups, students will develop a tour guide of a wooded area in their schoolyard, in their neighborhoods, or in a local park.

Students should be familiar with the skills introduced in "How Big is a Tree?," "Measure the Length of your Step," "What's Happening Below the Surface" and "Determining Site Index of an Area" from previous activities in this series. Teachers may wish to substitute "Cast of Thousands" from Project Learning Tree *The Changing Forest: Forest Ecology* module, for this project. "Cast of Thousands" provides background information, forest measurement instruction and opportunities for measurement, data collection, data analysis, organization and research.  Through participation in a Project Learning Tree environmental exchange box program, students can share information and samples with students from other regions of the country.

## Connections to the Standards

### Part 6

**The activity found on page 65 aligns with the following "National Science Education Standards" and the "Excellence in EE-Guidelines for Learning"**

### Grades 5-8

Science Content Standard A: Science As Inquiry
- *Abilities necessary to do scientific inquiry*

Science Content Standard C:  Life Science
- *Populations and ecosystems*

Science Content Standard F: Science in Personal and Social Perspectives
- *Populations, resources, and environments*

Excellence  in EE-Guidelines for Learning Strand 1: Questioning and Analysis Skills
- *Questioning*
- *Designing investigations*
- *Organizing information*

Excellence in EE- Guidelines for Learning Strand 2.2: The Living Environment
- *Systems and connections*

Excellence  in EE – Guidelines for Learning Strand 2.3: Humans and Their Societies
- *Culture*

Excellence  in EE- Guidelines for Learning  Strand 2.4: Environment and Society
- *Human/environment interactions*

Excellence in EE – Guidelines for Learning Strand 4: Personal and Civic Responsibility
- *Accepting personal responsibility*

### Grades 9-12

Science Content Standard A:  Science As Inquiry
- *Abilities necessary to do scientific inquiry*

Science Content Standard C:  Life Science
- *The interdependence of organisms*

Science Content Standard F:  Science in Personal and Social Perspectives
- *Population growth*
- *environmental quality*

Excellence  in EE-Guidelines for Learning Strand  1: Questioning and Analysis Skills
- *Questioning*
- *Designing investigations*
- *Organizing information*

Excellence in EE- Guidelines for Learning Strand 2.2: The Living Environment
- *Systems and connections*

Excellence  in EE – Guidelines for Learning Strand 2.3: Humans and Their Societies
- *Culture*

Excellence  in EE- Guidelines for Learning  Strand 2.4: Environment and Society
- *Human/environment interactions*

Excellence in EE – Guidelines for Learning Strand  4: Personal and Civic Responsibility
- *Accepting personal responsibility*

Working in cooperative groups, you will develop an urban forest environmental "tour guide" for your school yard, neighborhood, or local park site. This guide might by a scrapbook, project board display, pamphlet, power point presentation, or some other creative presentation device.

This activity will incorporate skills and concepts introduced in previous ***The Forest Where We Live*** units. It will include making measurements and observations and incorporate both your interviewing and reference research. Before beginning the measurement and observation phase, the size and shape of the plot or study area should be agreed upon by the class and plot boundaries should be marked.

## OBSERVATIONS AND MEASUREMENTS SHOULD INCLUDE

- number of species, their names, their abundance and locations
- diameter, height, and age of each of the trees
- tree damage and signs of disturbance
- the number of shrub species, their names, their abundance, size and location
- number of species of herbaceous plants/ground cover (grasses, wildflowers, ferns), their abundance, size, and location
- wildlife observations (sightings or signs such as scat, nests, shells)
- influential characteristics of the site (slope, drainage, sidewalks or roads)
- soil characteristics

## MATERIALS

After collecting the observations and measurements, prepare your "tour guide." While items need not appear in the order listed, each guide should include:

1. a map of the study area: use symbols, agreed upon in the class, to represent the various plant species and structures. Draw the map to scale and include a map legend.
2. a description of the site: write in essay form and include:
   - both the location and a general description of the site
   - site measurements and observations collected earlier (You may incorporate the data into tables, charts or graphs)
   - human use of the site and history of the area (remember the interviews)
   - interactions/relationships between trees and other organisms
   - interactions/relationships between the trees and their present-day physical (abiotic) environments
   - other influences of physical environment on tree growth
   - an evaluation of the diversity of the area
3. Develop a taxonomic key for the tree species growing on your site.
4. Prepare a one-page description of each tree species on your site.

***Include a one to three paragraph description of:***
- ***species characteristics***
- ***general habitat and range***
- ***native or introduced***
- ***wildlife value***
- ***other pertinent or interesting information.***

***Also include a:***
- ***photograph or sketch of a representative tree***
- ***bark rubbing***
- ***leaf sketch, leaf rubbing, or pressed leaf***
- ***sketch, photo, dried flower and fruit, or cone***
- ***two or three paragraph summary description of this urban site, its value, its problems and the interrelationships between people and this forested site.***

- wooden stakes (to mark boundary)
- twine
- measuring tape
- clinometer
- soil test kits
- tree borer (if possible)
- camera and film (optional)
- crayons, chalk, charcoal

# APPENDIX

# GLOSSARY

| WORD | DEFINITION |
|---|---|
| acidic | pH below 7 |
| adsorption | process by which molecules become attached to the surface |
| annual ring | visible circle in x-section of tree produced by one year's growth |
| apex | the tip, furthermost part of something; strictly the pointed or angular summit as in shoot or root apex |
| azimuth | compass direction, i.e., 120 degrees is southeast |
| bare root | a tree without soil on its roots when transplanted |
| basic | pH between 7 and 14 |
| bedrock | consolidated rock |
| biltmore | stick used to measure tree diameter and height |
| board foot | a standard unit of measure for lumber, (1"x1'x1') before surfacing or finishing |
| bole | a tree trunk |
| branch | a larger outgrowing stem that grows from the trunk |
| broadleaf | trees that have wide, flat leaves |
| buds | structures at the end and side stem that develop into a flower, leaf, twig or shoot |
| cambium | living cells that divide to form phloem and xylem |
| canopy | upper part of the forest, consisting of the crown of trees |
| chain | a tool used to determine horizontal distances |
| chlorophyll | the green pigments in plants that absorb the energy of sunlight for use in the manufacture of sugars from carbon dioxide and water |
| climatic range | geographic limits of growth for a particular type of tree |
| clinometer | a tool used to determine height of tree at given distance |
| commercial forest | trees grown for the production of lumber |
| compass | a tool used to determine direction |
| compost | a mixture of decomposing organic matter used as a fertilizer, mulch, or soil conditioner |
| conifer | trees that bear seeds in cones and have long needle-like leaves |
| cord stack of wood | 4'x4'x8' or the equivalent |
| crown | the upper branches and foliage of a tree |
| crown class | method of classifying a trees' position in the canopy |
| cruising | process of estimating the pulpwood or lumber in a stand of trees |
| DBH | diameter breast height; diameter of a tree trunk in inches 4.5 ft above ground |
| deciduous | plants that shed all of their leaves at the end of the growing season |
| defoliators | insects that remove leaves from trees |
| dendrochronology | the study of the age of trees by counting the rings of xylem growth |
| dendrology | the study of trees |
| dessication | the process of drying out |
| diameter tape | used to directly measure the diameter of a tree |
| drought | extended period of time when a significant lack of moisture persists |
| evergreen | plants that retain their green foliage throught out the year |

feeder roots ________ hair-like roots through which the tree obtains water and nutrients

flower _____________ the reproductive unit of a seed-bearing plant

forest _____________ a large tract of land covered with trees and underbrush

forest harvest ______ periodic removal of trees for lumber

forest pathology ____ study of diseases in forest trees

forest tract ________ a particular set of trees

forestry ____________ the science of managing trees, shrubs and animals

fruit _______________ product of plant consisting of ripened seeds with a tissue around it

fungus _____________ a large group of plants lacking chlorophyll like molds, mildews, rusts, mushrooms and smuts, subsisting upon dead or living organic matter

groundwater _______ subsurface water occupying the zone of saturation, the gravitational water below the water table

growth rate ________ how fast a tree will grow on an average site

heartwood _________ hard central wood consisting of dead cells that give strength to the tree (usually darker in color)

herbarium _________ an organized collection of dried or preserved plant specimens

humus _____________ black or brown layer of composted organic matter

increment borer ____ auger-like tool used to extract cores from the tree trunk to find age

insulation __________ a barrier of dead air space to reduce change in temperature

lateral roots ________ grow horizontally and help keep the tree upright

leaf _______________ single unit of foliage; usually the site of food manufacture by photosynthesis

lumber grades ______ system for determining potential uses of lumber

mulch _____________ a covering such as wood-chips, straw, leaves, etc., spread on the ground around plants to prevent excess evaporation and to enrich the soil

NIMBY _____________ Not In My Backyard

nutrients ___________ mineral elements and compounds which a plant uses for tissue growth

outer bark _________ external covering which helps to protect a tree from injury

pace ______________ number of steps for a specific distance (ie. 100 ft.)

percolation _________ the absorbtion of water into the soil; usually expressed as a rate

pH ________________ a term used to indicate the degree of acidity or alkalinity

phloem ____________ produced by the cambium and carries food from leaves to twigs, branches, trunk, and roots

photosysnthesis ______ process of making carbohydrate from water, carbon dioxide, chlorophyll and light

plant press _________ device for drying plant parts for preservation

BAF prism _________ device used to determine groups of trees of specific size

pruning ____________ the selective cutting of branches from trees to remove old stems, dead wood, or give it better shape

psychrometer _______ tool with two thermometers used to find humidity

root ball ___________ ball of soil containing the roots of a tree

root hairs __________ a hair-like tubular outgrowth from near the tip of a rootlet, functions in water and mineral absorption root _______________ underground part of a plant that extracts water, oxygen, and nutrients from the soil

sap _______________ the liquid that moves through the tissues of plants

seeds ______________ small body made by flowering plants which is capable of growing into a new plant

shade leaf _________ larger leaves found in the shade, capable of photosynthesis with indirect sunlight

silviculture _________ the art of producing and caring for a forest

site _______________ spot where a tree will grow - consider soil, light and moisture

soil classification ____ system to describe the characteristics of a given soil

soil density _________ how much one cubic centimeter of soil weighs (weight per unit volume)

soil drainage ______ the speed and extent of water movement over and through the soil

soil horizon_________ layers of mature soils

soil profile _________ a diagram of the vertical section of soil noting the horizon layers i.e., A,B,C

subsoil _____________ soil below the usual depth of cultivation, brown or reddish colored soil with more clay than surface soils

sun leaf ____________ smaller leaves found growing exposed to full sunlight

tap roots ___________ grow vertically downward and anchor the tree

topsoil _____________ surface layer of mature soil, containing large amounts of organic material

transect ___________ a straight line that bisects a given unit or area

transpiration ______ the release of water vapor by the leaves into the air

tree _______________ a woody plant usually over 20 feet high at maturity

tree form __________ tree shape usually one of 8 types or habits

tree tolerance _____ the ability of trees to endure shade, salt, insects, weather, etc.

trunk ______________ the main stem of the tree that transports nutrients

twigs ______________ smaller stems that come from the branches

vasculum __________ field container for collecting plant parts

watershed _________ the land that drains into a given stream or pond

wind meter_________ device used to determine speed of wind

windbreak _________ vegetation planted across the prevailing wind direction to reduce windspeed

xylem _____________ complex tissue in higher plants that carries sap from roots to leaves

## More Resources & Links:

***Introduction to Ecology***, Paul Colinvaux (adult level)
***Ecology: The Circle of LIfe***, Harold R. Hungerford (youth level)
***Master Tree Finder***, May Theilgaard Watts (nature study guide)
Posters are available via American Forest Institute, Director of Education, 16196 Massachusetts Ave., N.W. Washington, D.C. 20036 or the USDA.
www.forestry.uga.edu

# Activity A: 3-Stage Data Collecting and Analyzing Chart

45 minutes, small groups

Working in your group, fill out the land use category and column 1 of the chart below.

Land Use Category

| **Column 1**<br>What we want to find out about our land use category in the area | **Column 2**<br>How to collect the information | **Column 3**<br>How to record the information |
|---|---|---|
| | | |

Adapted from "Investigating Your Environment"

# Activity B: Analyze Factors and Alternatives to Present Conditions

25 minutes, groups

**Analyzing Factors and Alternatives to Present Conditions**

(This activity is designed to brainstorm all possible alternatives.) List the factors contributing to the issue. Take each factor and ask, "How can we change this factor (eliminate, modify, substitute) to bring about a change in the issue?" Consider all alternatives, no matter how silly they may seem.

| Factor | How it contributes to the problem or issue | Alternatives to its present condition (Elimination Modification Substitution) | Describe how the change will effect the problem or issue |
|---|---|---|---|
| | | | |

Describe the alternatives or combination of alternatives that might bring about an improvement or solution to the problem of the environment investigated. Give reasons for your choices.



Adapted from "Investigating Your Environment"

# Activity B: Analyze Factors and Alternatives to Present Conditions (Example)

25 minutes, groups

**Analyzing Factors and Alternatives to Present Conditions**
(This activity is designed to brainstorm all possible alternatives.) List the factors contributing to the issue. Take each factor and ask, "How can we change this factor (eliminate, modify, substitute) to bring about a change in the issue?" Consider all alternatives, no matter how silly they may seem. **Example: Traffic Management**

| Factor | How it contributes to the problem or issue | Alternatives to its present condition (Elimination Modification Substitution) | Describe how the change will effect the problem or issue |
|---|---|---|---|
| *Width of streets* | *Cause traffic jam* | *Put in walking or bicycle paths* | *Eliminate car traffic, cause changes in working-social patterns* |
| | | *One-way streets* | *Ease congestion because of one-way flow* |
| *Everyone starts and quits work at the same time* | *Causes traffic jam* | *Mass transit* | *Minimize number of vehicles, no congestion, less air pollution, etc.* |
| | | *Adjust starting, closing, working hours* | *Spread out traffic over a longer period of time* |

Describe the alternatives or combination of alternatives that might bring about an improvement or solution to the problem of the environment investigated. Give reasons for your choices.



Adapted from "Investigating Your Environment"

# Activity C: Develop an Action Plan

30 minutes, small groups

**Select one of the solutions suggested by your group in Activity B. Write it below under "Suggested Solutions." Complete the rest of the chart.**

**ACTION PLANNING FOR PROBLEM SOLVING**

| Suggested Solution | Type of Action Necessary to Implement the Solution | Identify Change Agents Who Could Help Implement the Solution | Implementation Steps to Problem Solution | Evaluation Methods: How Will You Follow Up and Evaluate the Effectiveness of Your Actions? |
|---|---|---|---|---|
| | | | | |



Adapted from "Investigating Your Environment"

## Activity D: Implement the Plan

20 minutes, individual

Describe the part you could play in implementing your group's action plan.

A. As an individual:

B. As a member of a community action group:

C. As part of the political decision making process in your community.

Adapted from "Investigating Your Environment"

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