

# Healthy Forests, Healthy Waters



Grade 7 Field Experience





## Healthy Forests, Healthy Waters

### Overview Healthy Forests, Healthy Waters

This unit reviews the application design process and shows students how professionals in the real world use the design process to solve the local problem of health and sustainability of our city forests. Students are introduced to the importance of urban forests and green spaces particularly in terms of watersheds (stormwater runoff). Students will participate in various steps of the design process while evaluating and restoring (optional) an urban forest. These steps include 3 investigations in the forest: 1) Percent canopy cover; 2) relative % of evergreen versus deciduous trees. 3) Percent invasive cover. Students will then analyze these data using the Tree-iage analysis to identify the solution (strategy) for restoration. Lastly, students use the diameter of the trees they measured during the evaluation process to use the [www.treebenefits.com](http://www.treebenefits.com) to determine the amount of water these trees intercept in the forest.

### Lesson 1 –Introduction to urban forest’s value and Solving Problems (the Design Process)

In this lesson students will learn what urban forests are and why they are important. Students will look at a map and discuss amount of green spaces and watersheds. Optionally, students will investigate in their neighborhoods green spaces.

Students view the **Urban Forestry PowerPoint**. Then students review the steps for the design process. Next students read page 2 of *Green Seattle Partnership: Forest Steward Field Guide* and come up with a statement to define the problem facing Urban Forests in the area Seattle being the example.

### Lesson 2-Researching the problem: Identifying 6 Native Trees

Students will learn to identify 6 trees by their physical characteristics and categorize them as to whether they are deciduous or evergreen and conifer or broadleaf.

### Lesson 3-Researching the problem: Learning Invasive Plants

Students learn to identify one invasive plant and to become an expert on it. Students use a chart to summarize information about their invasive plant. Students analyze the information in terms of invasive plant’s effect on urban forest ecosystems. Students then teach others about their invasive plant doing a jigsaw so that every student learns about 4 invasive plants. Optional: In groups students create a “worst weed” presentation such as a skit or poster. (Core Standard)

#### **Lesson 4- Researching the problem: Urban Forest Evaluation -Planning Field Investigations-Virtual Lab**

Students will plan and conduct a descriptive and comparative investigation in order to perform the Tree-iage analysis of their area of the Forest site or the entire forest site. In lesson 5 students view **PowerPoint of the protocols** for the field investigations and review procedures in notebooks. They practice with the tools before going out into the field. They enter predictions into their journals.

#### **Lesson 5- Field Experience– Conducting Field Investigations**

In groups of 8, students will create circle plots in the forest to conduct the 3 investigations in the forest in order to perform the Tree-iage analysis (Lesson 8) of their Forest site. Students will take data to answer all 3 questions-1) Percent canopy cover; 2) relative % of evergreen versus deciduous trees. 3) Percent invasive cover. Students will also identify and measure diameter of the trees in their plots to estimate the value of the forest in terms of water interception

#### **Lesson 6-Analyzing data and writing conclusions**

Students individually edit their procedures and write conclusions for their 3 investigations and then use that data to do the tree-iage analysis (Lesson 8) and decide on the restoration strategy (solution to the problem).

#### **Lesson 7-Generating a possible solution -Tree-iage analysis (step 3 of design process)**

Students write a report of their Tree-iage findings and create a presentation, PowerPoint, website (or other) to inform middle and elementary students of their findings.

#### **Lesson 8- Tree Benefits: Healthy Forests/ Healthy Waters**

Students use the circumference data from their forest plots to determine the diameters of the trees in their plots. They determine the average diameter for each species of tree and then go to [www.treebenefits.com](http://www.treebenefits.com) to determine the amount of water each type of tree intercepts. Next they multiply by the number of each tree in the 1/10 acre plot and then multiply by 10 to get the amount water intercepted per acre of this forest.

# Healthy Forests, Healthy Waters

## Forest Evaluation Field Experience

### Grade 7 Science

Lesson	Activities	Concepts/Skills	Habits of Mind	Resources
1. Introduction- Urban Forests Value and the Design Process-Defining the Problem	Forest Benefits Tree Tales Quiz Then and Now Evaluation of Green Space Green Seattle Partnership page Seattle Parks page WSU page Healthy Forest PPT	Benefits of Forests: Interdependence with Healthy Waters  Non-fiction reading		Tall Tree Tales (PLT) Then and Now Lesson <i>Healthy Forests</i> PowerPoint Green Seattle Partnership page Seattle Parks page WSU page
2. Tree Identification- Researching the problem	Tree Identification and Classification Journal Entry: Inferences	Observing Classifying Compare/Contrast Inferring	Gathering Data Through the Senses Striving for Accuracy and Precision Thinking Interdependently	<i>Healthy Forests</i> PowerPoint Tree Identification Cards Student Field Journals
3. Invasive Plant ID- researching the problem	Defining Native/Non- Native/Invasive Plants Invasive Plant ID Give One-Get One Journal Entry: Summarizing the Impact of Invasive Species on the Forest Core Addition-WORST WEED activity	Invasive Plants ID Summarizing Finding Evidence	Thinking and Communicating with Clarity and Precision Applying Past Knowledge to New Situations	<i>Healthy Forests</i> PowerPoint Invasive Plants ID Cards Information Pages Native/Non- Native/Invasive Definition Cards <i>Ivy Out</i> Video Student Field Journals



Lesson	Activities	Concepts/Skills	Habits of Mind	Resources
4. Researching the problem: City Forest Evaluation -Planning Field Investigations	Learning the Data Collection and Investigation Protocols Viewing a Demonstration Journal Entry: Data Sheets and Student Role Reflections Field Experience Expectations <i>Virtual Tour</i> PowerPoint Protocol Review: Circle Plot Data Collection Model Journal Entry: Expectation Review and Predictions	Inquiry Science Forest Health Indicators Data Collection and Investigation Protocols Observing Summarizing Finding Evidence Predicting	Striving for Accuracy and Precision	<i>Healthy Forests</i> PowerPoint Materials Tubs for Field Work Student Field Journals
5. Field Experience: Forest Evaluation	Restoration Work: Removing Invasive Species Data Gathering: Circle Plots Journal Entry: Recording Data and Reflecting on the Experience	Healthy Forests Indicators Observing Summarizing Finding Evidence	Gathering Data Through the Senses Thinking Interdependently Striving for Accuracy and Precision Applying Past Knowledge	Field Trip Permissions Materials Tubs for Field Work Circle Plot Data Collection Protocol Student Field Journals
6. Healthy Forests Data Analysis	Model with sample data Combine class data from field journals Analyze the data and summarize conclusions Answer three investigation questions	Data Analysis Analysis Summarizing	Striving for Accuracy and Precision Thinking Interdependently	Sample Data Set Student Field Journals <i>Processing and Analyzing Data</i> Recording Sheet

Lesson	Activities	Concepts/Skills	Habits of Mind	Resources
7. Tree-iage-Generating a possible solution	<p>Review the forest evaluation model</p> <p>Conduct Tree-iage Evaluation using sample data and student collected data</p> <p>Rate Forest health on a 1 to 9 scale</p> <p>Discuss forest restoration suggestions</p> <p>Create a group presentation that informs Federal Way City Staff of restoration suggestions?</p>	<p>Data Interpretation</p> <p>Healthy Forests/Forest Restoration</p> <p>Evaluation</p> <p>Synthesis</p> <p>Problem Solving</p>	<p>Applying Past Knowledge to New Situations</p> <p>Questioning and Problem Posing</p> <p>Thinking Interdependently</p>	<p>Student Collected Data</p> <p>Reading from <i>Green Seattle Partnership Stewardship Guide</i></p> <p>Tree-iage Model Overview</p> <p>Tree-iage Generator</p> <p><i>Healthy Forests</i> PowerPoint</p> <p>Forest Tree-iage Evaluation Project Check List</p>
8. Tree Benefits: Healthy Forests/ Healthy Waters	<p>Review statements from Tall Tree Tales</p> <p>Use circumference data to determine diameters and record on table provided</p> <p>Visit <a href="http://treebenefits.org">treebenefits.org</a>, using class averages to determine amount of water intercepted</p> <p>Estimate the amount of water intercepted by all trees in the Forest</p> <p>Discuss the benefits of water interception</p> <p>Revisit the connection between Healthy Forests and Health Waters</p> <p>Field Experience Assessment</p>	<p>Water Interception Benefits</p> <p>Data Interpretation</p> <p>Classifying</p> <p>Comparing/Contrasting</p>	<p>Striving for Accuracy and Precision</p> <p>Gathering Data through the Senses</p>	<p>Computers</p> <p><a href="http://www.treebenefits.org">www.treebenefits.org</a> website</p> <p>Data Collection Chart</p> <p>Assessment</p>



# Healthy Forests, Healthy Waters

## Field Experience

Healthy forests and waters are at the heart of our local quality of life. In the Forest students will engage in rich experiences to explore the complex issues relating to the health and sustainability of our community's natural resources. Through the combination of field experiences, students will practice the Habit of Mind of Thinking Interdependently as they:

- Learn to assess the health of a forest
- Make connections between the health of a forest and preserving water quality
- Determine actions they can take to improve the health of a forest
- Learn how our community protects and sustains its water resources
- Determine actions they can take to preserve water quality
- Replicate what scientists do to monitor the health of our environment
- Prepare to take action in their community

The goals of the Healthy Forests, Healthy Waters field experience are interdependent: some are Science-based, and some are Social Studies-based. Students will use what they learn in each to enrich their understanding of the other.

In the Forest, students will investigate the canopy cover, invasive species, and evergreen abundance in order to assess the health of the forest and make recommendations for improving it. They may also engage in forest restoration by removing invasive species.

Students will synthesize their experiences by choosing an action project as Community Contributors.

Understanding the science of natural resources helps us take responsible and effective actions as citizens to improve our society. Likewise, our common community interest in sustaining our resources gives us a purpose for conducting scientific investigations. The health of our forests, waters, and community depend on one another: they are INTERDEPENDENT.

Kristin Edlund


Pat Otto



# Healthy Forests, Healthy Waters

## Urban Forest Field Experience

### Science

	Monday	Tuesday	Wednesday	Thursday	Friday
<b>Week 1</b>	Introduction and Design Process	Tree Identification	Invasive Plant ID	Field Investigation: Virtual Lab	Virtual Tour
<b>Week 2</b>	Field Experience: Forest Evaluation	Healthy Forests Data Analysis	Tree-iage →		Tree Benefits: Healthy Forests/Healthy Waters 



# 1. Introduction Healthy Forests, Healthy Waters –Urban Forests/ Trees Value

**Lesson Title:** Field Experience Introduction and Tree Identification

**Implementation Time:** 1 Class Periods

**Resource(s):** Tall Tree Tales Quiz (PLT). Then and Now Lesson from WILD Science and Civics and Green Spaces (PLT)Articles:

- TREES SERVE AS SPEED BUMPS FOR THE RAIN
- Spare that Shrub
- Tree Benefits page
- Purpose of Soils for Salmon-The Relationship
- Between Soil and Water, 1999 Page 5 of <http://www.soilsforsalmon.org/pdf/RelationshipBetweenSoilandWater10-14-99.pdf>
- How Soil Amendments and Compost Can Aid in Salmon Recovery:The Soil-Water-Salmon Connection
- Grow Your Own Native Landscape page 1.

**Materials Needed:**

1. Field Experience PowerPoint, Copies of urban forest background information for students to read or teacher to read-page 86 of PLT: Places We Live.
2. Maps of area including restoration site from Google Earth. 1 map per group of three or four
3. Then and Now Lesson or Green Spaces-Transparency grids to use on maps to aid in estimations or transparency dots to do Then and Now with Students

**Lesson Focus**

- ☒ **Content Knowledge:**  
Field Experience  
Benefits of Forests  
Benefits of Trees
- ☒ **Habit(s) of Mind:**  
Thinking Interdependently

**Learner Outcome(s): What will happen for learners as a result of this lesson?**

Students will be introduced to the Healthy Forests, Healthy Waters field experience and the interdependence of forests and water





**Procedure:**

1. Give students the “Tall Tree Tales” true-or-false quiz. After students take the quiz, discuss the results. All statements are true. Call attention to the role of forests in filtering water to keep our water bodies healthy (thinking interdependently). From this quiz students could brainstorm a list of urban forests benefits.
2. Read the definition of urban forests in the background information or have students read the information to understand that losing urban forests is a national problem.
3. Explain that the Healthy Forests, Healthy Waters field experience will give students an opportunity to assess the health of a forest in our community. They will be Community Contributors and citizen scientists.
4. Show Students the watershed PowerPoint
5. Using local area maps (from Google Earth or elsewhere) assign groups to various sections in the area around the school. Have transparent grids for students to use for estimations. Have students follow the directions on the Green Inventory Sheet Answer to question 5. If they did the outdoor survey they can answer all the questions. (alternatively do Then and Now Activity
6. Discuss findings. Use questions 5-11 as discussion questions.
7. Begin the Healthy Forests PowerPoint. The first slides introduce the goal of the field experience and the problem that students will investigate.
8. Reinforce the interdependent relationship between healthy forests and healthy waters by reading to students or having students read some of the following articles/pages.
  - The Role of Forests in the Water Cycle
  - TREES SERVE AS SPEED BUMPS FOR THE RAIN
  - Spare that Shrub
  - Tree Benefits page
  - Purpose of Soils for Salmon-The Relationship Between Soil and Water, 1999 Page 5 of <http://www.soilsforsalmon.org/pdf/RelationshipBetweenSoilandWater10-14-99.pdf>
  - The Soil-Water-Salmon Connection
  - Grow Your Own Native Landscape page 1.
9. Have students summarize the importance of urban forests in our watersheds. Possible discussion questions to use:
  - Is there more or less green space than you expected?
  - What watershed are these areas in? Where does all the water eventually flow?
  - What role do green spaces and urban forests play in a watershed?
  - What are other threats to green spaces other than development?
  - How can we as a community protect and increase healthy green spaces?



# Student Page

## Tall Tree Tales

Circle T (true) or F (false) next to each statement below. Then, next to each statement, write the appropriate symbol(s) to indicate the nature of that statement:

A = Aesthetic, \$ = Economic, E = Ecological, H = Health, and S = Social.

T F 1. Trees increase the natural beauty of an area and make cities more livable.

T F 2. The presence of nature and parks helps ensure regular physical activity, which can reduce the risk of coronary heart disease, hypertension, colon cancer, osteoporosis, arthritis, and diabetes.

T F 3. Seeing green prevents people from being mean (i.e., it lowers their levels of aggression). One study found that apartment buildings with high levels of greenery had 56 percent fewer violent crimes than apartment buildings with little or no greenery.

T F 4. The number of rats increases as tree coverage decreases.

T F 5. More trees and grass in the common spaces of neighborhoods lead to better relationships between neighbors.

T F 6. Trees slow and absorb storm water and reduce runoff, thereby reducing flooding and stream degradation. The job done by trees for free in the Seattle area would cost \$2.4 billion if it were part of a storm water management system.

T F 7. Generally speaking, the larger a park, forest, or nature preserve, the more diverse the species of wildlife and plants it will contain.

T F 8. Prisons that incorporate some element of nature—even just a pleasant view—show higher rehabilitation rates.

T F 9. Trees can lower the temperature of a city by 6–10 degrees. They can thus reduce energy use and even save lives during heat waves.

T F 10. Tree leaves filter air pollutants. In large cities, those green filters are worth tens of millions of dollars in air pollution abatements each year.

T F 11. One acre of trees provides enough oxygen to support 18 people.

T F 12. Green settings can help relieve the symptoms of attention deficit disorder (ADD).

T F 13. Trees can add from 7 percent to 20 percent to a home's value.

T F 14. Habitat fragmentation is the greatest worldwide threat to forest wildlife and the primary cause of species extinction.

T F 15. An average tree can absorb 26 pounds of carbon dioxide (the primary greenhouse gas) each year.

T F 16. Across the nation, our parks, protected rivers, scenic lands, wildlife habitat, and recreational open space help support a \$502 billion tourism industry.

T F 17. Green views and access to green spaces can help urban residents cope with the stresses of daily activities.

T F 18. Patients whose hospital rooms overlook trees require less pain medication and recover more quickly than those whose rooms overlook brick walls.

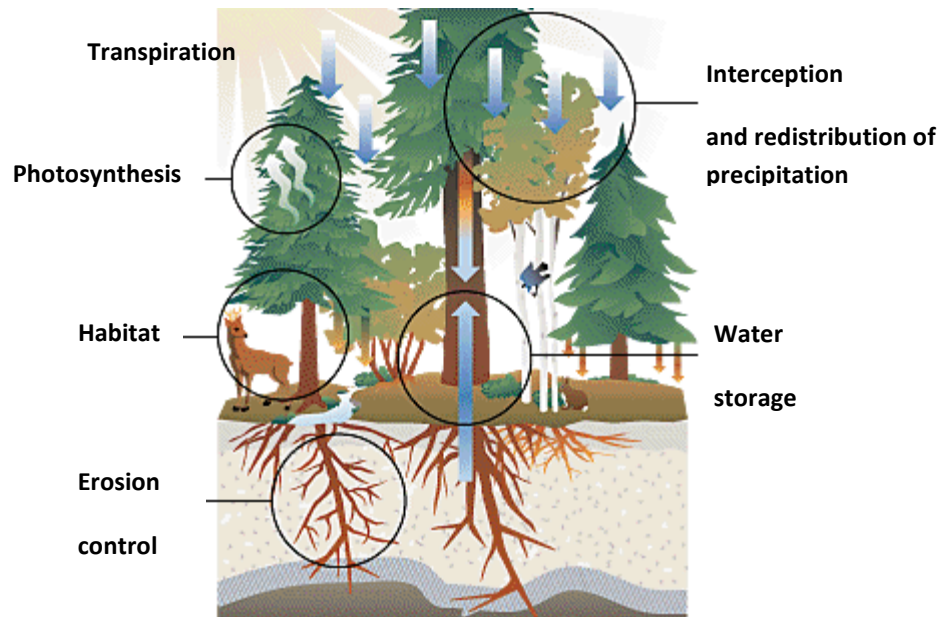
T F 19. New York City avoided spending \$6 billion to \$8 billion for the construction of new water treatment plants by instead spending \$1.5 billion to purchase and protect the upstate watershed that had traditionally accomplished those purification services for free.

T F 20. Tree-lined streets have the effect of reducing driving speeds, thus making neighborhoods safer for bikes and pedestrians.

Sources: American Forests 2005 (E). Carnegie Mellon University 1995 (C). Envision Utah 2003 (E). GreenInfrastructure.Net 2005 (E). Lerner and Poole 1999 (C). Lyman 2002 (E). Maryland Department of Natural Resources 2001 (E). TreeScape 2005 (E). University of Illinois Human-Environment Research Laboratory 2005 (E).



# The Role of Forests in the Water Cycle



Forests provide *habitat* for a wide variety of plants and animals and perform many other important functions that affect humans. *Photosynthesis* is the chemical process in the leaves that uses sunlight and carbon dioxide to produce energy-supplying sugars for the tree. In the process the foliage gives off pure oxygen for breathing. The forest canopy (the treetops) and root systems provide natural filters for the water we use from lakes and rivers. When it rains the forest canopy intercepts and re-distributes precipitation that can cause flooding and *erosion*, the wearing away of topsoil. Some of the precipitation flows down the trunks as *stemflow*, the rest percolates through the branches and foliage as *throughfall*. The canopy is also able to capture fog, which it distributes into the vegetation and soil. Forests also increase the ability of the land to store water. The forest floor can hold as much as five times its weight in water and a tree contains water in its roots, trunk, stems, and leaves. Because of all this stored moisture, forests help to maintain an even flow of water in rivers and streams in times of flood or drought. The roots of the trees and other vegetation hold the soil in place and control erosion from wind and rain, preventing flooding and clouding of streams and rivers.

"The Role of Forests," Microsoft® Encarta® Encyclopedia 99. © 1993-1998 Microsoft Corporation. All rights reserved.





## TREES SERVE AS SPEED BUMPS FOR THE RAIN

Seattle has long been known as the Emerald City for our lush green color. In past decades, however, that green has been fading. Estimates have been made that in the 1970s, 40% of Seattle was covered in trees. Today, Seattle has 23% canopy cover.

Trees are important because they not only provide us shade and oxygen; they also play an important role in slowing the flow of rainwater. As rain falls in Seattle, much of it runs off hard surfaces and into our storm drains and sewers. These systems can become overwhelmed after a hard rain, forcing them to expel raw sewage and other contaminants into our waterways. Seattle's trees slow rain as it falls, helping to avoid such spillage. Trees also absorb water through their roots, helping to soak up standing water in wet areas.

If you've ever been stuck outside in a rainstorm, you know you'll stay dryer if you stand under a tree rather than out in the open. This happens because raindrops are trapped by the tree's branches and leaves. In this way, trees serve as speed bumps for the rain. The more trees Seattle has, the slower rain will enter our stormwater systems.

In the fight to slow the rain, large trees are more effective than small trees. This is because large trees have more surface area on which to capture raindrops. Large evergreen trees are even better, because these trees hold their needles throughout the year, creating a more effective canopy to trap rainwater than deciduous trees that drop their leaves right as our rainy season begins. This means that evergreen trees are capable of reducing stormwater approximately 50% more than deciduous trees.

Recognizing the many benefits of urban trees, Seattle has set tree planting goals as part of its Urban Forest Management Plan. That plan, developed in 2007, is a guide for Seattle to raise tree canopy cover from our current 23% to 30% by 2037. Reaching 30% will require planting approximately 300,000 net new trees. Some of these new trees will be planted on parkland or along streets. Yet there is only so much public space. Sixty seven percent of Seattle is residential property. Therefore, the majority of the new tree planting in Seattle needs to take place on residential property.

The Seattle reLeaf program addresses this need for residential tree planting through initiatives such as the Trees for Neighborhoods program. *Trees for Neighborhoods* encourages planting by giving Seattle residents free trees and workshops on tree care. To ensure these trees survive to maturity, and provide maximum benefits, homeowners are encouraged to plant in fall and water through the first couple summers. More information on Seattle reLeaf can be found at [www.Seattle.gov/trees](http://www.Seattle.gov/trees)

Getting people to plant the large trees that trap the most rainwater can be challenging. Residents usually prefer small trees that fruit and flower, says Jana Dilley, Program Manager at reLeaf. The most popular species in the 2010 *Trees for Neighborhoods* program were dogwood, magnolia, and a fruiting plum tree. Large trees can be difficult to plant in small urban yards, given such factors as space constraints, power line concerns, or views. Dilley said it's important to encourage those who do have enough space to plant large trees. In 2010, *Trees for Neighborhoods'* large tree offerings included shore pine, western red cedar, Douglas fir, katsura, and red oak. As these trees grow and add canopy, we can reduce rainwater runoff and create a greener, more sustainable city.

Trees are important in slowing rainwater but they have many other benefits as well. Trees remove pollutants from the air. Trees along streets calm traffic, leading to fewer accidents. Trees encourage residents to walk outside more, creating healthier residents and communities. Dilley commented "As Seattle's population grows it will take creative thinking to strike a balance between density and open space for trees and greenery."

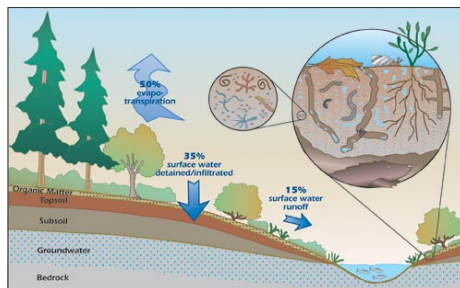
[http://www.seattle.gov/util/groups/public/@spu/@conservation/documents/webcontent/01\\_013145.pdf](http://www.seattle.gov/util/groups/public/@spu/@conservation/documents/webcontent/01_013145.pdf)

## The Soil-Water-Salmon Connection



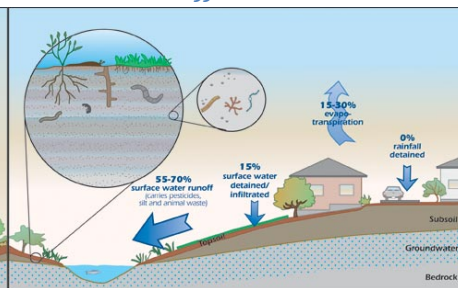
**In native forests around Puget Sound, soil and plants absorb most rainfall** and minimize stormwater runoff. 50% of the rain that falls returns to the sky as "evapo-transpiration" (as tree roots pull water from the soil and it evaporates from leaves and needles). Almost all the rest filters slowly into and through the soil, to feed streams year 'round. But typical development practices remove forests and topsoil, degrading the land's ability to hold and recycle rainwater. After typical development, only 15-30% of rain evaporates, while most rushes swiftly off roofs, roads, and compacted soil (known as "impervious surfaces"). This erodes streams, causes flooding, and carries pollution and sediment, damaging essential habitat for salmon and other aquatic life.

**Native Soil**  
- rain soaks in



[Click image to enlarge.](#)

**After Development**  
- rain rushes off



[Click image to enlarge.](#)

**Native soils and forests are disappearing rapidly in the Puget Sound region.** Conventional development practice has been to strip topsoil during grading, compact the whole site with heavy equipment during construction, and replace only 1-2 inches of soil over the compacted subsoil before landscaping.

**The impacts on salmon, water quality, and streams are well-documented.** Not only are winter peak storm flows much higher, but summer stream flows are much lower because groundwater is non being recharged. Scientists at the University of Washington and elsewhere have documented significant loss of stream health with the first 5-10% of impervious area constructed in watersheds under conventional development practices.



### 3. Healthy Forests, Healthy Waters Field Experience

**Lesson Title:** Invasive Plant ID

**Implementation Time:** 55 minutes

**Resource(s):**

**Materials Needed:** Invasive plant information pages (English ivy, Himalayan blackberry, morning glory, cherry laurel, English holly, Scotch broom, knotweed and lamium/ deadnettle) – at least 5 copies of each for students, ID Cards for the above invasive plants – 5 copies of each card so every group has one of each, Invasive Plant chart, Native/Non-Native/Invasive definition cards, Field Journals

#### Lesson Focus

- ☒ **Content Knowledge:**  
Native and Invasive Plants
- ☒ **Content Skill(s):**  
Identifying Invasive Plants
- ☒ **Thinking Skill(s):**  
Summarizing  
Finding Evidence
- ☒ **Habit(s) of Mind:**  
Thinking and Communicating  
with Clarity and Precision  
Applying Past Knowledge to  
New Situations

**Learner Outcome(s):** What will happen for learners as a result of this lesson?

Students will prepare for the field experience by learning what an invasive plant is and becoming an expert on 1 invasive plant. Students will summarize and analyze the invasive plant's effect on urban forest ecosystems and teach others about the invasive plant.

**Procedure:**

1. Recall what students learned about the goal of the field experience. Remind them that they will be collecting data to assess and improve the health of the forest. Review Healthy Forests PowerPoint from the previous lesson. Present slides 25–46.
2. Recall what students learned previously about native trees. Explain that in order to assess the health of the forest, students will also need to recognize non-native and invasive plants. First, they will need to understand what these terms mean and why they are important.
3. Arrange students in groups of 4. Give each group a set of definition cards. Sets describe either Native, Non-Native, or Invasive plants. Each student should take one of the cards from the group's set.
4. Direct students to share their card with their group. Each group should then generate a short definition/explanation of their category (native, non-native, or invasive) for the class. Have groups share their definitions by writing them on the board or posting sentence strips. Check for accuracy and/or misconceptions.
5. Show the video, "Ivy Out," and/or the slides showing the growth of invasive plants. Discuss the impact of invasive plants and tell students that they will become an expert on one.

*Continued on next page...*



## Healthy Forests, Healthy Waters Field Experience

*Invasive Plant ID, page 2*

### Procedure:

6. Arrange students in pairs. Give each pair of students a different invasive plant to study. They should receive a descriptive sheet about their plant and a plant I.D. card with pictures and information. Tell students that they will become an expert on that invasive plant. Tell students to turn to the Invasive Species data chart on page 6 of their Field Journals. Explain/model how they will summarize the information about their plant on the chart. Though they will work as a pair, each student should fill in their own chart individually for their plant.
7. After students have filled in the row on the chart for their invasive plant, use the Give One/Get One strategy in order for students to learn about other invasive plants. Students should circulate through the room, recording information about other invasive plants until their chart is filled.
8. Explain that students will work to identify invasive plants in the forest as part of their evaluation.
1. **Optional:** Find other invasive weed cards for your forest or area.

[http://www.wnps.org/education/resources/weedid\\_cn.html](http://www.wnps.org/education/resources/weedid_cn.html)

### Closure/Assessment:

Have students record their inference or summary in their journals (page 6):

What negative impact do invasive plants have on the forest ecosystem?





## Invasive Plant Definition Cards

### Invasive Plant Definition

1. Invasive species are non-native species that overruns or outcompetes native species in natural communities or ecosystems and causing ecological, economic, or health problems.

Project Learning Tree [www.plt.org](http://www.plt.org)

### Invasive Plant Definition

2. Invasive plant or animal species that has the ability to significantly displace desirable species or to reduce the yield of growing crops.

Project WILD <http://www.projectwild.org/>

### Invasive Plant Definition

3. Invasive plants are non-native plants that compete with native plants in many ways including: occupying space, changing the structure of the plant community, causing physical and chemical alterations of the soil, and covering and shading native plants. Invasive plants interfere with animal life, too, by altering the structure of their habitat and by eliminating favored food plants through competition.

Native-Native Plant Society  
[http://www.wnps.org/about\\_wnps/native\\_definition.html](http://www.wnps.org/about_wnps/native_definition.html)

### Invasive Plant Definition

4. Invasive plants are non-native plants introduced into Washington State. They spread quickly and can be difficult to control. They invade our croplands, rangeland, forests, prairies, rivers, lakes, wetlands, and estuaries, causing both ecological and economical damage that affects us all.

Parks Canada <http://www.pc.gc.ca/eng/pn-np/ab/waterton/natcul/natcul1/y.aspx>

## Native Plant Definition Cards

### Native Plant Definition

1. A native species is a plant or animal that occurs naturally in a certain area or habitat. Because it evolved in that area over time, it typically co-evolved with other species that served to keep its population in check through predation, competition, or disease.

Project Learning Tree [www.plt.org](http://www.plt.org)

### Native Plant Definition

2. Native species; a plant or animal species that produced, grew, or originated in a certain region.

Project WILD <http://www.projectwild.org/>

### Native Plant Definition

3. Washington native plants are those species that occur or historically occurred within the state boundaries before European contact based upon the best available scientific and historical documentation.

Native-Native Plant Society

[http://www.wnps.org/about\\_wnps/native\\_definition.html](http://www.wnps.org/about_wnps/native_definition.html)

### Native Plant Definition

4. Generally a native plant is one that was in a land before explorers brought new plants. The definition of a native plant in Washington State is a native plant that was here before the first explorers arrived in the 1700's, therefore, 300 years ago.

## Non-Native Plant Definition Cards

### Non-Native Plant Definition

1. Non-native species are ones that have been introduced or moved by human activities to an area where they do not naturally occur. A non-native species is not necessarily harmful and some non-natives are beneficial (e.g., apple trees).

Project Learning Tree [www.plt.org](http://www.plt.org)

### Non-Native Plant Definition

2. Non-native; an organism that has been introduced into a new area.

Project WILD <http://www.projectwild.org/>

### Non-Native Plant Definition

3. A plant species which has not lived in a particular region for thousands of years, but has moved in from another region, usually within the past 250 years

Native-Native Plant Society  
[http://www.wnps.org/about\\_wnps/native\\_definition.html](http://www.wnps.org/about_wnps/native_definition.html)

### Non-Native Plant Definition

4. When plants are moved from their natural range to new ecosystems, they are considered to be non-native.

Parks Canada <http://www.pc.gc.ca/eng/pn-np/ab/waterton/natcul/natcul1/y.aspx>

## Invasive Species

Species and Where it Came From	Why/How Did it Get Here?	Characteristics Helping it Thrive	Effects on Ecosystem	Removal

# English Ivy

## Native to:

- Europe, Western Asia and Northern Africa

## How did it get to the United States?

- It was most likely brought to the U.S. by European immigrants.
- English ivy (4 types) has been intentionally sold and planted as an ornamental/decorative plant. It is popular because it is an evergreen and provides year-round cover.

## Where does it grow?

- Throughout Washington State
- Because ivy has been so widely planted, it has spread throughout the Pacific Northwest and has shown up even in some fairly remote and pristine forests.

## Characteristics and Impacts:

- English ivy contains slightly toxic compounds. The sap can cause dermatitis and blistering in some people.
- Because English ivy is evergreen and well-adapted to the mild Pacific Northwest climate, it grows all year round in western Washington and can out-compete many other plant species (that don't grow all year round).
- Stems are sturdy and do not have thorns.
- The roots are strong, but do not grow very deep. As a result, thick mats of ivy that cover hillsides can increase problems with erosion and landslides as water runs down under the ivy. Entire mats of ivy and soil can slide downhill.
- Older vines can be tree-like, as much as five to twelve inches thick, and can reach over 90 feet long.
- Ivy spreads outward through its long vines that grow roots at the nodes (small bumps on the vine). The vines form small rootlets that have a glue-like substance that attaches to any surface so they can climb anything.
- Ivy can create thick mats by covering everything around it. These mats crowd out native plants such as wildflowers, ferns and young trees (no light can reach the ground and the roots have no space to grow).
- The extremely thick mats of ivy also provide homes and hiding places for pest animals, such as the Norway rat.
- When an ivy plant matures, it begins to produce berries. (Ivy can take many years to mature.)



- The seeds in the berries are eaten and distributed mostly by birds such as starlings, European house sparrows, band-tailed pigeons, robins and cedar waxwings. (However, the berries have been reported to be poisonous to some birds.)
- English ivy can grow in the sun or shade and is adapted to a wide range of soil types. So, it can grow easily almost everywhere seeds are dropped.
- Ivy plants take water and nutrients away from other plants.
- When English ivy is allowed to grow up tree trunks it can increase the risk of the trees being blown over in windstorms because the large amount of thick ivy creates a “sail” in the tops of the trees.
- Tree bark is more likely to have disease and rot problems and the tree health can be damaged when ivy covers a tree. Thick ivy growth reduces the amount of light and air that reach the tree. (Diseases and rot grow well in darker, damp areas.)
- On walls and fences, ivy rootlets dig into the wood and mortar and can cause structural damage.

### **How it is being managed/controlled/eliminated:**

- Physical removal of English ivy vines and roots is often the most effective method of control. Gloves (and sometimes even goggles) should be worn.
- Hand-pulling combined with loosening the soil with a shovel, pulaski (looks like a skinny axe) or weeding fork will work well when removing most stands of ivy.
- Older plants have thick, woody stems and roots and will require more effort to remove. However, older stems also will not re-sprout as much so leaving some root behind is probably not a problem.
- Ivy growing up tree trunks can be controlled by removing all the vines from the lower trunk of the tree because the upper vines will die if they are not rooted in the ground.
- After ivy is removed, the area should be mulched or planted to help prevent a re-invasion by ivy or other weeds. (But the area should be checked in the spring for new ivy growth.)
- Foliar treatment – spraying chemicals on the leaves – is not as easy and often less effective, mainly because the leaves are thick and waxy. However, if removing ivy from a large area, other options can be considered, such as other types of chemical control.

#### **Credits**

<http://www.kingcounty.gov/environment/animalsAndPlants/noxious-weeds/weed-identification/english-ivy.aspx>  
[http://www.wnps.org/education/resources/weedid\\_cn.html](http://www.wnps.org/education/resources/weedid_cn.html)



# English Holly

## Native to:

- English holly is native from the British Isles (including England, Wales, Scotland and Ireland) to southern and central Europe
- English holly is considered by some as naturalized in Washington. A naturalized plant is a plant that is established (commonly found) in an area where it did not originally exist.

## How did it get to the United States?

- It is grown commercially (for profit) in the Pacific Northwest and commonly used in decorations and floral arrangements as well as in landscapes (yards, building grounds).

## Where does it grow?

- Holly is frequently found in the understory of forests in Western Washington (even in forests far away from human activity).
- Grows in shade or sun in well drained soil. (It is well suited to Western Washington's climate and soils)

## Characteristics and Impacts:

- English holly is a large, dense (thick), and slow-growing, evergreen tree or shrub.
- It can grow either a single-trunked tree or a multi-stemmed thicket (bunch of bushes) and get to be 15 to 50 feet tall and up to 15 feet wide or more.
- Leaves usually have sharp, sturdy spines along the edges (although leaves may be smooth on older branches).
- When English holly grows, the branches and leaves block any incoming sunlight, which creates very dark shade underneath it.
- Flowers are small, whitish, not easily seen and sweetly scented.
- English holly plants must be pollinated by bees to produce seeds.
- Holly uses a lot of water to grow and can take moisture away from plants around it.
- In the winter, the female English holly plants have bunches of red, yellow or orange berries, that are poisonous to people but not to birds.





- English holly berries are eaten and carried by birds into forests where it can form dense thickets that take over the tall shrub layer and prevent the growth of native tree and shrub species.
- Also spreads from spreading roots or branches or stems that get buried by soil and begin to root.

### **How it is being managed/controlled/eliminated:**

- English holly is not officially considered a noxious weed. It is called a “Weed of Concern”. Because of this, landowners don’t have to control or remove it.
- Small plants can be pulled or dug up when soil is moist.
- Weed wrenches (a tool that pulls out plants) can be used on larger shrubs to pry up the entire plant. Bigger plants have deep and spread out roots, so digging can be a lot of work and can really tear up the ground.
- English holly can be cut off at the base of the “trunk”, but the plant usually re-sprouts. If this is watched and continually cut, it can keep holly from spreading.

### **How it is being managed/controlled/eliminated, continued:**

- Putting herbicide (chemicals that kill certain plants) on the cut off stump or a frilled trunk (cut all the way around the trunk with an axe in a downward motion) of a holly plant are the most effective ways of killing holly.
- Spraying herbicide on the leaves is not very effective because the leaves are thick and waxy leaves. .
- Removing small plants/early growth as soon as possible can help prevent holly from taking over an area.
- One of the best ways to control English holly is to avoid buying or planting it.

#### **Credits**

<http://www.kingcounty.gov/environment/animalsandplants/noxious-weeds/weed-identification/english-holly.aspx>

<http://your.kingcounty.gov/dnrp/library/water-and-land/weeds/Brochures/English-Holly-Fact-Sheet.pdf>

[http://www.mo.nrcs.usda.gov/technical/forestry/out/controlling\\_undesirable\\_info\\_sheetfinal1\\_06.pdf](http://www.mo.nrcs.usda.gov/technical/forestry/out/controlling_undesirable_info_sheetfinal1_06.pdf)

<http://biology.burke.washington.edu/herbarium/imagecollection.php?Genus=Ilex&Species=aquifolium>



# Himalayan Blackberry

## Native to:

- Armenia and southwest Asia
- It is naturalized in many other parts of the world, including Washington State. A naturalized plant is a plant that is established (commonly found) in an area where it did not originally exist.

## How did it get to the United States?

- It was first brought to Europe in the early 1800's.
- It was then introduced to North America in 1885 by Luther Burbank as the "Himalaya Giant". It became established on the west coast by 1945.

## Where does it grow?

- It is widespread throughout the Pacific Northwest.
- Blackberry can be found in a myriad of habitats such as vacant lands, pastures, forest plantations, roadsides, creek gullies, river flats, riparian areas (along rivers and the edges of wetlands), fence lines, and right-of-way corridors.

## Characteristics and Impacts:

- Himalayan blackberry is a strong, sprawling plant with stems that have large stiff thorns.
- It is different from the native plant - trailing blackberry. Unlike the low-growing native plant, Himalayan blackberry has tall, arching reddish-brown canes, much more robust plants, rounder leaflets and larger fruits and flowers
- Himalayan blackberry's main canes (the parts of the plant that look like vines) can get up to 10-15 feet tall and the trailing canes (the ones that spread out) can grow up to 40 feet long.
- The trailing canes typically grow roots at the tips, creating new plants called "daughter plants".
- Individual plants can reach a density of 520 canes per square meter. That means if you put a wooden or plastic square that was a meter long and a meter wide down on the ground, 520 blackberry canes would fit inside.
- Because blackberry plants can grow in thick bunches, it blocks out the sunlight for young or low-growing plants. As a result, it creates a monoculture (an area with just one type of plant) and displaces (kicks out) native and beneficial (helpful) plants. In other words, it completely takes over areas where native and beneficial plants should grow.



## Himalayan Blackberry, page 2

- Thick areas of blackberry can also prevent or limit the movement of large animals, keeping them from reaching water sources or other food sources.
- Flowers range in color from white to pink and bloom in the spring.
- In mid-summer to early August, it has an edible black fruit. (Many people believe it is a tasty fruit.)
- Seeds can remain in the soil for several years and then begin to grow.
- In addition to seeds, new plants can grow from roots or buried stem fragments (pieces).
- Himalayan blackberry is a perennial – it dies back with colder temperatures, but begins to grow when the temperatures warm up.
- Blackberry roots do not grow very deep. As a result, riversides covered with blackberry often have problems with damaged banks and erosion (the loss of soil).

### How it is being managed/controlled/eliminated:

- Himalayan blackberry can be very difficult to control.
- The best way to get rid of blackberry is to use a variety of methods over several years.
- Blackberry can be controlled by digging it up, mowing over it, spraying herbicide (chemicals that kill plants), plowing, and/or livestock grazing (especially goats).
- If the top of a blackberry plant is removed repeatedly, by mowing, cutting or grazing with goats, will eventually kill the plant if it is done regularly and over several years.
- Cutting the top of the plant off and then digging up main root does a better job at getting rid of the blackberry plant than just cutting it.
- Blackberry can be controlled with herbicides, but the chemicals can harm the user and the environment.

### Credits

<http://www.kingcounty.gov/environment/animalsAndPlants/noxious-weeds/weed-identification/blackberry.aspx>  
<http://your.kingcounty.gov/dnrp/library/water-and-land/weeds/BMPs/blackberry-control.pdf>  
[http://www.nwcb.wa.gov/weed\\_info/written\\_findings/CLASS%20C%20PDFs/Draft%20Written%20Findings%20for%20Rubus%20armeniacus.pdf](http://www.nwcb.wa.gov/weed_info/written_findings/CLASS%20C%20PDFs/Draft%20Written%20Findings%20for%20Rubus%20armeniacus.pdf)  
[http://en.wikipedia.org/wiki/Rubus\\_armeniacus](http://en.wikipedia.org/wiki/Rubus_armeniacus)  
[http://www.scn.org/cedar\\_butte/cb-himal.html](http://www.scn.org/cedar_butte/cb-himal.html)  
[http://www.wnps.org/education/resources/weedid\\_cn.html](http://www.wnps.org/education/resources/weedid_cn.html)



# Morning Glory

## **Native to:**

- Europe

## **How did it get to the United States?**

- Probably brought as a garden plant.

## **Locations in Washington where it is invasive:**

- It can grow in a variety of conditions from full sun to full shade and is adapted to dry summers.
- Found in wet areas, greenbelts, forested parks, and farmlands as well home gardens.
- Grows all over the United States

## **Characteristics and Impacts:**

- Can grow in full sun to full shade
- Is drought tolerant
- Fast growing-can climb as much as 9 feet from one rhizome
- Deep rooted vine grows along ground until contact with a structure then climbs aggressively
- Reproduces vegetatively from roots, rhizomes, stem fragments and by seeds that can last over 40 years.
- Roots form mats underground in all directions
- Roots can grow down to 5 meters deep in soil
- Out-competes native plants replacing them
- Stems grow quickly from rhizomes covering and smothering other vegetation
- Especially a problem in disturbed wetland areas
- Extremely difficult to get rid of once it has taken over an area
- Reduces crop production in fields by up to 60%
- Threatens restoration by being able to out compete new plantings



### How it is being managed/controlled/eliminated:

- Removal needs to continue over several years
- Prevent seed production by removing young plants
- Do not compost in backyard as small stems can re-sprout. (City compost is okay, or put in plastic bags and put in garbage.)
- Do not dig around where there are a lot of morning glory roots as small fragments will re-sprout.
- Repeated hand pulling in spring works, but must be done over several years.
- Smother plants mulch, black plastic or plastic mats, but again must cover for several years and be checked for sprouts along edges and through cracks
- Cutting this plant does NOT work
- Herbicides can work and should be painted/brushed on leaves. Again, must be repeated
- Plant other plants to become established in area once plants removed

### Credits

[http://your.kingcounty.gov/dnrp/library/water-and-land/weeds/Brochures/Bindweed\\_factsheet.pdf](http://your.kingcounty.gov/dnrp/library/water-and-land/weeds/Brochures/Bindweed_factsheet.pdf)

<http://www.colostate.edu/Depts/CoopExt/Adams/weed/bindweed.html>

<http://www.agf.gov.bc.ca/cropprot/weedguid/bindweed.htm>



# Cherry Laurel

## **Native to:**

- Asia Minor and southeastern Europe

## **How did it get to the United States?**

- Probably brought to this country as a garden and landscape plant.

## **Locations in Washington where it is invasive:**

- Urban forests in King County.
- Second most common invasive tree species in King County (67% of study plots)
- Naturalized in Washington, Oregon, British Columbia, and California
- In Washington most common west of the Cascades.

## **Characteristics and Impacts:**

- Tall and grows in bunches
- 10–30 feet tall and grows very fast up to 30 cm per year
- Wilted leaves, stems, and seeds are poisonous (may kill you if eaten).
- Second most common invasive tree species in King County (67% of study plots) with average of 46 stems/acre
- Reproduces through seeds spread by birds and other animals
- New plants also grow when stems touch the ground
- When cut laurel will re-sprout from the roots and cut stems
- Grows in sun or shade
- Grows in moist or dry soils, but does best in moist, well drained soils
- Out competes native forest species particularly tree seedlings and native shrubs
- Could replace native canopy trees over time
- Thrives in our climate and could become a threat to urban forests



### How it is being managed/controlled/eliminated:

**Note:** This plant is slightly irritating so where gloves when working or being clipped by students.

- Dig up small plants by hand or weed wrench (use gloves as plant is poisonous)
- Clip plant before flowering or remove spent flowers so no fruit can form
- Trees can be girdled by stripping a small section bark and cambium which should kill the tree
- Large trees require cutting trunks and large branches by hand or chainsaw as close to the ground as possible.
- Stems should be chipped and used as mulch
- After cutting plants are likely to re-grow. Five options for dealing with re-growth
  1. Dig out stumps, turn over, replant
  2. Monitor stem growth and cut any new growth over several years until tree stops sending up new sprouts
  3. Immediately after cutting tree down treat with herbicide (glyphosate or triclopyr)
  4. Chip notches around the trunk and apply herbicide or inject trunk with herbicide
  5. Spray re-growth with herbicide

#### Credits

<http://www.kingcounty.gov/environment/animalsAndPlants/noxious-weeds/weed-identification/english-laurel.aspx>

[http://www.evergreen.ca/docs/res/invasives/cherry\\_factSheet.pdf](http://www.evergreen.ca/docs/res/invasives/cherry_factSheet.pdf)





# Scotch Broom

## Native to:

- British Isles

## How did it get to the United States?

- It was introduced as decorative (ornamental) plant for people's yards and was also used for erosion control along roadsides.

## Where does it grow?

- Can be found throughout most of Washington, with massive amounts along the coastal region.
- Frequently found on roadsides, pastures, open areas, and areas of recent soil disturbance.

## Characteristics and Impacts:

- Also called Scotch broom.
- It is in the pea family.
- It is a big fire hazard.
- Scot's broom is a legume, so it does not need nitrogen to grow. It grows quickly in places where native plants grow more slowly (because most plants need nitrogen to grow).
- It produces many seeds.
- Its seeds are hard-coated and 1 seed can last 50 to 80 years. They are toxic (poisonous) to livestock (cows, goats, sheep) and horses.
- It aggressively spreads to create a monoculture (an area with just one type of plant) and displaces (kicks out) native and beneficial (helpful) plants. In other words, it completely takes over areas where native and beneficial plants should grow.
- Scot's broom causes a considerable loss of grassland and open forest, growing where grasses animals use for food and young trees should be growing.
- Because fewer types of plants are able to grow in areas where Scot's broom takes over, fewer animals are able to live in the area. (Scot's broom invasions create a loss of wildlife habitat, which results in less wildlife.)



### How it is being managed/controlled/eliminated:

- It is difficult and expensive to get rid of Scot's broom and it requires a long-term plan – over several (many) years.
- Fire causes the seeds to germinate (grow) faster, so controlled burning and then removal of young plants is being used in some areas to get rid of Scot's broom.
- Ways to remove actual plants: hand pulling, digging up plants. In flat areas, chopping, cutting or mowing can be done. Cutting the plants is recommended if herbicide (poison that kills plants) is going to be applied.
- Letting goats feed on Scot's broom can be a cost effective (affordable) method for controlling the plant.

### Credits:

<http://www.wnps.org/education/resources/index.html>

[http://www.nwcb.wa.gov/weed\\_info/Cytisus\\_scoparius.html](http://www.nwcb.wa.gov/weed_info/Cytisus_scoparius.html)

<http://www.kingcounty.gov/environment/animalsAndPlants/noxious-weeds/weed-identification/scotch-broom.aspx>

[http://www.wnps.org/education/resources/weedid\\_cn.html](http://www.wnps.org/education/resources/weedid_cn.html)



# Japanese Knotweed

## Native to:

- Asia: Japan, China and Korea

## How did it get to the United States?

- It was brought over in the late 1800s.
- Asian cooks grew the plants in logging camps as food sources.
- It has been planted as an ornamental (decorative) plant in gardens, for erosion control and as food plants (forage) for livestock (such as cows).

## Locations in Washington where it is invasive:

- It can grow in a variety of difficult conditions including full shade, high temperatures, high levels of salt in the soil (salinity) and dry areas.
- Grows best in open, sunny, and moist areas where the typical temperatures are not extremely hot or extremely cold (temperate climate).
- Knotweed will grow along or in: stream banks; disturbed areas such as old gardens, roadsides or railroad right-of ways; and flood zones.

## Characteristics and Impacts:

- The most common [type of knotweed](#) in western Washington is the Bohemian Knotweed, which is a cross between the Japanese and Giant knotweeds.
- These three types of knotweed are known by many different names, including: Elephant Ear Bamboo, Mexican Bamboo, Donkey Rhubarb, Outhouse Weed
- It grows quickly. It can grow 6 feet in only 4 weeks.
- Knotweed plants typically grow to be between 4 and 12 feet tall.
- Knotweed roots can grow 7 feet deep and 30 feet from the base of the plant.
- If not controlled, it can grow to have 30,000 stems (plants) per acre.
- The plant can grow through cement – damaging sidewalks, the foundations of homes and buildings and other structures
- Grows from seeds or small pieces of the plant. Cut or broken stems will root if in moist soil or water.
- It can be spread by humans, animals and weather (floods).
- It has no known natural enemies: no wild organisms (animals) eat or kill it.
- Knotweed crowds out native plants and keeps them from growing where they belong. For example, knotweed can keep native plants from growing along creeks, increasing the chances of erosion along the sides.



## Japanese Knotweed, page 2

- The stems of the plant die and fall over at the end of the growing season. This can clog small waterways such as creeks.
- Knotweed contains a chemical called oxalic acid which can make health problems such as arthritis and kidney stones worse.
- Knotweed is used by some people:
  - The young stems are eaten as a vegetable. They taste like mild rhubarb.
  - It is grown and used to create a nutritional supplement (vitamin).
  - It is a traditional medicinal treatment (medicine that has been used for hundreds of years) in China and Japan. The roots of the Japanese knotweed are used as a natural laxative.
  - Some beekeepers like knotweed because it has flowers the bees can use to make honey when other plants don't.

### How it is being managed/controlled/eliminated:

- It takes a long time to remove stands (groups of plants) of knotweed. It is a many-year effort.
- Young plants can be pulled when the soil is soft, but every part must be removed.
- Chemicals called herbicides (chemicals that kill plants) can be used to control or kill knotweed, but people have to be careful with these poisons near water; and knotweed tends to grow near water.
- Cutting the plants over and over, year after year can sometimes help stop the plants from growing and spreading. Although sometimes, cutting causes the plant to grow more.
- Goats can be helpful in keeping knotweed from growing by eating the plants repeatedly. But, once the goats are removed, the plants grow back.
- Some research is being done on several types of insects and fungus infections that have kept knotweed from taking over too much space in Japan.
- The most common way to remove large sections of knotweed is by both cutting and putting herbicides on the plant.

#### Credits

<http://www.kingcounty.gov/environment/animalsandplants/noxious-weeds/weed-identification/invasive-knotweeds/bohemian-knotweed.aspx>  
[http://www.na.fs.fed.us/fhp/invasive\\_plants](http://www.na.fs.fed.us/fhp/invasive_plants)  
<http://www.invasivespeciesinfo.gov/plants/knotweed.shtml>  
<http://www.naturalbiodiversity.org/biobullies/japanese%20knotweed.shtml>  
<http://www.naturalbiodiversity.org/biobullies/downloads/Japanese%20Knotweed.pdf>  
[http://en.wikipedia.org/wiki/Japanese\\_knotweed](http://en.wikipedia.org/wiki/Japanese_knotweed)  
[http://www.wnps.org/education/resources/weedid\\_cn.html](http://www.wnps.org/education/resources/weedid_cn.html)



# Yellow Archangel (Lamium)

## Native to:

- Europe and Asia and probably introduced to North America for ornamental use

## How did it get to the United States?

- Grown and sold as an ornamental because the silver green leaves and dense, sprawling growth make it ideal for hanging baskets and shady places.
- Spreads quickly from yards into forested sites and ravines.

## Where does it grow?

- Yellow Lamium is frequently found in dense mats covering the forest floor
- Grows in ravines, greenbelts and forested parks throughout Western Washington
- This commonly used landscape plant is very competitive and fast-growing in the forest habitats of western Washington

## Characteristics and Impacts:

- Can grow in a wide range of conditions from full sun to full shade
- Leaves are typically variegated with silvery-grey markings and are oval-shaped and toothed.
- Stems are square, leaves are opposite.
- Fast-growing perennial ground cover that may be either trailing or upright depending on conditions.
- Flowers are small, yellow and tubular; they grow in pairs of clusters
- Outcompetes native plant species and provides poor food and shelter for native wildlife.
- Spreads by stem fragments, rooting at nodes, and by seed.
- Grows well in a variety of soil types from sandy to heavy clay
- Spreads readily from cuttings and root fragments.
- It prefers moist soil but can also tolerate dry shady sites and drought.
- Plants also produce numerous seeds per stem



## Yellow Archangel (Lamium), page 2

### How it is being managed/controlled/eliminated:

- Prevention: Avoid planting near parks and natural areas or choose a different ground cover.
- Because yellow archangel spreads readily by stem cuttings, it is very important to discard plant material in such a way as to prevent spreading. Never dump clippings in parks or natural areas.
- Roots are not deep so plants can be hand-pulled.
- To fully remove, plants must be pulled up by the roots, being careful to remove all root and stem fragments. This is easiest to do fall through early spring.
- Dense infestations could probably be controlled by sheet-mulching although there is no information on this.
- Herbicides can be effective on yellow archangel, especially if combined with manual control and monitoring for surviving plants. Take care to avoid native vegetation by selectively spot-spraying.

### Credits

[http://www.shim.bc.ca/invasivespecies/\\_private/yellowarchangel.htm](http://www.shim.bc.ca/invasivespecies/_private/yellowarchangel.htm)


<http://www.kingcounty.gov/environment/animalsAndPlants/noxious-weeds/weed-identification/yellow-archangel.aspx>

<http://your.kingcounty.gov/dnrp/library/water-and-land/weeds/Brochures/Neighborhood-Bullies.pdf>








*General: Evergreen woody perennial; up to 40' vines*




Seedlings


Young leaves




Form: Spreading and climbing vines



Vines engulfing a tree



Berries and mature leaves



**Management Strategies**

- Non-designated noxious weed
- Always remove
- Thick roots and stolons: remove all fragments; cut large roots at base of trees
- Primary spread: Stolons, roots, seed
- Note: Aggressive strong root system, tolerates deep shade, will dominate and kill large trees


*Check with parks department or school district for proper disposal*

**English Ivy**  
*Hedera helix*  
A Non-native Plant



WPGS: 130

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*General: Evergreen woody perennial; up to 40' vines*




Seedlings


Young leaves




Form: Spreading and climbing vines



Vines engulfing a tree



Berries and mature leaves



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**English Ivy**  
*Hedera helix*  
A Non-native Plant

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## **Extension Lesson 3-WORST WEED Lesson-Teaching Others**

**Overview:** Students will create a sign, skit, poster, video, brochure, or other presentation to inform the public about invasive plants in urban forests.

**Materials:** 1. Invasive Plant information sheets-one for each student English ivy, Himalayan blackberry, cherry laurel, English holly, and morning glory-bindweed, Scot's broom and knotweed extra. Each group gets one type of plant, but need copies for individuals. 2. Copies of graphic organizer. 3. Rubrics check list for signs/presentations.

1. Students learned about invasive species and their negative impacts on urban forests in the invasive plant identification lesson. Now is a chance for students to pick one of the invasive plants as the Worst Weed and defend their position.
2. Give students the assignment that they are to become the "agent" for a particular invasive plant. As the "agent," each student (or student team) must research and create a persuasive piece (speech or commercial - this is the teacher's choice) to convince students in another class (or classes) at the school or a different school (such as younger students at an elementary school) that THEIR weed is the WORST. After presentations, a vote can be taken to determine the Worst Weed.
3. Students are broken up into groups or work individually. Each group (individual) is assigned one of the 8 invasive plants.
4. Students use graphic organizer to summarize knowledge from Invasive plant cards, and their field experience to create a Worst Weed persuasive sign, skit, poster, video, or other presentation. Students need to use visuals in their product.
5. Students present their Worst Weed persuasive piece. Video taping is an excellent way to share skits and presentations with others. This could be a presentation to younger school students.
6. Students, staff, or another class vote on which weed is the WORST or decide which sign should be made into a sign in the forest.

**Teacher Note:** Designing interpretive signs lesson from Stilly Snohomish Task Force for more information about making interpretive signs -and examples are given.

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**BASIC INFORMATION  
AND POSITION**

(Plant name, where it's from and w  
you want people to believe)

**Give reasons why it is threat to Urban  
Forests**

**What can be done about the invasive plant**

**CONCLUSION**

(Restate your position in a  
different way.)

**CONCLUSION**

# BASIC INFORMATION AND POSITION

(Plant name, where it's from and what  
you want people to believe)

## REASONS

(Why should they believe it?)

## SUPPORT

(Facts, examples, quotes,...)

## CONCLUSION

(Restate your position in a  
different way.)

## CONCLUSION



## Forest "Worst Weed" skit or oral presentation Contest

Points for presentation for "Worst Weed" contest	Points
Has a clear beginning, middle, and end to presentation	1
Gives plant name and where it is from	1
Gives 3 reasons why it is the worst weed or is a threat to Seattle Park Forests (1 point for each reason)	1-3
Supports reasons with further data or quotes (1 point for each supporting data or quotes)	1-3
Restates position at least once	1
Speaks clearly	1
Makes eye contact with audience:	1
All members of team had a role	1
<b>Total</b>	<b>8-12</b>

**Note:** Could use without points to give to students as a check list.

## Forest "Worst Weed" Sign

Points for Sign for "Worst Weed" contest	Points
Clear Title	1
Gives plant name and where it is from	1
Gives reasons why it is threat to Seattle Park Forests (1 point for each reason)	1-3
Supports reasons with further data or quotes (1 point for each supporting data or quotes)	1-3
Gives information about what can be done about the invasive plant (1 point for each way)	1-2
Uses visuals to get message across	1
Graphics and lettering are clear and neat	1
All members of team had a role	1
<b>Total</b>	<b>8-12</b>

**Note:** Could use without points to give to students as a check list.

# WANTED

## DEAD!



### Morning glory

This plant is a fast growing vine than can form dense, tangled mats. It has white funnel-shaped flowers.

**These invasive species are wanted for threatening our native ecosystems by spreading into our streams, rivers and forests, and jeopardizing salmon and other wildlife that live in these habitats.**

### What you can DO:

**Look for these invasive plants in your communities and work with others to remove them. Call (425) 252-6686 for more information.**

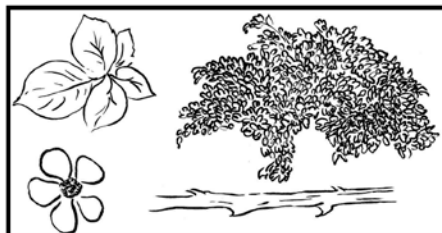


### Japanese knotweed

This plant can resprout from a tiny part of its stem that gets washed downstream. It can grow to over 15 feet tall, and has stalks that resemble bamboo. It spreads along water edges and threatens salmon, that need shade.

### Himalayan blackberry

This common invasive plant has thorns and edible blackberries, which are often spread by birds. It forms large clumps and chokes out other plants.



### English ivy

This is an evergreen vine that is common in urban areas, often seen growing on the ground or climbing up trees.

### What are Invasive Species?

**They are living things that are from a foreign place, often brought here by people, that have escaped from human control and are spreading. Invasive plants rapidly multiply and overwhelm native plants, and can harm animals and other organisms by disrupting food chains. Invasive species are a leading cause of why native species are listed under the Endangered Species Act.**

Sign designed by Mrs. Strickland's 2005-6 seventh grade honors biology class at Centennial Middle School in Snohomish

Sign sponsored by Washington State's Office of the Superintendent of Public Instruction

For more information, contact the Stilly-Snohomish Task Force at (425) 252-6686

## **Lesson 7-WORST WEED Lesson-Teaching Others**

**Overview:** Students will create a sign, skit, poster, video, brochure, or other presentation to inform the public about invasive plants in urban forests.

**Materials:** 1. Invasive Plant information sheets-one for each student English ivy, Himalayan blackberry, cherry laurel, English holly, and morning glory-bindweed, Scot's broom and knotweed extra. Each group gets one type of plant, but need copies for individuals. 2. Copies of graphic organizer. 3. Rubrics check list for signs/presentations.

1. From the planning and removing invasive plants students learned about invasive species and their negative impacts on urban forests.
2. Give students the assignment that they are to become the "agent" for a particular invasive plant. As the "agent," each student (or student team) must research and create a persuasive piece (speech or commercial - this is the teacher's choice) to convince students in another class (or classes) at the school or a different school (such as younger students at an elementary school) that THEIR weed is the WORST. After presentations, a vote can be taken to determine the Worst Weed.
3. Students are broken up into groups or work individually. Each group (individual) is assigned one of the 5 (7) invasive plants.
4. Students use graphic organizer to summarize knowledge from Invasive plant cards, and their field experience to create a Worst Weed persuasive sign, skit, poster, video, or other presentation. Students need to use visuals in their product.
5. Students present their Worst Weed persuasive piece. Video taping is an excellent way to share skits and presentations with others. This could be a presentation to younger school students.
6. Students, staff, or another class vote on which weed is the WORST or decide which sign should be made into a sign in the forest.

**Teacher Note:** Designing interpretive signs lesson from Stilly Snohomish Task Force for more information about making interpretive signs -and examples are given.

:



**BASIC INFORMATION  
AND POSITION**

(Plant name, where it's from and w  
you want people to believe)

**Give reasons why it is threat to Urban  
Forests**

**What can be done about the invasive plant**

**CONCLUSION**  
(Restate your position in a  
different way.)

**CONCLUSION**

# BASIC INFORMATION AND POSITION

(Plant name, where it's from and what  
you want people to believe)

## REASONS

(Why should they believe it?)

## SUPPORT

(Facts, examples, quotes,...)

## CONCLUSION

(Restate your position in a  
different way.)

## CONCLUSION



## Forest “Worst Weed” skit or oral presentation Contest

Points for presentation for “Worst Weed” contest	Points
Has a clear beginning, middle, and end to presentation	1
Gives plant name and where it is from	1
Gives 3 reasons why it is the worst weed or is a threat to Seattle Park Forests (1 point for each reason)	1-3
Supports reasons with further data or quotes (1 point for each supporting data or quotes)	1-3
Restates position at least once	1
Speaks clearly	1
Makes eye contact with audience:	1
All members of team had a role	1
<b>Total</b>	<b>8-12</b>

**Note:** Could use without points to give to students as a check list.

## Forest “Worst Weed” Sign

Points for Sign for “Worst Weed” contest	Points
Clear Title	1
Gives plant name and where it is from	1
Gives reasons why it is threat to Seattle Park Forests (1 point for each reason)	1-3
Supports reasons with further data or quotes (1 point for each supporting data or quotes)	1-3
Gives information about what can be done about the invasive plant (1 point for each way)	1-2
Uses visuals to get message across	1
Graphics and lettering are clear and neat	1
All members of team had a role	1
<b>Total</b>	<b>8-12</b>

**Note:** Could use without points to give to students as a check list.

## 4. Healthy Forests, Healthy Waters Field Experience

**Lesson Title:** Field Investigation Virtual Lab

**Implementation Time:** 55 minutes

**Resource(s):** Healthy Forests PowerPoint, Tree-iage Analysis page from GSP booklet

**Materials Needed:** Map of park, Plant ID cards – one set per group or laminated pages (evergreen trees - Douglas-fir, Western hemlock, red cedar, grand fir, and madrona), from lesson 4 Invasive plant ID cards – one set for each group (Himalayan blackberry, English ivy, morning glory, cherry laurel, and English holly), stakes/flags for study plots, Two-foot squares for each group, photos of % canopy cover – one for each group, two strings 37.2 feet long for each group with one marked with 1 foot increments, compass, data sheets, measuring tapes, Field Journals

### Lesson Focus

- ☒ **Content Knowledge:**  
Inquiry Science  
Forest Health Indicators
- ☒ **Content Skill(s):**  
Data Collection  
Investigation Protocols
- ☒ **Thinking Skill(s):**  
Observing  
Summarizing  
Finding Evidence  
Predicting
- ☒ **Habit(s) of Mind:**  
Thinking Interdependently  
Striving for Accuracy  
Gathering Data through the Senses

### **Learner Outcome(s): What will happen for learners as a result of this lesson?**

Students will plan and conduct 3 investigations in order to perform the Tree-iage analysis of their area of the Forest site or the entire forest site. Students view **PowerPoint of the protocols** for the 3 field investigations and review procedures in their journals. They practice with the tools before going out into the field.

### **Procedure:**

1. **Share Background:** Foresters and forest ecologists use standard  $\frac{1}{10}$  acre circular plots when they take inventory and investigate forested sites so that is the protocol we are following in this lesson. Students should open their journals to page \_\_\_\_.
2. Slide 48 shares the **Essential Question:** What is the condition of our local forest? Post the essential question on the board. Have students record this essential question in their journal on page \_\_\_\_.
3. **Questioning:** Share with students that urban foresters in Seattle have come up with a way to evaluate the health of a forest called Tree-iage Analysis. Three questions must be answered in order to use that analysis:
  - a. Descriptive Question (part of Y axis): **Is canopy cover greater than 25%?**
  - b. Descriptive Question (X axis): **What percentage of the forest is covered in invasive plants?**
  - c. Comparative Question (part of Y axis): **Which type of tree (evergreen or deciduous) is more abundant in the forest?**

*Continued on next page...*



## Healthy Forests, Healthy Waters Field Experience

*Field Investigation Virtual Lab, page 2*

### Procedure:

4. Besides evaluating the health of the forest tell students that when they are evaluating the forest they will also be measuring the circumference of the trees in their study plots to look at value of those trees in terms of benefiting water resources using an on-line calculator from [www.treebenefits.org](http://www.treebenefits.org) . Optional: Students could also submit tree data with circumference to national data bank. <http://www.itreetools.org/>
5. Explain that students will learn the protocol they will follow for investigating each of the 3 questions. Explain that a protocol is a set of procedures that standardizes the way we collect and process data so that it is reliable and consistent. Their journals will help them stick to the protocol in the field. Have students turn to page 7 in their journals, where they will find the three investigations.
6. **Circle Plots:** Direct students to journal page 7 with the protocol for the Circle Plots. Present slides 50-58. Reinforce that 37.2 feet circle plots make a circle that is 1/10 of an acre. Have students read the description of creating circle plots in their journals. Partner-share: have students check to make sure their partner understands the procedure.
7. **Canopy Cover:** Students should turn to journal page 8. Present slides 59-69. As you present the slides, have the students record the procedure in their journals. Make sure they see where they will record their data when they are in the field. 4 students on the team will gather this data when they find the stake at the center of their circle plot.
8. **Percentage (%) of Invasive Cover:** Students should turn to journal page 9. Present slides 69-85. Use a group of students to demonstrate the procedure for the whole class. Have students review the procedure steps in their journals. Make sure students see that the first thing they will do in the field will be to make a prediction about what they will find based on what they see. 4 students will gather this data.
9. **Evergreen Tree Abundance:** Students should turn to journal page 12. Present slides 85-94. Review the protocol and data sheet. Students should notice that the data sheet on journal page 13 also asks for circumference of trees. Circumference is measured at 4.5 feet from the ground so that measurements are consistent. Tell students that when foresters and ecologist measure trees they always measure trees at 4.5 feet from the ground to be consistent when measuring trees. Explain also that in the United States all tree measurements are done in inches. Demonstrate for the class measuring circumference at 4.5 feet above the ground. The 4 students who gathered canopy cover data will begin collecting this data by identifying trees and measuring their circumference. After the invasive cover data has been gathered, those 4 students will join in the tree identification/measurement data gathering.
10. Explain that measuring the circumference of the trees in their study plots will help them determine the value of those trees in terms of benefiting water resources using an on-line calculator from [www.treebenefits.org](http://www.treebenefits.org) . (Optional: Students could also submit tree data with circumference to national data bank. <http://www.itreetools.org/> )

*Continued on next page...*



## Healthy Forests, Healthy Waters Field Experience

*Field Experience Introduction and Tree Identification, page 3*

### Procedure:

11. **Photos:** Assign one person in each group to take photos documenting the data from each investigation: canopy cover, invasive plants, evergreens.

**Teacher Note:** If plot is too thick with invasive plants, circle plots can be halved. All groups should do halved plots as the area of those plots is  $\frac{1}{4}$  the area of the original plots and you want multiple trials to be the same. If plots are really thick with invasive plants, students can just count the trees along the 5 foot string/cord lines where the invasive plant cover is taken.

### Other Resources:

- Submitting tree data to national data bank  
<http://www.itreetools.org/>
- **More information: Random Sampling lesson.**  
[http://oceanexplorer.noaa.gov/explorations/02arctic/background/education/media/arctic\\_sample.pdf](http://oceanexplorer.noaa.gov/explorations/02arctic/background/education/media/arctic_sample.pdf)
- **Field investigation Guide types of questions:**  
<http://www.pacifieducationinstitute.org/resources/pdf/Field%20Investigation%20Guide%20updated%20April%202009.pdf>

### Closure/Assessment:

Team roles:

Teams will reflect on the procedures and determine their roles:

- Which four students will gather the canopy cover data and begin the tree ID/measurement?
- Which four students will gather the invasive cover data before joining the others to ID and measure trees?

Record roles in their journals on page 5.

Reflect on page 5: What strengths do I bring to my role?





# Field Investigation Procedures

There should be 8 students per plot. All 8 students will help create the circle plots. Then 4 students will investigate canopy cover while 4 students will investigate the invasive percent cover. Each student will start identifying and measuring circumference of trees after their canopy or invasive work has been done.

## Creating Circle Plots

1. Four students find the stake that marks the center of their plot. Each holds one end of a rope (four ropes total).
2. Each of the four other students takes the other end of a rope and walks away from the center until the rope ends. They each place a flag at their spot.
3. Go back to the center and walk outward again in a different direction, flagging the new spot.
4. Repeat one more time if needed. The flags mark the outer boundary of the circle plot. The flags do not need to be numbered sequentially around the circle.

## Investigation 1: Is canopy cover greater than 25%?

1. Four students in each group at the center of the plot will use the photographs of  $> 25\%$  and  $\leq 25\%$  canopy cover to determine their canopy cover.
2. Standing in the middle of the circular plot they will look up through their hands forming a circle and decide whether or not the site is greater or less than/equal to 25% canopy cover.
3. Record on data sheet.

## Investigation 2: What percentage of the forest is covered in invasive plants?

1. Eight students will collect this data. They will work in pairs. One in each  $\frac{1}{4}$  of the plot. There is only one set of equipment so students will need to share
2. Before collecting data on invasives have students predict whether coverage will be ( $< 5\%$ ;  $5\% - 50\%$ ;  $> 50\%$ )
3. Students walk to a numbered flag.
4. Stretch a marked rope between the center stake and the flag.
5. Go to the first random number given on the data sheet along the cord and place a  $2\text{ ft} \times 2\text{ ft}$  square to the right of the line.
6. Record whether or not each foot is over 50% covered with invasive plants by shading in the appropriate boxes on the data sheet.

**Note: square must be over 50% to be counted.**



7. Go to the next random number along the line and place the 2 feet square to the left of the line and again record whether or not each foot has over 50% invasives.
8. Complete all 4 random areas for that line and record on data sheet.
9. Do 2 more lines at different flags within the study plot for a total of 12 sample squares or 48 smaller squares.

### **Investigation 3: Which type of tree (evergreen or deciduous) is more abundant in the forest?**

**Note:** It may be helpful to leave the ropes lying on the ground so students could focus on  $\frac{1}{4}$  or  $\frac{1}{2}$  of the plot at a time and then when other students finish their task they could join them measuring and recording circumferences. This will help avoid overcounting these.

1. Before starting collecting data in study plots have students predict which type of tree, evergreen or deciduous, will be most abundant in the Forest.
2. Within the circle that is flagged off, students will identify every canopy tree they encounter over 5 inches [5 inches is the standard from national data banks] in diameter and record the type of tree.
3. Students will categorize each tree as to whether it is deciduous or evergreen and record on the data sheet along with the tree's name.
4. Students will measure the circumference of each of the tree at 4.5 feet above the ground and record on the data sheet.



# Type of Tree Abundance Data Collection Sheet

**Question #3:** Which tree type, evergreen or deciduous, is more abundant in the forest?

Prediction: \_\_\_\_\_

Recorder's Name: \_\_\_\_\_

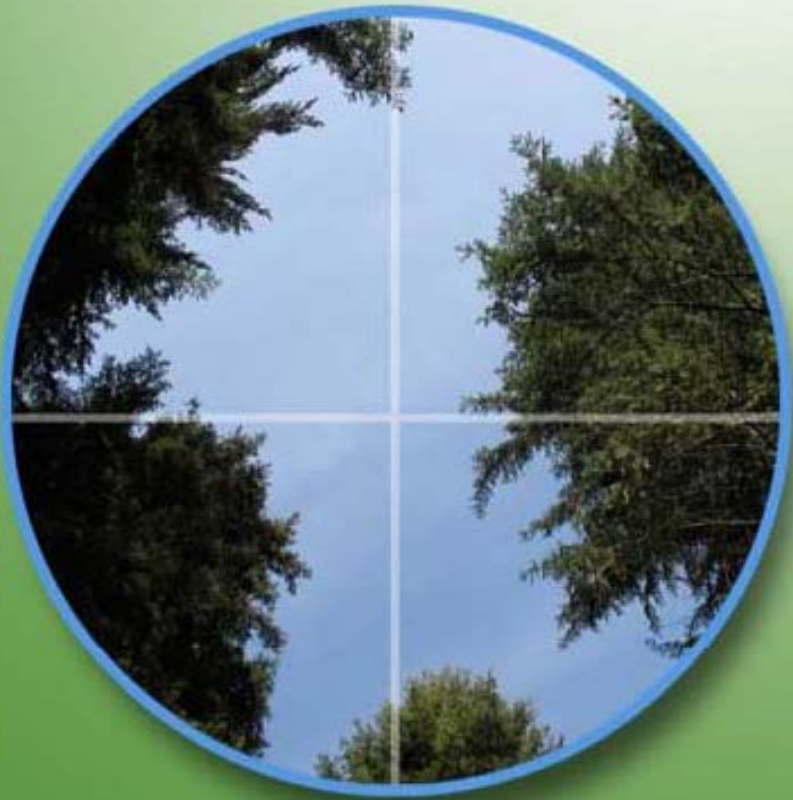
Team Member's Names: \_\_\_\_\_

Plot Location: \_\_\_\_\_ Teacher's Name: \_\_\_\_\_

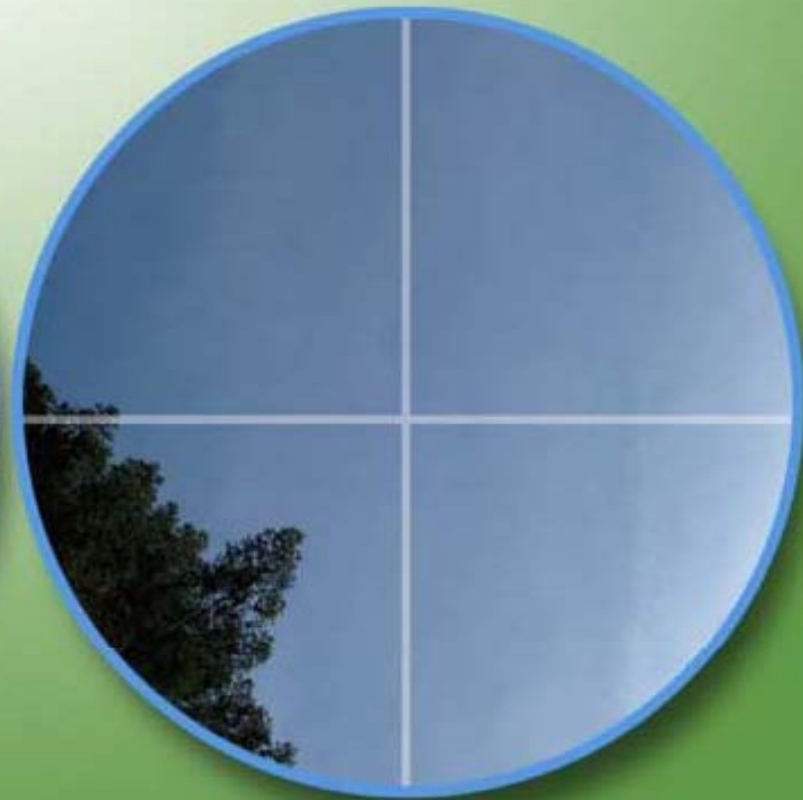
Number	Name of Tree	Evergreen (E) or Deciduous (D)	Circumference (at 4.5 ft high)	<u>Diameter</u> <u>Circumference</u> $\pi$
1				
2				
3				
4				
5				
6				
7				
8				
9				
10				
11				
12				
13				
14				
15				
16				
17				
18				
19				
20				



# Measuring Canopy Cover



Greater than 25%



Less than 25%



## 5. Healthy Forests, Healthy Waters Field Experience

**Lesson Title:** Field Experience: Evaluating a Local Urban Forest

**Implementation Time:** 1 school day

**Resource(s):**

**Materials Needed:** Materials tubs for field work, permission forms, Data Collection Protocol, student Field Journals, Field Investigation Procedures

### Lesson Focus

- ☒ **Content Knowledge:**  
Assessing the Health of a Forest
- ☒ **Content Skill(s):**  
Conducting Field Investigations
- ☒ **Thinking Skill(s):**  
Observing  
Summarizing  
Finding Evidence
- ☒ **Habit(s) of Mind:**  
Thinking Interdependently  
Striving for Accuracy and Precision  
Gathering Data through the Senses  
Applying Past Knowledge to New Situations

### **Learner Outcome(s): What will happen for learners as a result of this lesson?**

Students will conduct 3 investigations in the forest in order to evaluate the health of that forest. Students will also participate in restoration work to improve the health of the Local Urban Forest

### **Procedure:**

**Teacher Note:** If possible groups will be 32 students. Ensure that permission forms are in hand for each student, and that each student has clothing appropriate for the field and optional restoration work.

1. Ensure that chaperones are greeted and trained for their responsibilities. Share the goals of the unit and field experience.
2. The students will leave on the buses at approximately \_\_\_\_\_ and return at approximately \_\_\_\_\_.
3. You will need to bring materials with you.
4. Remind students to bring their Field Journals because they will be used extensively throughout the day. Remind them that their work will be evaluated using the rubric on the back of their journal.

*Continued on next page...*



## Healthy Forests, Healthy Waters Field Experience

*Field Experience: Evaluating a Local Forest, page 2*

### **Procedure:**

5. Ensure that students know their team and chaperone. Make sure that students know how to assemble with their team and chaperone at the site. Optional: seat students with their team and chaperone on the bus.
6. **Oversee student field work and restoration work throughout the day. Provide copies of the investigation protocols to each group/chaperone. Use the protocols to guide the students' work.**

### **Closure/Assessment:**

Students should self-reflect on their field experience.

Students' Field Journals should be assessed using the rubric on the back page of the journal.



## 6. Healthy Forests, Healthy Waters Field Experience

**Lesson Title:** Processing and Analyzing Data

**Implementation Time:** 55 minutes

**Resource(s):**

**Materials Needed:** Student Field Journals, Data Analysis Student Page, chart paper

### Lesson Focus

- ☒ **Content Knowledge:**  
Forest Health
- ☒ **Content Skill(s):**  
Analyzing Data
- ☒ **Thinking Skill(s):**  
Summarizing
- ☒ **Habit(s) of Mind:**  
Striving for Accuracy and Precision  
Thinking Interdependently

### **Learner Outcome(s): What will happen for learners as a result of this lesson?**

Students will analyze the data collected by their class at the forest in order to assess and improve the health of the forest.

### **Procedure:**

1. Review field experience with students. Explain that next, students will use the data they collected in their investigations to assess the health of the forest. Students will use the data they collected on pages 8, 9, 11, and 13 of their journals in the tables on journal pages 16–18 and 21–23.
2. First, model with sample data. Using the sample data, Go over process first with sample data from another forest and answer the 3 investigation questions:
  - a. Is canopy cover greater than 25%?
  - b. What percentage of the forest is covered in invasive plants?
  - c. Which type of tree (evergreen or deciduous) is more abundant in the forest?
  - d. Write the answers to the 3 questions on the board.
3. Explain that students will combine the data from all the circle plots that their class used. For each of the three investigations, each team should share its data with the class. Post the results on chart paper, and have students record the data from each plot on the charts found on their analysis sheets (journal pages 16, 17, 18). Reinforce the Habit of Mind, Thinking Interdependently.
4. Percent canopy cover
  - Students review procedures in their journals and write any changes or challenges that occurred in the field. Ask students if what actually happened in the field that was different from the protocol. This often happens in field studies and should be noted.
  - This is estimation data and is only above or below 25%. To summarize the data, students will conclude how many plots out of the total number of plots evaluated were greater than 25% canopy cover. This will answer the question, Is the canopy cover in our forest greater than 25 %? This is the mode of the data; mode may be reinforced as a math concept.

*Continued on next page...*





## Healthy Forests, Healthy Waters Field Experience

*Processing and Analyzing Data, page 2*

### **Procedure:**

- If 2 plots are over 25% cover and 2 less than or equal to 25%, these 2 groups will need to be analyzed further as 2 separate groups.
  - Students record the result on page 16 of their journal.
5. Percent invasive plant cover – 4 square feet random samples
- Students review procedures for any changes that occurred in the field from the protocol, and note changes in their journals.
  - Each student calculates the total % of invasive cover for their 12 random sample squares (48 small squares found on journal page 11).
  - Students record % on the class chart. Combine class data and find class average percentages. If one plot is very different from the others, you may want to treat it separately. Record on journal page 17.
  - Students individually write a conclusion answering the question: What percent of the forest is covered in invasive plants? Students also summarize what invasive plants were found in the forest (journal page 17).
6. Tree type composition
- Students should review their procedures and note any changes to the protocol that occurred in the field.
  - Students will calculate the percentage of evergreen trees for their plot (pages 11–12) or all the class plots combined. Again, if 1 or 2 plots are very different, you may want those groups to use only their own data. Record class data on journal page 18.
  - Each student will write a conclusion answering the question: Which type of tree (Evergreen or Deciduous) is more abundant in the Forest? (Journal page 18)
- Conclusions should:
- a. State the time, date and location of the data collected
  - b. Answer the investigative question: Which type of tree is more abundant?
  - c. Give supporting data for your conclusion, explaining how the data is connected to your answer.
  - d. Refer to your Field Journal: Was your original prediction correct?
7. Optional: Students may use printed Google maps to find their sample plots and put sample plots on map to scale. Students put their data on the map to show a visual of their data.

### **Closure/Assessment:**

Reflection (exit slip):

Thinking Interdependently: In what ways is it important for us to use our entire class' data for analyzing the forest, instead of our own data alone?

What have you learned about Striving for Accuracy as an important Habit of Mind for scientists in field investigations?

How might our class' data be useful to someone ten years in the future?



# Investigation 1: Canopy Cover

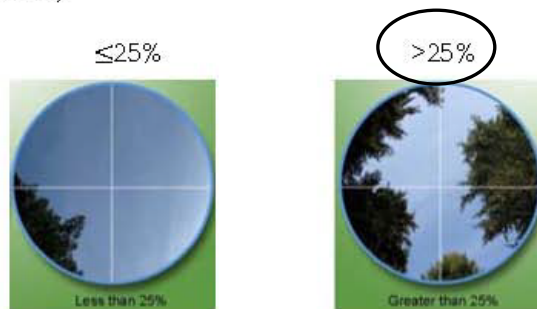
**Question:** Is canopy cover greater than 25%?

**Materials:** Canopy Cover Card  
Hands

## Procedure:

1. Use the photographs of >25% and ≤25% canopy cover to determine the canopy cover of the circle plot.
2. Stand in the middle of the circle plot.
3. Stretching arms up, form a circle with 2 hands.
4. Loop up through the circle formed by 2 hands and decide whether the site's canopy cover is greater than 25% or less than/equal to 25%.
5. Record below and share data with group members.

Investigative Question 1: What is the canopy cover %?  
(Circle one)



# Investigation 2: Invasive Cover

**Question:** What is the percentage of invasive plant cover in the forest at Lake Wilderness Arboretum?

**My Prediction:** Invasive plant cover in the forest will be  
(Circle one)

Less than 5%      5% - 50%      Greater than 50%

**Materials:** Invasive Plant ID Cards  
Marked Ropes  
2 x 2 plastic Grid

## Procedure:

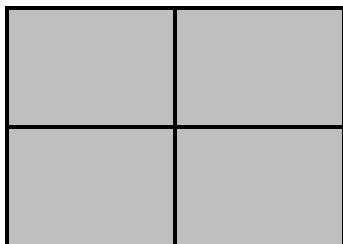
1. Predict (above) the level of invasive coverage.
2. Using the Invasive Plant ID Cards, identify invasive species. Record below and share data with team members.

Circle any of the following invasive plants present in the plot:

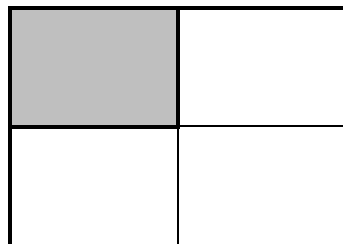
English Ivy	English Holly	Himalayan Blackberry	Bindweed/ Morning Glory
Cherry Laurel	Scot's Bloom	Knotweed	Lamium

**Directions:** Shade in each cell containing more than 50% invasive plant cover

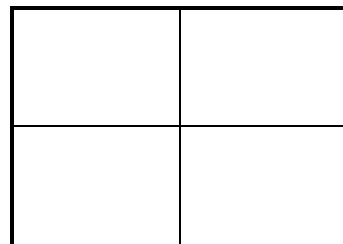
**Transect Line: Flag #2**



**Grid 1 = #15**



**Grid 2 = #24**



**Grid 3 = #34**



**Grid 4 = #35**

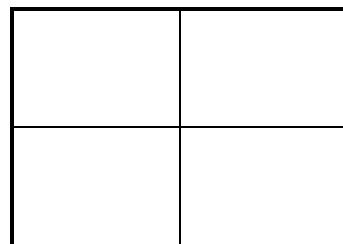
**Transect Line: Flag #7**



**Grid 1 = #2**



**Grid 2 = #13**



**Grid 3 = #18**

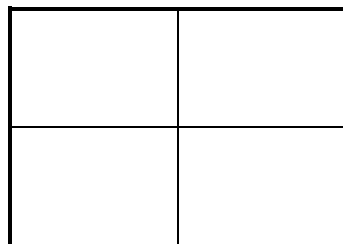


**Grid 4 = #23**

**Transect Line: Flag #10**



**Grid 1 = #3**



**Grid 2 = #12**



**Grid 3 = #14**



**Grid 4 = #28**

# Type of Tree Abundance Data Collection Sheet

**Question #3:** Which tree type, evergreen or deciduous, is more abundant in the forest?

Prediction: \_\_\_\_\_

Recorder's Name: \_\_\_\_\_

Team Member's Names: \_\_\_\_\_

Plot Location: \_\_\_\_\_ Teacher's Name: \_\_\_\_\_

Number	Name of Tree	Evergreen (E) or Deciduous (D)	Circumference	Diameter <u>Circumference</u> $\pi$
1	Big Leaf Maple	D	60	
2	Douglas-Fir	E	69	
3	Douglas-Fir	E	66	
4	Western Hemlock	E	42	
5	Madrona	E	36	
6	Western Red Cedar	E	27	
7	Red Alder	D	30	
8	Big Leaf Maple	D	75	
9	Western Hemlock	E	57	
10	Western Red Cedar	E	63	
11				
12				
13				
14				
15				
16				
17				
18				
19				
20				



# Processing and Analyzing Data Student Pages

## 1. Is canopy cover greater than 25%?

Canopy cover for 5 sample plots in the Forest

Plot 1	Plot 2	Plot 3	Plot 4	Plot 5

Write a short sentence answering the question:

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## 2. What percentage of the forest is covered in invasive plants in the Forest?

Percent of sample squares (% of 48 total) which had invasive plants

Plot 1	Plot 2	Plot 3	Plot 4	Plot 5	Average %

Circle all the invasive plant species observed in the Forest:

English Ivy

English Holly

Himalayan  
Blackberry

Bindweed/  
Morning Glory

Cherry Laurel

Scot's Bloom

Knotweed

Lamium

Write a summary of the results including types of invasive plants observed in plots:

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3. Which type of tree (evergreen or deciduous) is more abundant in the forest?

Percent of Evergreens in Each Sample Plot

Plot 1	Plot 2	Plot 3	Plot 4	Plot 5	Average % Evergreens

Write a conclusion that answers the question. Be sure to include:

- Summary what the study was about
- Limit the conclusion to date, time, and place
- Answer the investigative question
- Give supporting data
- Explain how the data and the answer are connected – or say whether their predictions were correct

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## 7. Healthy Forests, Healthy Waters Field Experience

**Lesson Title:** Tree-iage Analysis

**Implementation Time:** 55 minutes

**Resource(s):** Green Seattle Partnership Stewardship Guide; Healthy Forests PowerPoint

**Materials Needed:** Data Analysis sheets from previous lesson, Tree-iage Analysis page of the *Forest Steward Guide*, Dichotomous (flow chart) key to analysis, Forest Tree-iage Evaluation Project Checklist and Rubric, computers with PowerPoint

### Lesson Focus

- ☒ **Content Knowledge:**  
Forest Health Evaluation and Restoration
- ☒ **Content Skill(s):**  
Data Interpretation  
Forest Restoration
- ☒ **Thinking Skill(s):**  
Synthesis  
Evaluation  
Problem Solving
- ☒ **Habit(s) of Mind:**  
Questioning and Problem Posing  
Thinking Interdependently  
Applying Past Knowledge to New Situations

### **Learner Outcome(s): What will happen for learners as a result of this lesson?**

Using their data as a class, students perform a Tree-iage analysis, reporting their findings in a presentation to the community.

### **Procedure:**

1. Make sure students have their data analysis sheets that they used in the previous lesson (journal pages 16–18). Arrange students in pairs.
2. Recall the field experience and students' analysis of the data their class collected. Explain that today, students will use a new protocol to generate ways to improve the health of their local forest. Students will practice the thinking skill of Evaluation: Judging Using Criteria. They will use several criteria for healthy forests to judge the health of their local forest.
3. Remind students that this type of forest evaluation is used all over the Puget Sound area by urban foresters. Seattle, Renton, Kent, and Tacoma have all adopted this evaluation model for their urban forests – students will do “real-life” work! Reinforce the Habit of Mind, Applying Past Knowledge to New Situations, as students use the data they collected during the field experience in a new way.

**Teacher Note:** Before working with student-collected data, use the sample data that was used in the previous lesson (for modeling data analysis) to model the following Tree-iage analysis first.

4. Answer the 3 questions and put them on the board:
  1. Is canopy cover greater than 25%?
  2. What percentage of the forest is covered in invasive plants?
  3. Which type of tree (evergreen or deciduous) is more abundant in the forest?

*Continued on next page...*



# Healthy Forests, Healthy Waters Field Experience

## Tree-iage Analysis, page 2

### Procedure:

5. Direct student to the Tree-iage Generator on page 20 of their field Journals. Present slides \_\_\_\_\_. View Power Point section with the Tree-iage matrix (view it a 2<sup>nd</sup> time when using student data) and present the slides. Using the sample data results in generating Restoration Strategy #2: Invasive Plant Reduction
6. Arrange student in pairs. Have students read the 2-page Green Seattle Partnership handout (from the Forest Steward Guide) with the Tree-iage analysis matrix.
7. When students have read the handout, present the question:  
**What is the best thing to do with this forest site and why?**
  - First, ask students to write down the percentage of canopy cover.
  - Next, ask students to look at the tree composition (evergreen/deciduous) and decide (and record) whether the Tree Composition Value is low, medium, or high.
  - Finally, ask students to determine and record whether the invasive threat is low, medium, or high.
8. Tell students that they will now follow a flow chart to determine which restoration strategy is correct for your local forest site. As a whole class, work through the dichotomous key (flow chart) with their combined class data using the Tree-iage Generator page to determine the restoration strategy for the local forest site.
9. **Discussion** – Encourage students to practice the Habit of Mind, Questioning and Problem Posing. Discuss the following questions with the students:
  - What does it mean that the invasive plant threat is high in terms of the implementation plan? *(the invasive plants will take more than a onetime effort to get rid of them)*
  - What does it mean that the Tree composition value is medium for the implementation plan? *(the tree composition is mostly deciduous trees and for restoration we would then plant more evergreen trees)*
  - Why do you think forests dominated by evergreen trees are considered higher value? *(Evergreens intercept more water in the winter when most of our rain falls and these are the forests that were dominate a hundred years ago)*
  - Why do you think this analysis is important to Park planners? *(planners can see which areas will take the most time and money to restore)*
  - How does this information help us restore the urban forest? *(It lets us know how much work-time and money – It will be to get rid of invasives and how much planting needs to occur)*

### Closure/Assessment:

#### Reporting Out

Explain that students will work in groups to create a presentation that accurately reports their Tree-iage findings and informs the local government agency about the health of the forest and recommendations for improving it. Use the Forest Tree-iage Evaluation Project Checklist (journal page 25) to communicate the elements and criteria for the presentation. Explain that students will use the Effective Communicator outcome to select the top-rated presentations to share with the local urban forester. Reinforce the thinking skill of Synthesis: creating a new whole – students will combine their data and findings with their creativity and presentation skills to create an effective product that will influence others.





# Forest Tree-iage Project Evaluation Checklist

**Teacher Note:** Determine how many students you wish on a team. Consider two, three or four. Students can divide the information needed and create PowerPoint slides to convey the descriptions and data. You may want to have the classes select the most compelling presentations to share with the people from their community. Consider having students present in groups, choosing the best to present to the class for selecting the top presentation.

Presentations should include the following:

1. Describe a problem facing urban forests.
2. Describe why urban forests are important.
3. Present a summary of data collected, including canopy cover and percent of invasive plants
4. Describe the type(s) of invasives found.
5. Describe the percent of types of trees in the forest (deciduous, evergreen).
6. Communicate the restoration strategy as determined by the Tree-iage Generator
7. Summarize what this strategy means in terms of invasive removal.
8. Summarize what this strategy means in terms of plants to be planted.
9. Provide photos or other visuals.

Use the Effective Communicator indicators to evaluate the group projects, selecting the top rated projects to share with their local community.



Name: \_\_\_\_\_

Date: \_\_\_\_\_

## Forest Tree-iage Project Evaluation Checklist

Presentations should include the following:

- ☐ Description of the problem facing urban forests
- ☐ Description of why urban forests are important
- ☐ A summary of data collected, including canopy cover and percent of invasive plants
- ☐ Description of the type(s) of invasives
- ☐ Description of the percent of types of trees in the forest
- ☐ Description of the restoration strategy as determined by the Tree-iage Generator
- ☐ Summary of what this strategy means in terms of invasive removal
- ☐ Summary of what this strategy means in terms of plants to be planted
- ☐ Photos or other visuals



Name: \_\_\_\_\_

Date: \_\_\_\_\_

## Effective Communicators

	Exceptional <b>4</b>	Meets Standard <b>3</b>	Approaches Standard <b>2</b>	Little or No Evidence of Standard <b>1</b>
<input type="checkbox"/> Communicates with clarity and precision				
<input type="checkbox"/> Delivers information effectively and in multiple formats				
<input type="checkbox"/> Presentation includes all components				
<input type="checkbox"/> Listen, interpret, and evaluate				
<b>Total Points</b>				





*Our Vision: A healthy, livable city with sustainable forested parklands*

The Green Seattle Partnership is a public-private venture between the City of Seattle, its residents, and the Cascade Land Conservancy. Our vision is of healthy, sustainable forested parklands, diverse and invasive-free, supported by an aware and engaged community in which individuals, neighborhoods, nonprofits, businesses and City government are working together to protect and maintain Seattle's forested parklands for current and future generations.

### **Why the Green Seattle Partnership?**

Most of the trees in Seattle are near the end of their natural lifespan. At the same time, invasive plants have choked out the seedlings that would replace today's forest. Within 20 years, 70% of our forested parklands (2,500 acres) will be ecological dead zones. The Green Seattle Partnership is committed to creating healthy forested parklands supported by long-term community stewardship and establishment of resources within the city

### **Our Goals**

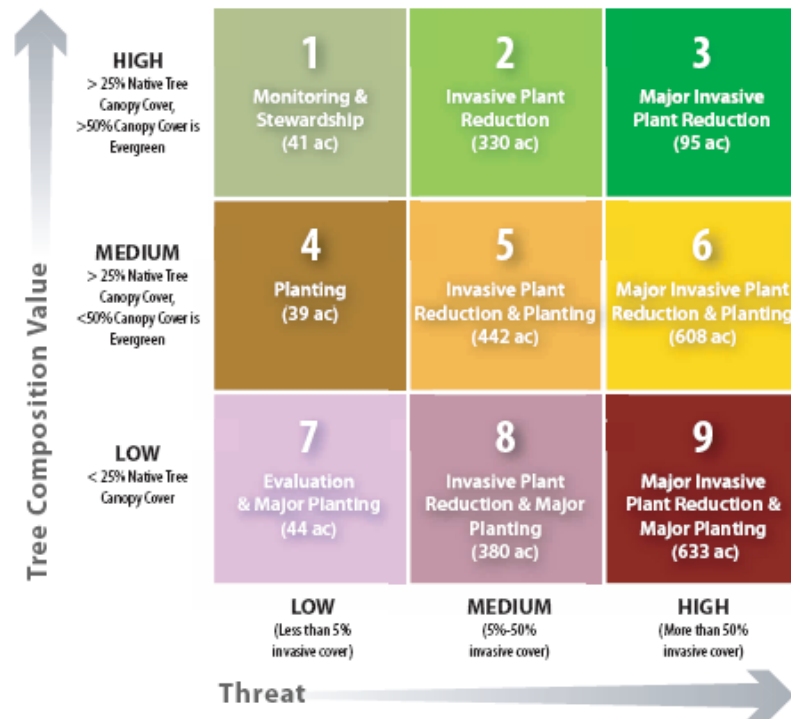
- **Restore 2,500 acres of forested parkland in the City of Seattle by 2025.**
- **Establish financial and volunteer resources to provide long-term maintenance and ensure the sustainability of forested parklands**
- **Galvanize an informed, involved and active community around forest restoration and stewardship.**

To achieve these goals the Green Seattle Partnership utilizes volunteers, contractors and staff to forward our progress in restoring Seattle's forested parklands.



# Tree-iage Analysis

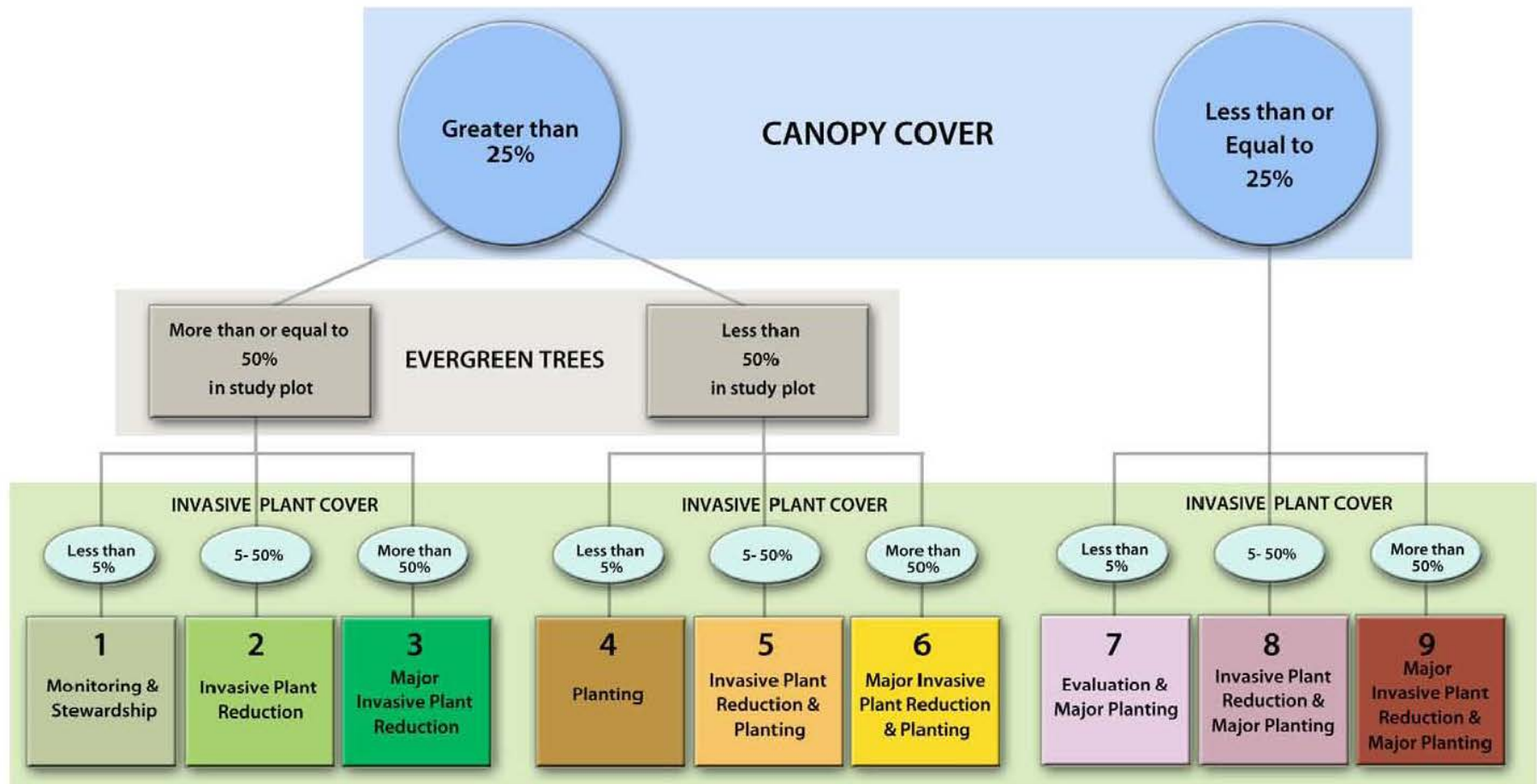
The Green Seattle Partnership developed an approach called the tree-iage model to assess forest conditions and identify priority areas. Each category in the tree-iage model requires a different restoration strategy. This model will be used on GSP sites to help prioritize restoration efforts.



- **High-value forest** – Seattle’s highest-quality forest stands are dominated by mature, native evergreen canopy species with more than 50% native conifers, madrona or forested wetlands.
- **Medium-value areas** have more than 25% native tree cover, but less than 50% cover by conifers or other native evergreens.
- **Low-value areas** are forested, but have less than 25% native tree cover.



# Tree-iage Generator





## 8. Healthy Forests, Healthy Waters Field Experience

**Lesson Title:** Tree Benefits

**Implementation Time:** One 60 minute class period

**Resource(s):** Computers

**Materials Needed:** Tree circumferences data from field experience; Data Collection Chart; Field Experience Assessment, Field Journals

### Lesson Focus

- ☒ **Content Knowledge:**  
Tree Benefits
- ☒ **Content Skill(s):**  
Data Recording and Interpretation
- ☒ **Thinking Skill(s):**  
Classifying  
Comparing/ Contrasting
- ☒ **Habit(s) of Mind:**  
Striving for Accuracy and Precision

### **Learner Outcome(s): What will happen for learners as a result of this lesson?**

Students will explore the interdependence of a healthy forest with healthy waters by calculating water interception.

### **Procedure:**

**Teacher Note:** You may want to conduct this lesson as a teacher guided demonstration when calculating the information on Table #3. Students should calculate tree diameter averages, average number of trees per acre, and at the website, record the amount of water intercepted by the average tree of each species. You may choose to demonstrate how to use this data to estimate the total amount of water intercepted by the forested acres.

1. Remind students of the two statements below that were part of the Tall Tree Tales Survey. These include the following:
  - Trees slow and absorb storm water and reduce runoff, thereby reducing flooding and stream degradation. The job done by trees for free in the Seattle area would cost \$2.4 billion if it were part of a storm water management system.
  - New York City avoided spending \$6 billion to \$8 billion for the construction of new water treatment plants by instead spending \$1.5 billion to purchase and protect the upstate watershed that had traditionally accomplished those purification services for free.
2. Discuss the benefits of trees and their connection to a healthy water supply.

*Continued on next page...*





## Healthy Forests, Healthy Waters Field Experience

*Tree Benefits, page 2*

### Procedure:

3. Direct students to pages 21–24 of their Field Journals. Tell student they are now going to use the circumference data they collected on page 13 of their journals to estimate the forests value in terms of water interception.

**Step #1: Determine Average Tree Diameter:** For each tree species have students use the data on page 13 of their journal to calculate the average diameter in their plot and record these on the class data table (Table #1, page 1). Then have them find the class average diameter for each species. Transfer these class averages for each species to Table #3, Column B (page 23). Remind them that they are Striving for Accuracy and Precision as they calculate the diameters and create the averages.

**Step #2: Determine Average Number of Trees per Acre:** For each tree species have students first calculate the average number of trees per plot and record on the data table (page 22).

Have students calculate the class average.(Table #2) Then multiple the class average for each species by 10 to determine the average number of trees per acre. Record in the last column of Table #2 and transfer the data to Table #3, Column D (page 23).

**Step #3: Determine Amount of Water Intercepted by the Trees:** Tell students go to [www.treebenefits.org](http://www.treebenefits.org) and find out the amount of water that each species intercepts for the average diameter tree of that kind. Record the gallons of water intercepted by each tree species on Table #3, Column C (page 23).

**Step #4: Determine the Estimated Total Amount of Water Intercepted:** Multiply Column C x D x E and record in Column F (page 23).

**Step #5: Determine Total Amount of Water Intercepted by all Tree Species at your local forest:** Add the values in Column F (page 23).

**Teacher Note:** The website also contains estimates of tree values. You may want to provide opportunity for students to do some free exploration at the website to identify additional pieces of interesting information and have a discussion of what students are discovering (page 24).

4. Discuss with students:
  - What is the importance of water interception?
  - How does a healthy forest support healthy water?
  - What might be the implications of maintaining healthy forests for both our local environment and for our world environment?

### Closure/Assessment:

Use the assessment provided to check for understanding of field experience goals.

Score by assigning one point for each correct response – 10 points total.



Plot # \_\_\_\_\_

## Average Tree Diameter per Plot

Name of Tree	Diameter of trees in ¼ plot (inches)					
	¼ plot 1	¼ plot 2	¼ plot 3	¼ plot 4	# trees/plot	Average diameter/plot
Douglas-fir						
Western Red Cedar						
Western Hemlock						
Madrona						
Big Leaf Maple						
Red Alder						



**Table #1: Average Tree Diameter per Plot**

Name of Tree	Average diameter of trees in plot (inches)				
	Plot 1	Plot 2	Plot 3	Plot 4	Class Average
Douglas-fir					
Western Red Cedar					
Western Hemlock					
Madrona					
Big Leaf Maple					
Red Alder					

**Table #2: Average number of Trees per Plot and per Acre**

Name of Tree	Average number of trees per plot					
	Plot 1	Plot 2	Plot 3	Plot 4	Class Average per Plot	x 10 (Trees per Acre)
Douglas-fir						
Western Red Cedar						
Western Hemlock						
Madrona						
Big Leaf Maple						
Red Alder						

**Table #3: Estimated Amount of Water Intercepted  
by 6 Tree Species in your local forest**

	A	B	C	D	E	F
	Tree Species	Average Diameter from Table #1	Amount (gal) of Water Intercepted by average diameter tree (from Website)	Average number of trees per acre from Table #2	Forested acres	Estimated Total Amount of Water intercepted
1	Douglas-Fir					
2	Western Hemlock					
3	Western Red Cedar					
4	Madrona					
5	Big Leaf Maple					
6	Red Alder					
Total amount of water intercepted by 6 tree species at _____ local Forest						



Name: \_\_\_\_\_

Date: \_\_\_\_\_

## Healthy Forests/Healthy Waters Assessment

1. Explain the connection between healthy forests and healthy waters.
2. Describe how we can measure the health of a forest.
3. What are two ways that we can improve the health of a forest?
4. How is Striving for Accuracy and Precision important to data collection?
5. What is one way you used the Habit of Mind of Thinking Interdependently?
6. As you reflect on this field experience, what did you learn about the importance of monitoring each of the following in your local forest?
  - Native Plants:
  - Invasives:
  - Tree Population:
  - Canopy Cover:
7. What's one action can you take as a Community Contributor to preserve the health of our local forest and water?

# Healthy Forests, Healthy Waters

## Field Journal



### Urban Forest Evaluation

Name: \_\_\_\_\_

Team: \_\_\_\_\_

Teacher: \_\_\_\_\_

Period: \_\_\_\_\_

# Citizen Science Field Journal

This is your field experience notebook – use it to record your observations and ideas, to draw what you see, and to help you with your field investigations.

You will engage in the following activities:

- Working as a Member of a Team, pg. 5
- Creating Circle Plots, pg. 7
- Measuring Canopy Cover, pg. 8
- Identifying Tree Types and Abundance, pgs. 12-13
- Engaging in Restoration Work, pgs. 14-15
- Processing and Analyzing Data, pgs. 16-18
- Assessing the Health of the Forest, pgs. 19-20
- Understanding Tree Benefits, pgs. 21-24
- Reflecting on the field experience, pgs. 26-28

Our trip to: \_\_\_\_\_

Date: \_\_\_\_\_



We wish to thank the Pacific Education Institute, Green Seattle Partnership, and Tahoma School District for generously sharing ideas and resources for developing this field experience and journal.

# Map

(Paste Map Here)



# My Role as Citizen Scientist

Follow rules and directions

Respect your chaperone

Stay with your group (keep chaperone  
in eyesight)

Wear name tag

Complete journal tasks

Work diligently as Quality Producers  
and Community Contributors in field  
investigation and restoration work

## In the Forest

**Walk! Don't Run**

**Quiet Voices**

**Show Respect and Care for All Living Things**

**Be Mindful of Safety!**



# Preparing for Our Field Experience

Think about how you use and apply the following thinking skills and Habits of Mind.

## Thinking Skills

Observing  
Comparing/Contrasting  
Finding Evidence  
Analyzing  
Summarizing

## Habits of Mind

Responding with Wonderment and Awe  
Taking Responsible Risks  
Gathering Data through the Senses  
Questioning and Problem Posing  
Remains Open to Continuous Learning

# The Problem

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## Our Essential Question

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## Investigative Questions

1. Is the canopy cover greater than 25%?
2. What percentage of the forest is covered in invasive plants?
3. Which type of tree (evergreen or deciduous) is more abundant in the forest?

## Taking Action:

How can the health of the forest be improved?

# My Group

Me: \_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

Our chaperone: \_\_\_\_\_

## Our Field Investigation Roles

Create the circle plot (page ____)	ALL
Gather canopy cover data (Investigation 1, page ____)	_____ _____ _____ _____
Gather invasive cover data (Investigation 2, page ____)	_____ _____ _____ _____
Tree ID/measurement (Investigation 3, page ____)	ALL

What strengths do I bring to my role?

Our schedule:		
a.m.	<input type="checkbox"/> Field Investigation	<input type="checkbox"/> Restoration
p.m.	<input type="checkbox"/> Field Investigation	<input type="checkbox"/> Restoration

# Invasive Species

Species and Where it Came From	Why/How Did it Get Here?	Characteristics Helping it Thrive	Effects on the Ecosystem	Removal

Infer/Summarize: What negative impact do invasive plants have on the forest ecosystem:

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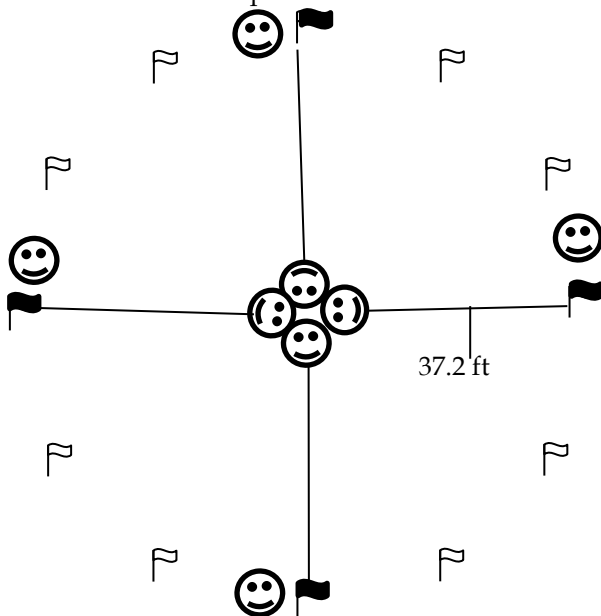
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# Creating Circle Plots

**Materials:** Per study plot: 4 ropes or measuring tapes and 12 flags

**Procedure:**

1. Students are in groups of 8.
2. Four students find the stake that marks the center of their study plot. They face out putting their backs together. Each holds one end of a 37.2 feet rope or measuring tape (four ropes total).
3. Each of the four other students takes the other of end of one of a ropes and walks away from the center until the rope ends. They each place a flag at this spot. ( represented by the black flag in the diagram)
4. Now the students at the outside of the circle either go back to the center and walk outward again with the rope in a different direction 2 more times, flagging the 2 new spots (represented by the white flags). Or students can leave the rope where it is and just estimate 2 more flags between them and the rope line to their right.
5. The flags mark the outer boundary of the circle plot that is 1/10 of an acre. Leaving the ropes on the ground allow pairs of students to know their  $\frac{1}{4}$  section of the plot where they are to identify and measure trees and invasive plants.



# Investigation 1: Canopy Cover

**Question:** Is canopy cover greater than 25%?

**Materials:** Canopy Cover Card  
Hands

## Procedure:

1. Use the photographs of  $>25\%$  and  $\leq 25\%$  canopy cover to determine the canopy cover of the circle plot.
2. Stand in the middle of the circle plot.
3. Stretching arms up, form a circle with 2 hands.
4. Look up through the circle formed by 2 hands and decide whether the site's canopy cover is greater than 25% or less than/equal to 25%.
5. Record below and share data with group members.

Investigative Question 1: What is the canopy cover %?  
(Circle one)



# Investigation 2:

## Invasive Cover

**Question:** What is the percentage of invasive plant cover in the forest?

**My Prediction:** Invasive plant cover in the forest will be  
(Circle one)

Less than 5%

5% - 50%

Greater than 50%

**Materials:** Invasive Plant ID Cards  
Marked Ropes  
2 x 2 plastic Grid

### Procedure:

1. Predict (above) the level of invasive coverage.
2. Using the Invasive Plant ID Cards, identify invasive species. Record below and share data with team members.

Circle any of the following invasive plants present in the plot:

English Ivy	English Holly	Himalayan Blackberry	Bindweed/ Morning Glory
Cherry Laurel	Scot's Broom	Knotweed	Lamium



3. Working in pairs, create a transect line by stretching a marked rope between the center stake and Flag #2, #5, #7, or #10.
4. For each grid on the transect line (data collection sheet on next page), find its spot on the rope by counting the marks out from the center stake. Example: for Flag #2, Grid 1, count 15 marks from the center on line 1.
5. Place the grid next to the mark on the rope. Each time the grid is moved to a new mark, move it to the opposite side of the rope as well. Example: Place Grid 1 to the right of the right, place Grid 2 to the left of the rope, etc.
6. For each grid, record whether each foot square is over 50% covered with invasive plants by shading the appropriate boxes on the data sheet (next page).
7. Complete grid for all 4 transect (flag) lines (12 grids total) by obtaining data from the other pairs in your team.



**Directions:** Shade in each cell containing more than 50% invasive plant cover

Line 1 – Flag #2


Grid 1 = #15

Line 2 – Flag #5


Grid 2 = #21

Line 3 – Flag #7


Grid 3 = #14

Line 4 – Flag #10


Grid 4 = #3

Grid 1 = #24


Grid 2 = #12


Grid 3 = #18


Grid 4 = #28


Grid 1 = #34


Grid 2 = #13


Grid 3 = #24


Grid 4 = #35


# Investigation 3:

## Tree Types and Abundance

**Question:** Which type of tree (evergreen or deciduous) is more abundant in the forest?

**My Prediction:**  
(Circle one)

Deciduous

Evergreen

trees will be most abundant in the forest.

**Materials:** Tree ID Cards  
Measuring tapes

**Procedure:**

1. After collecting invasive plant data, divide circle plot into fourths by running ropes perpendicular and stretching to flags.



2. Working in pairs, identify every canopy tree over 5 inches in diameter (this is the standard for national data banks) in your fourth of the plot
3. For each tree over 5 inches diameter, record on the data sheet:
  - Tree type (big-leaf maple, Douglas-fir, etc.)
  - Evergreen or deciduous
  - Circumference (in inches): measure circumference of the tree at 4.5 feet high

# Type of Tree Abundance Data Collection Sheet

#	Name of Tree	Evergreen (E) or Deciduous (D)	Circumference (at 4.5 ft high)	Diameter <u>Circumference</u> $\pi$
1				
2				
3				
4				
5				
6				
7				
8				
9				
10				
11				
12				
13				
14				
15				
16				
17				
18				
19				
20				

# Restoration Work

**My Job:**

**What my job included:**

**Equipment I used:**

The restoration work I did is important for the forest's health because

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How I felt after working on restoration in the Forest

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# Processing and Analyzing Our Data

**Investigative Question 1:** Is canopy cover greater than 25%?

Canopy cover for 5 sample plots in the Forest.

Plot 1	Plot 2	Plot 3	Plot 4	Plot 5

Write a short sentence answering the question:

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# Processing and Analyzing Our Data

**Investigative Question 2:** What percentage of the forest is covered in invasive plants at Forest?

Percent of sample squares (% of 48 total) which had invasive plants

Plot 1	Plot 2	Plot 3	Plot 4	Plot 5	Average %

Circle all the invasive plant species observed in the Forest:

English Ivy	English Holly	Himalayan Blackberry	Bindweed/ Morning Glory
Cherry Laurel	Scot's Bloom	Knotweed	Lamium

Write a summary of the results including types of invasive plants observed in plots:

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# Processing and Analyzing Our Data

**Investigative Question 3:** Which type of tree (evergreen or deciduous) is more abundant in the forest?

Percent of Evergreens in Each Sample Plot

Plot 1	Plot 2	Plot 3	Plot 4	Plot 5	Average % Evergreens

Write a conclusion that answers the question. Be sure to include:

- Summary of what the study was about
- Limit the conclusion to date, time, and place
- Answer the investigative question
- Give supporting data
- Explain how the data and the answer are connected – or say whether their predictions were correct

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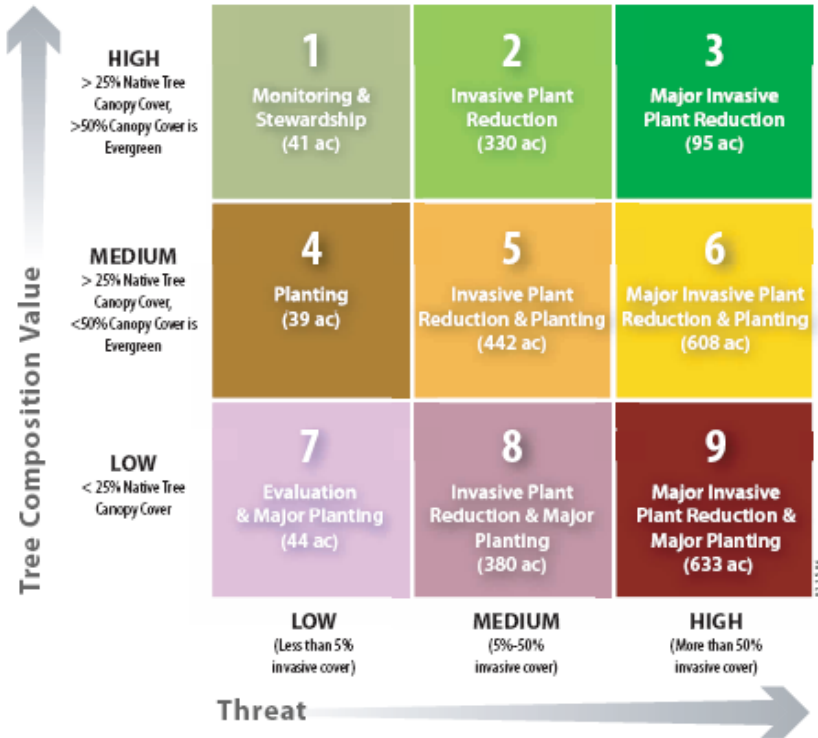
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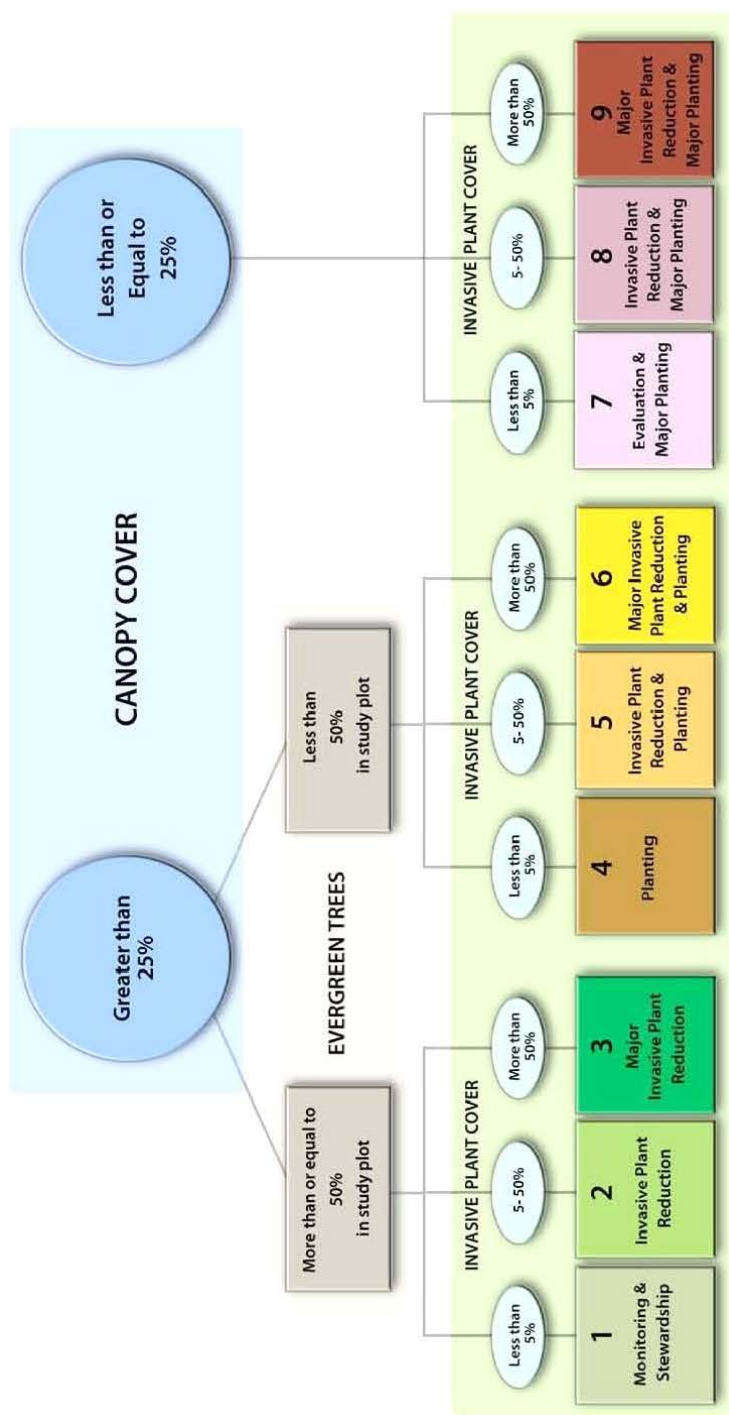
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# Tree-iage Analysis

The Green Seattle Partnership developed an approach called the tree-iage model to assess forest conditions and identify priority areas. Each category in the tree-iage model requires a different restoration strategy. This model will be used on GSP sites to help prioritize restoration efforts.



- **High-value forest** – Seattle’s highest-quality forest stands are dominated by mature, native evergreen canopy species with more than 50% native conifers, madrona or forested wetlands.
- **Medium-value areas** have more than 25% native tree cover, but less than 50% cover by conifers or other native evergreens.
- **Low-value areas** are forested, but have less than 25% native tree cover.



# Plot # \_\_\_\_\_

## Average Tree Diameter per Plot

Name of Tree	Diameter of trees in ¼ plot (inches)				# trees	Ave diameter
	¼ plot 1	¼ plot 2	¼ plot 3	¼ plot 4		
Douglas-fir						
Western Red Cedar						
Western Hemlock						
Madrona						
Big Leaf Maple						
Red Alder						

**Table #1:**  
**Average Tree Diameter per Plot**

Name of Tree	Average diameter of trees in plot (inches)				
	Plot 1	Plot 2	Plot 3	Plot 4	Class Average
Douglas-fir					
Western Red Cedar					
Western Hemlock					
Madrona					
Big Leaf Maple					
Red Alder					

## Table #2: Average number of Trees per Plot and per Acre

Name of Tree	Average number of trees per plot					
	Plot 1	Plot 2	Plot 3	Plot 4	Class Average per Plot	x 10 (Trees per Acre)
Douglas-fir						
Western Red Cedar						
Western Hemlock						
Madrona						
Big Leaf Maple						
Red Alder						

**Table #3: Estimated Amount of Water Intercepted by 6 Tree Species in the Forest**

	A	B	C	D	E	F
	Tree Species	Average Diameter from Table #1	Amount (gal) of Water Intercepted by average diameter tree (from Website)	Average number of trees per acre from Table #2	Forested acres	Estimated Total Amount of Water intercepted in Forest
1	Douglas-Fir					
2	Western Hemlock					
3	Western Red Cedar					
4	Madrona					
5	Big Leaf Maple					
6	Red Alder					
Total amount of water intercepted by 6 tree species in the _____ Forest						

# Tree Benefits

[www.treebenefits.org](http://www.treebenefits.org)

Interesting!	New Questions I have



# Project Evaluation Checklist

Presentations should include the following:

- ☐ Description of the problem facing urban forests
- ☐ Description of why urban forests are important
- ☐ A summary of data collected, including canopy cover and percent of invasive plants
- ☐ Description of the type(s) of invasives
- ☐ Description of the percent of types of trees in the forest
- ☐ Description of the restoration strategy as determined by the Tree-iage Generator
- ☐ Summary of what this strategy means in terms of invasive removal
- ☐ Summary of what this strategy means in terms of plants to be planted
- ☐ Photos or other visuals

# Field Experience Reflection

	What was Fun	What was Challenging
Field Investigation Circle Plots Canopy Cover Invasive Cover Tree ID		
Forest Restoration Work		
Data processing and Analysis		
Project		

# Field Experience Reflection

What I liked most about the field experience was

What I hope others will learn about health forests is

# Field Experience Journal Rubric

	4	3	2	1
<b>Quality Producer</b>	-Student completes all pages in the journal	-Student completes most of the pages in the journal	-Student completes some of the pages in the journal	-Students completes only a few of the pages in the journal
<b>Complex Thinker</b>	-Student demonstrates insight into assessing the health of a forest -Data provided for forest tasks is precise and detailed Student reflections show depth of understanding	-Student demonstrates basic understanding of assessing the health of a forest -Data provided for forest tasks is clear and complete Student reflections show basic understanding	-Student demonstrates some understanding of assessing the health of a forest -Data provided for forest tasks somewhat clear and complete Student reflections show some understanding	-Student demonstrates little or no understanding of assessing the health of a forest -Data provided for forest tasks is incomplete and vague Student reflections show little or no understanding
<b>Effective Communicator</b>	-Writing is clear and readable -Student elaborates on ideas presented	-Writing is clear and readable -Student provides some elaboration on basic ideas	-Writing is somewhat clear and readable -Ideas are briefly stated with little elaboration.	-Writing is difficult to read -Ideas are unclear and/or incomplete
<b>Community Contributor</b>	-Student completes restoration work communicating why this work is important	-Student completes restoration work communicating some understanding of its importance	-Student completes restoration work without reflecting on its importance	-Student does not complete restoration work

# Introduction and Lesson 1





# Our Goal?

## Evaluate and Restore Our Local Forests

Help to evaluate and recommend restoration strategies for our local forests so that it will become healthy and stay that way.

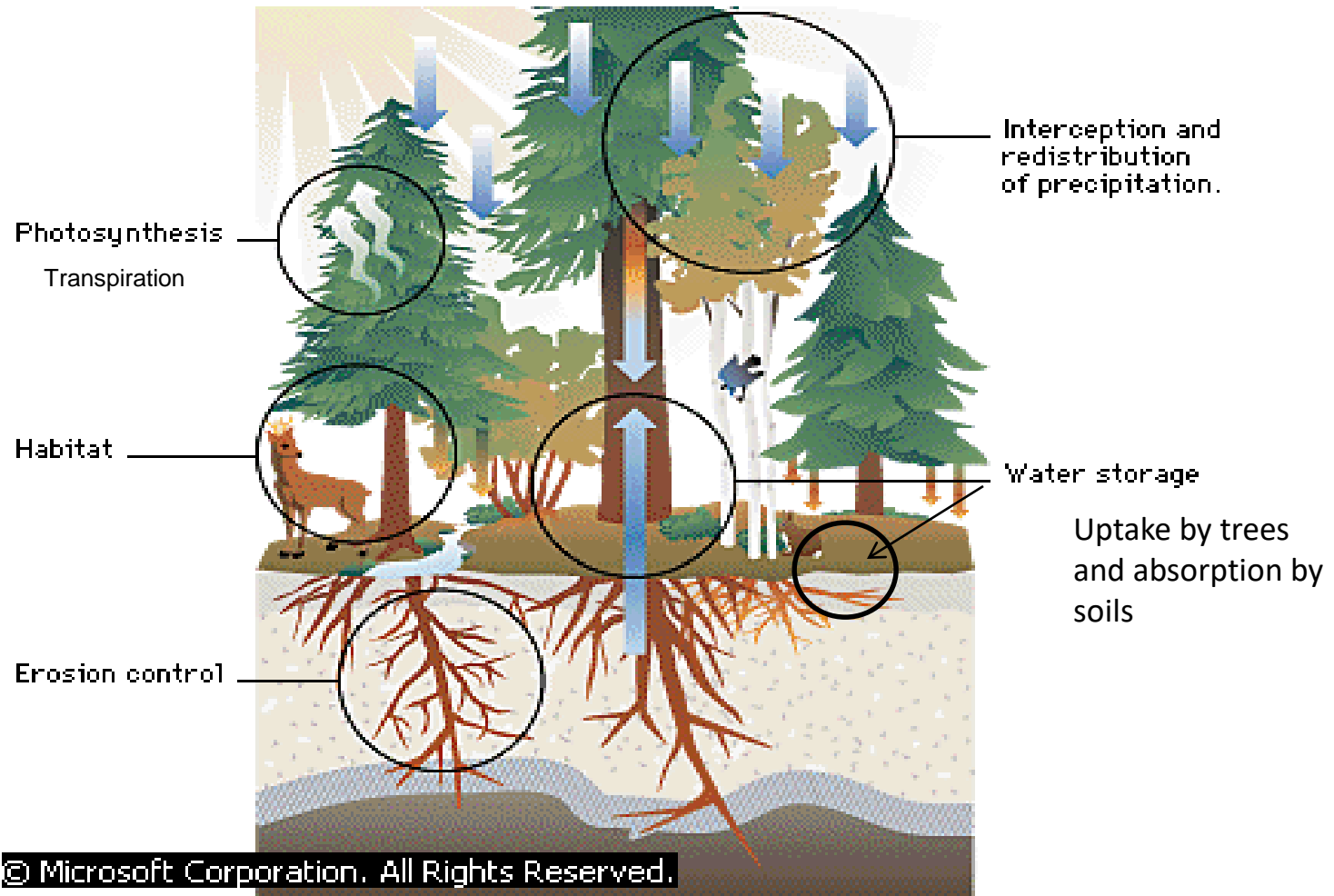


# Why Do We Care?

## A Healthy Urban Forest:

- Cleans the air
- Stabilizes the soil through plant roots
- Intercepts rainwater to prevent erosion
- Soaks up and stores rainwater releasing it slowly into creeks, streams and rivers
- Pumps water up through plants
- Cleans water through its natural soil filter
- Supports local biodiversity

# The Role of Forests in the Water Cycle





# Why Monitor Your Forest?

Values	Threats
Cleans stormwater	Pollutants reaching our lakes and Puget Sound
Prevents Erosion	Silt making streams turbid-killing fish
Create Rich Tree Composition	Poor Tree Composition
Remove Invasive Species	High Invasive Species
Increase Dense Canopy Cover	Low Canopy Cover
Enhance Species Diversity	Non-Varied Species
Support Wildlife	Poor Wildlife Habitat
Promote Geographic/Social Equity	Poorly Distributed Tree Canopy
Sustain Community Involvement	Community Not Interested



# Introduction

Read articles

**GREEN SEATTLE**  
PARTNERSHIP

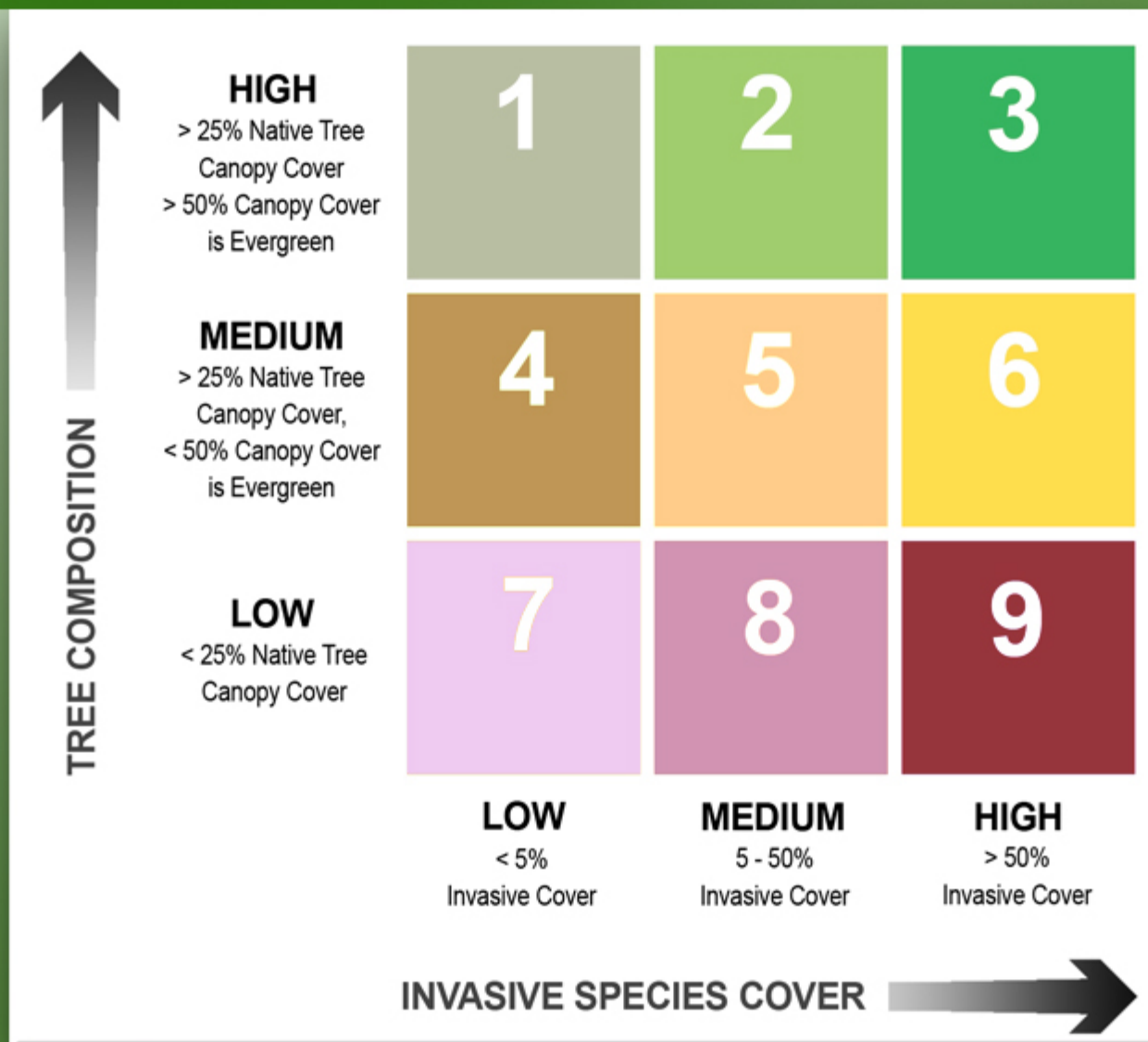
URBAN FORESTRY PROJECT



# Forest Evaluation- Green Seattle Partnership

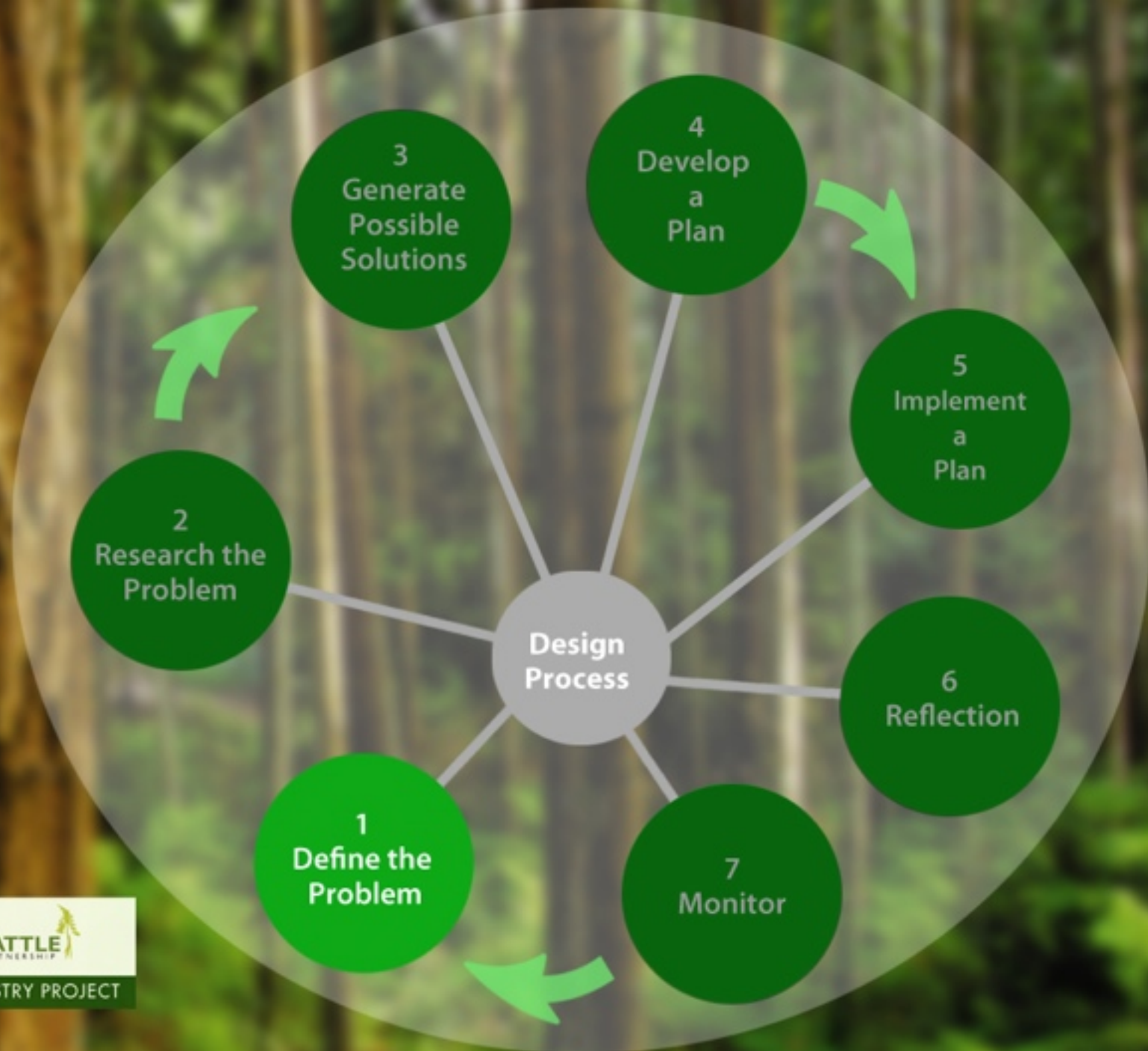
- Developed by Urban Foresters in Seattle
- Local Cities have adopted this protocol
- This is the protocol we will use to evaluate our local urban forest

# GSP Tree-age Matrix











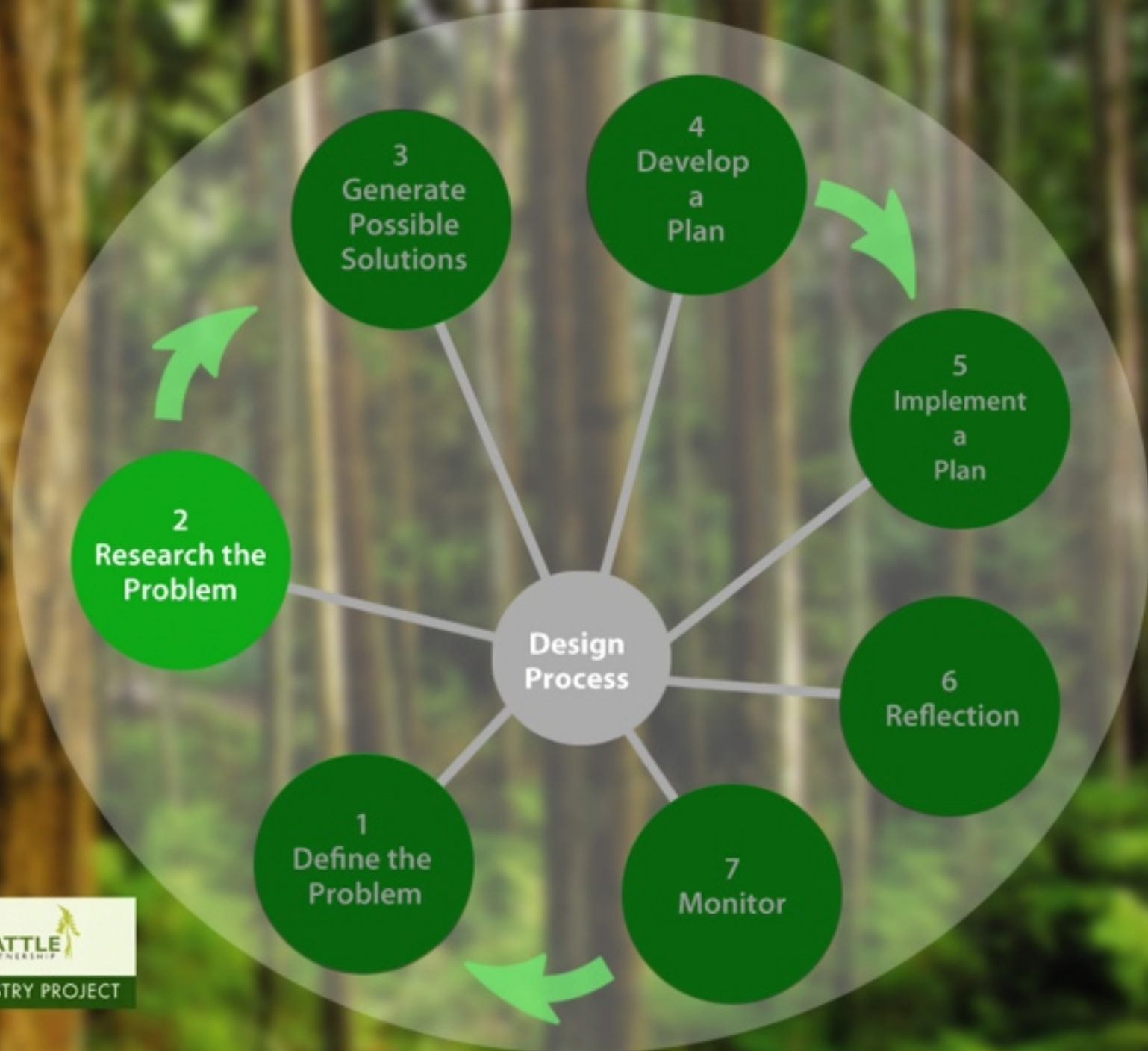


1

# Define the Problem

**Our local forests  
aren't as healthy  
as they should be.**







# 2

## Research the Problem

### ESSENTIAL QUESTION:

What is the Condition of  
Our Local Urban Forest?



# What Do We Need to Know First?

1. Learn the types of native trees in our forest.
2. Learn the invasive plants in our forest.



# What is the Condition of our Local Forest?

## INVESTIGATIONS

1. Is the percentage of canopy cover greater than 25%?
2. What percentage of the plant life on the ground is invasive?
3. Which tree type (Evergreen/Deciduous) is more abundant in the forest?

























# What Do We Need to Know First?

1. Learn the types of native trees in our forest.
2. Learn the invasive plants in our forest.









Cedar





Cedar





Cedar





Cedar





Douglas-fir



Western Hemlock



Big Leaf Maple



Western Red Cedar



Madrona



Red Alder





Western Red Cedar



Grand Fir



Douglas-fir



Western Hemlock



Bigleaf Maple



Red Alder



Madrona



# Lesson 2

## URBAN FORESTRY PROJECT





# What Do We Need to Know First?

1. Learn the types of native trees in our forest.

2. Learn the invasive plants in our forest.

































**Help!**

**Help!**

**Help!**

**Help!**































# SUCCESSION





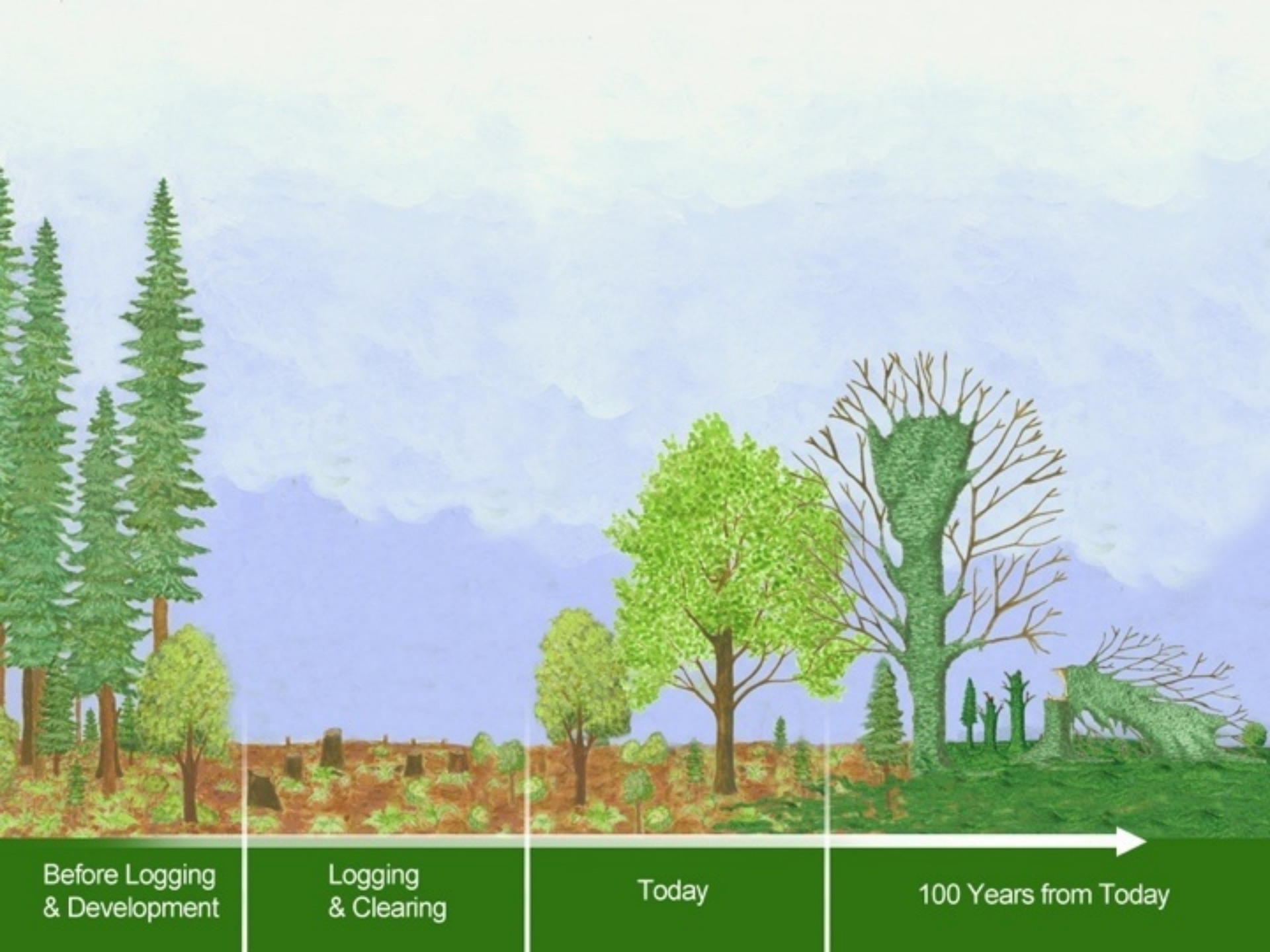


Before Logging  
& Development

Logging  
& Clearing

Today

100 Years from Today



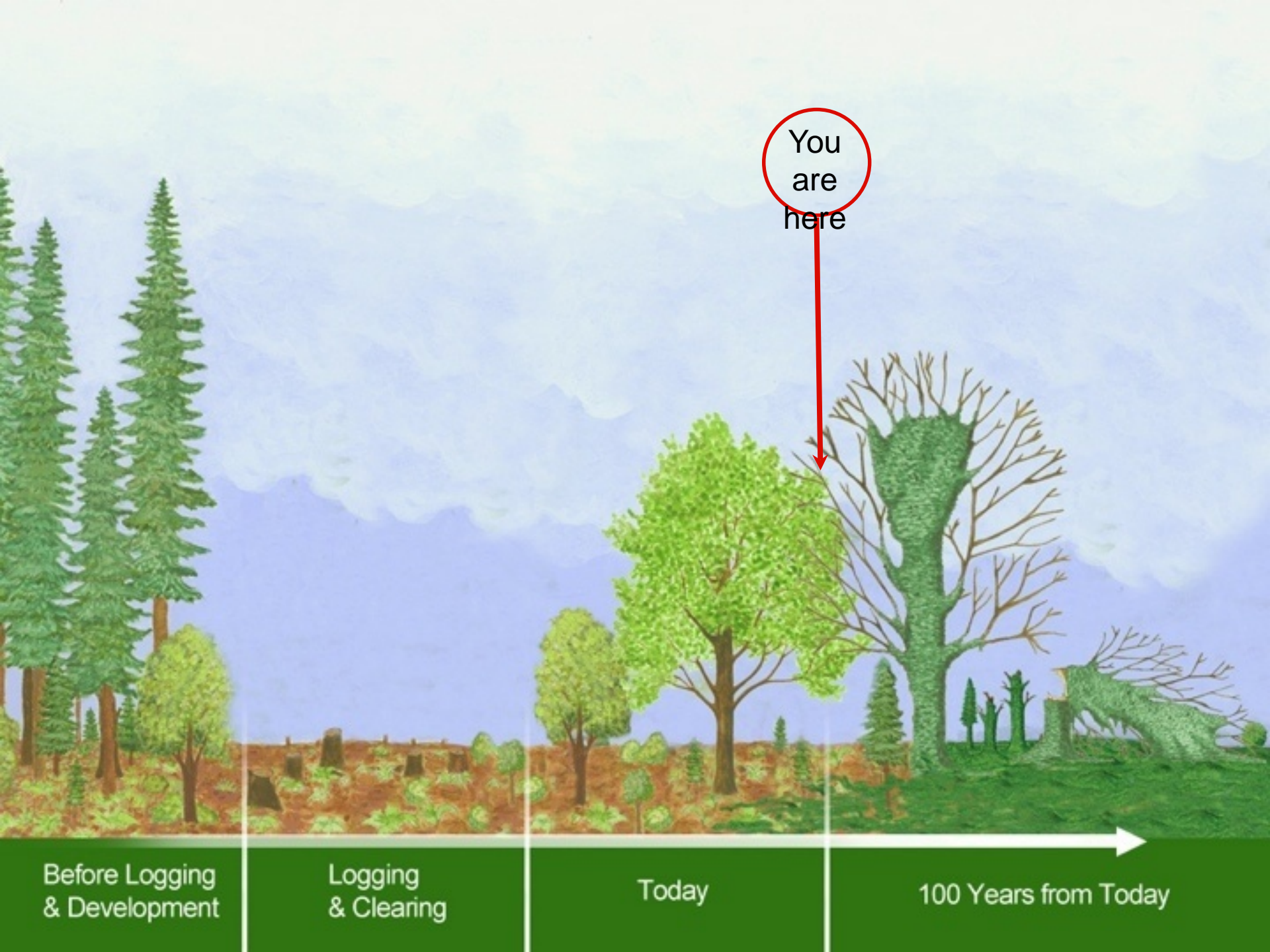
Before Logging  
& Development

Logging  
& Clearing

Today

100 Years from Today





You  
are  
here

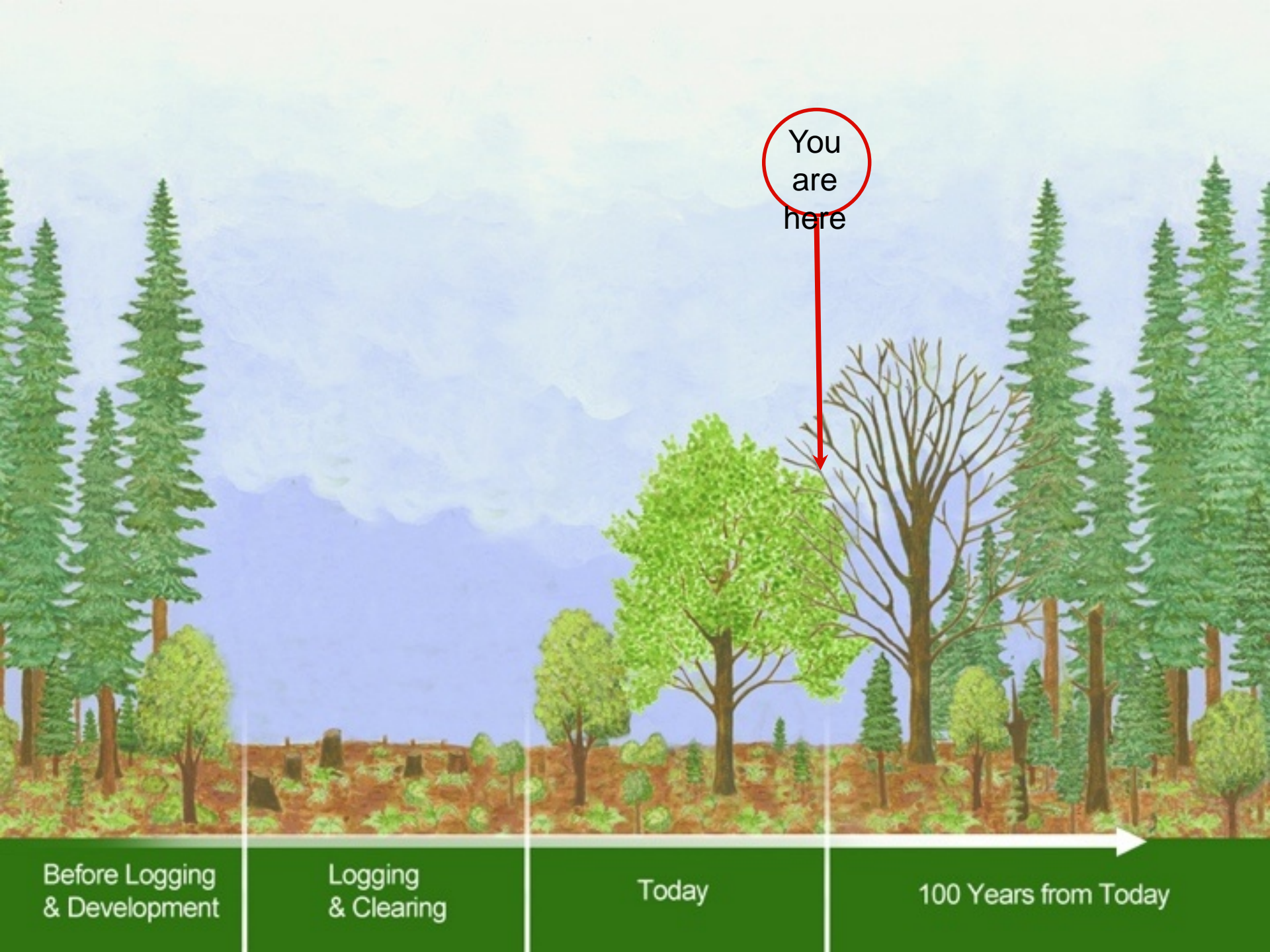
Before Logging  
& Development

Logging  
& Clearing

Today

100 Years from Today





You  
are  
here

Before Logging  
& Development

Logging  
& Clearing

Today

100 Years from Today



# Lesson 3-Planning for the Investigations





# ESSENTIAL QUESTION:

**What is the Condition of our Local Forest?**



# What is the Condition of our Local Forest?

## INVESTIGATIONS

1. Is the percentage of canopy cover greater than 25%?
2. What percentage of the plant life on the ground is invasive?
3. Which tree type (Evergreen/Deciduous) is more abundant in the forest?



# Create Study Plots

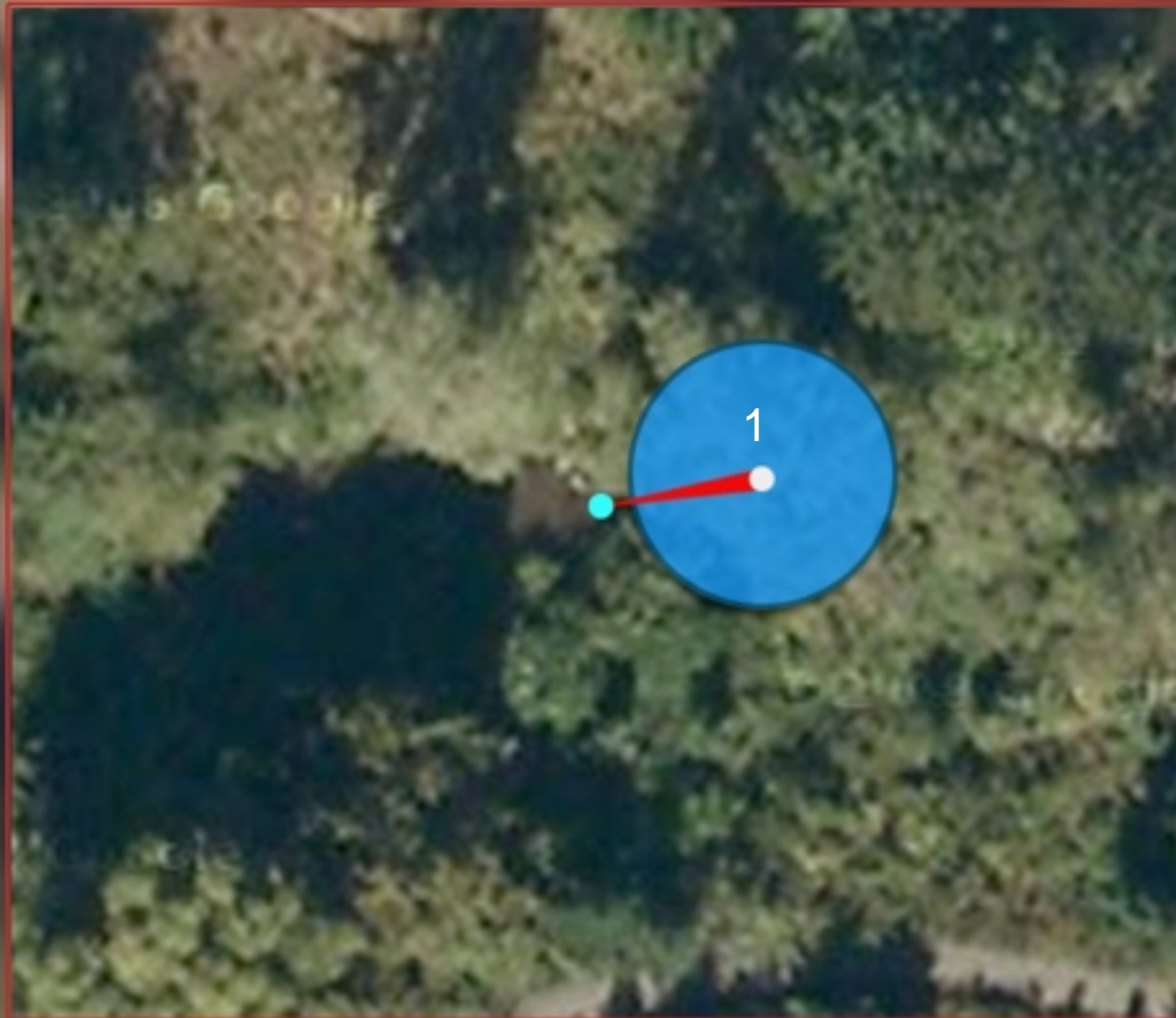


# Create Study Plots





# Create Study Plots



# Create Study Plots





# Create Study Plots





# Create Study Plots



# Create Study Plots





# Create Study Plots

37.2 foot rope  
1/10<sup>th</sup> of an Acre





# Create Study Plots

## Directions for making plots

1. Four students find the center of the plot that is staked.
- 2. Four students each having ropes that are 37.2 feet long stretch their ropes out perpendicular to each other. When they are fully stretched out students flag that spot.**
3. Next have the students come back to center and rotate slightly where they leave the center.
- 4. Again students stretch the ropes out their full length and flag again.**
5. Repeat 1 more time
- 6. Twelve flags should now be in place creating the circle plot.**

# Create Study Plots





# Investigation 1

Is the percentage of canopy cover greater than 25%?





## Canopy Cover and Invasive Ground Cover Abundance Data Collection Sheet - Plot #\_\_\_\_

Teacher's Name: \_\_\_\_\_ Date: \_\_\_\_\_

Recorder's Name: \_\_\_\_\_

Team Member's Names: \_\_\_\_\_

**Question #1:** *What is the Canopy Cover %?:* (Circle One)     $\leq 25\%$      $> 25\%$

**Question #2:** *What is the % of invasive plant cover in the forest at Lake Wilderness Arboretum?*

*Prediction Statement:* \_\_\_\_\_.

***Please circle any of the following invasive plants present in the plot:***

English Ivy      English Holly      Himalayan Blackberry      Bindweed/Morning Glory      Cherry Laurel

Scot's Broom      Knotweed      Lamium

## Canopy Cover and Invasive Ground Cover Abundance Data Collection Sheet - Plot #\_\_\_\_

Teacher's Name: \_\_\_\_\_ Date: \_\_\_\_\_

Recorder's Name: \_\_\_\_\_

Team Member's Names: \_\_\_\_\_  
\_\_\_\_\_

**Question #1:** *What is the Canopy Cover %?:* (Circle One)     $\leq 25\%$      $> 25\%$

**Question #2:** *What is the % of invasive plant cover in the forest at Lake Wilderness Arboretum?*

*Prediction Statement:* \_\_\_\_\_.

***Please circle any of the following invasive plants present in the plot:***

English Ivy      English Holly      Himalayan Blackberry      Bindweed/Morning Glory      Cherry Laurel  
  
Scot's Broom      Knotweed      Lamium

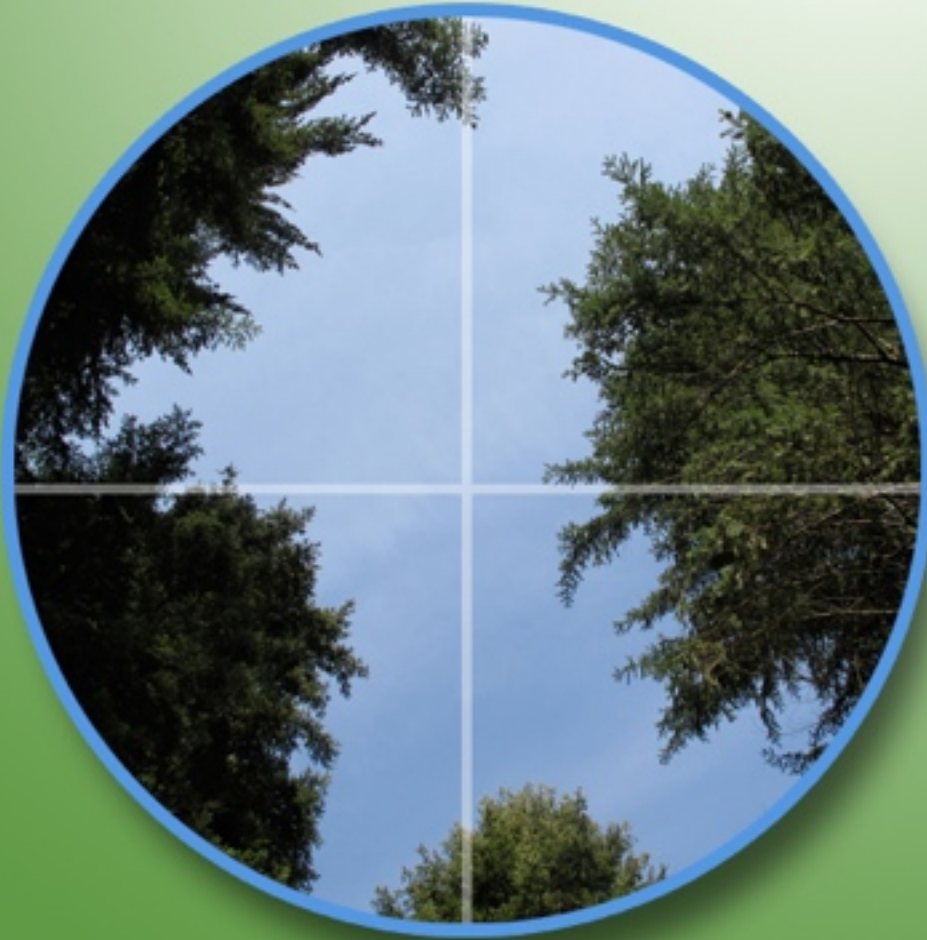
# Measuring Canopy Cover







# Measuring Canopy Cover



Greater than 25%



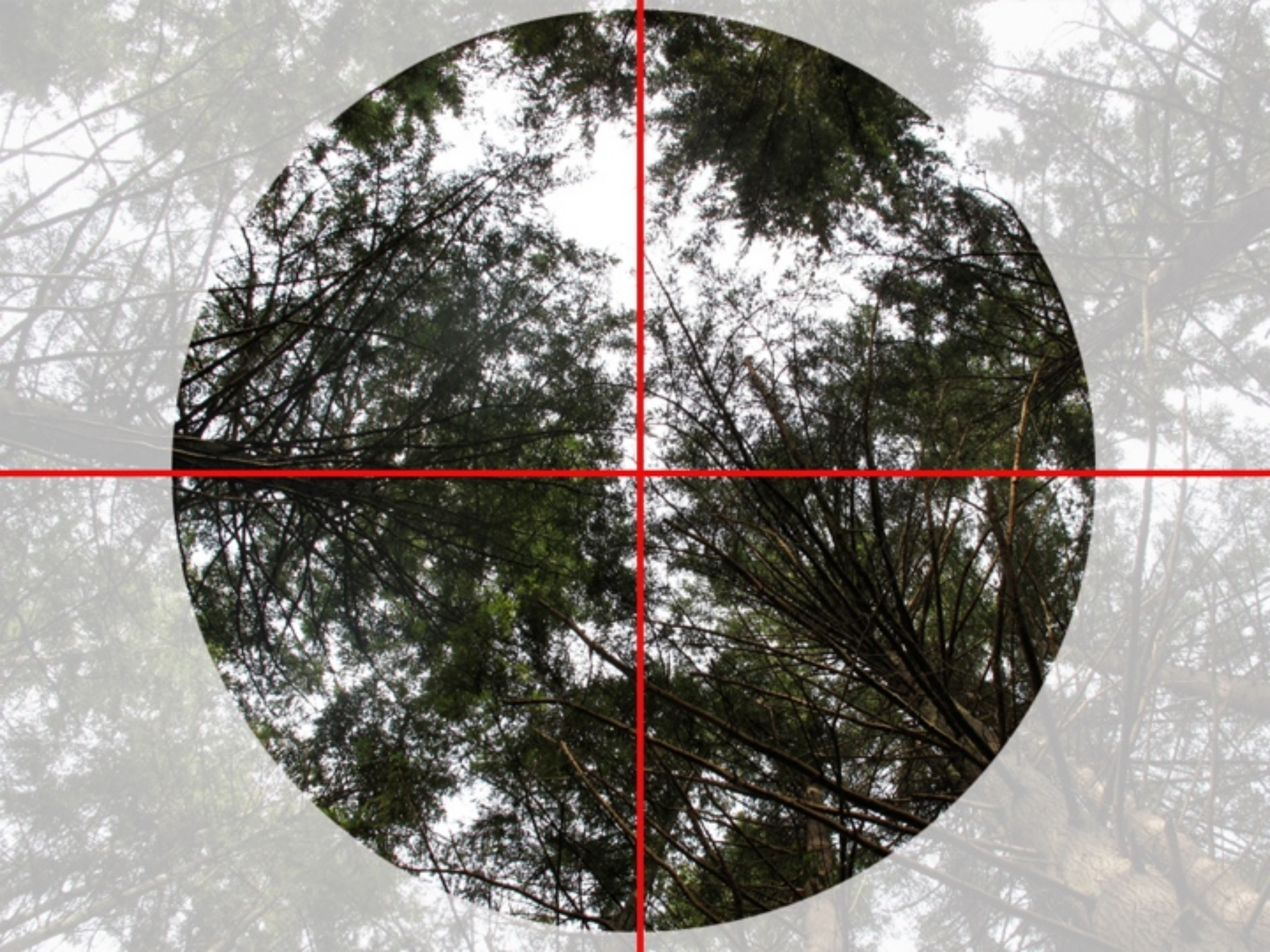
Less than 25%



**So What Is This One?**







# Canopy Cover and Invasive Ground Cover Abundance Data Collection Sheet - Plot #\_\_\_\_

Teacher's Name: \_\_\_\_\_ Date: \_\_\_\_\_

Recorder's Name: \_\_\_\_\_

Team Member's Names: \_\_\_\_\_

**Question #1:** *What is the Canopy Cover %?:* (Circle One)     $\leq 25\%$     **>25%**

**Question #2:** *What is the % of invasive plant cover in the forest at Lake Wilderness Arboretum?*

*Prediction Statement:* \_\_\_\_\_.

***Please circle any of the following invasive plants present in the plot:***

English Ivy      English Holly      Himalayan Blackberry      Bindweed/Morning Glory      Cherry Laurel

Scot's Broom      Knotweed      Lamium



# Investigation 2

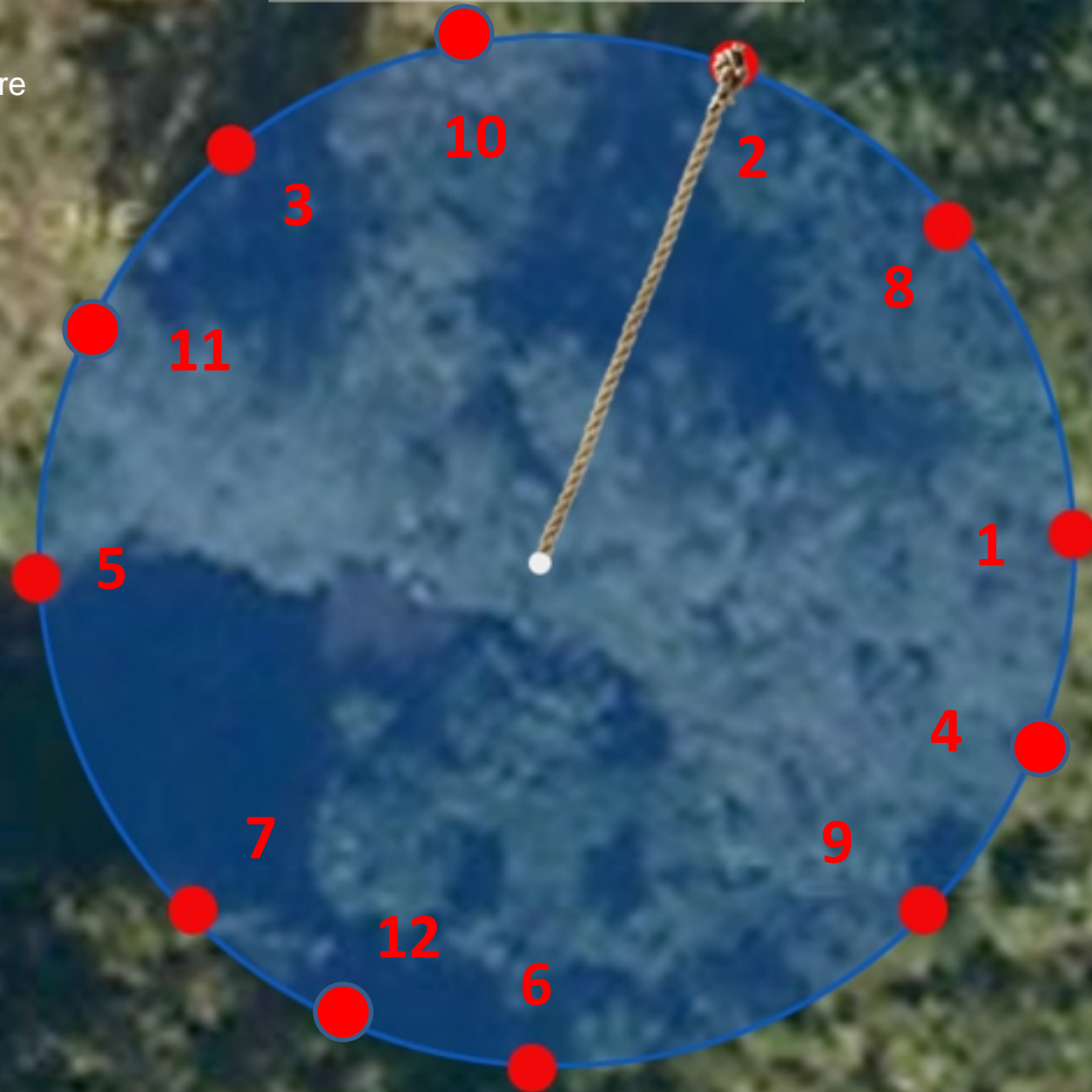
*What is the % of invasive plant cover in the forest at Lake Wilderness Arboretum?*





# Create Study Plots

37.2 foot rope  
1/10<sup>th</sup> of an Acre



**Question #2:** *What is the % of invasive plant cover in the forest at Lake Wilderness Arboretum?*

**Prediction Statement:** \_\_\_\_\_

**Please circle any of the following invasive plants present in the plot:**

English Ivy      English Holly      Himalayan Blackberry      Bindweed/Morning Glory      Cherry Laurel  
Scot's Broom      Knotweed      Lamium

**Directions:** Shade in each cell containing more than 50% invasive plant cover

**Transect Line: #2**


Grid 1= #15


Grid 2= #24


Grid 3= #34


Grid 4= # 35

**Transect Line: #7**


Grid 1= #2


Grid 2= #13


Grid 3= #18


Grid 4= #23

**Transect Line: #10**


Grid 1= #3


Grid 2= #12


Grid 3= #14


Grid 4= #28

**Question #2:** What is the % of invasive plant cover in the forest at Lake Wilderness Arboretum?

Prediction Statement: \_\_\_\_\_

**Please circle any of the following invasive plants present in the plot:**

English Ivy      English Holly      Himalayan Blackberry      Bindweed/Morning Glory      Cherry Laurel  
Scot's Broom      Knotweed      Lamium

**Directions:** Shade in each cell containing more than 50% invasive plant cover

**Transect Line: #2**


Grid 1= #15


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Grid 4= # 35

**Transect Line: #7**


Grid 1= #2


Grid 2= #13


Grid 3= #18


Grid 4= #23

**Transect Line: #10**


Grid 1= #3

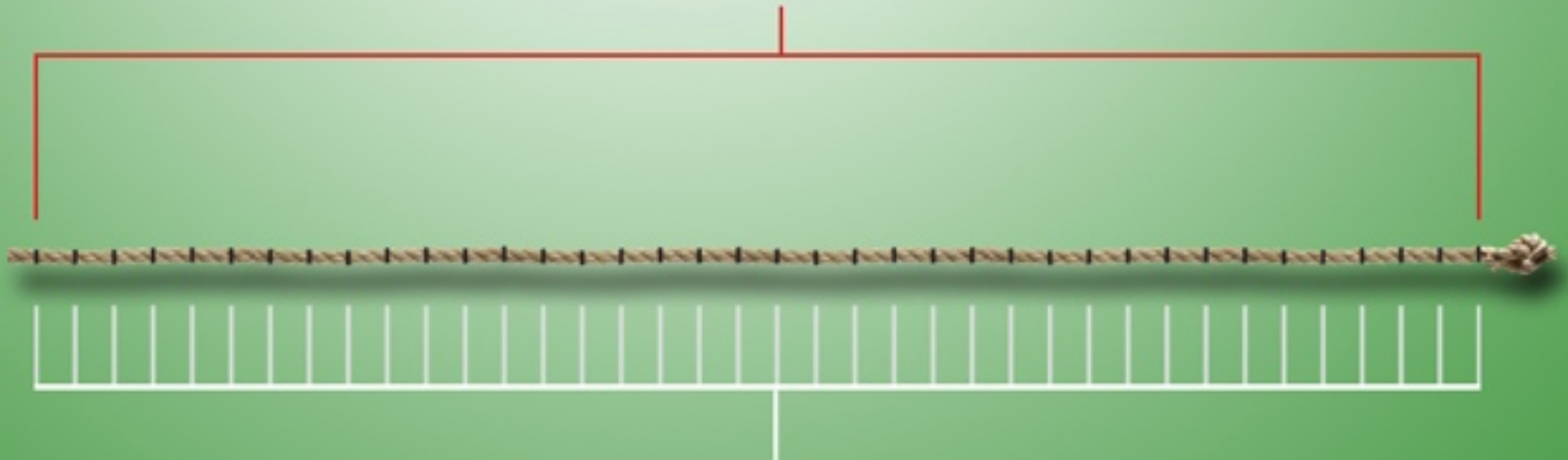

Grid 2= #12


Grid 3= #14


Grid 4= #28



37 ft. Long Rope



1 ft. Intervals


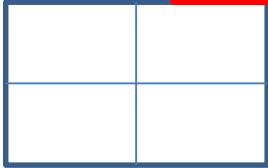
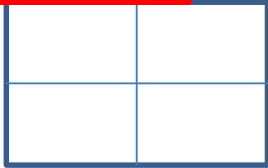
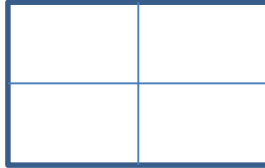
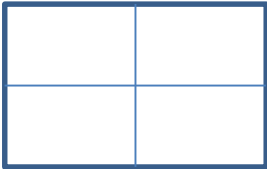


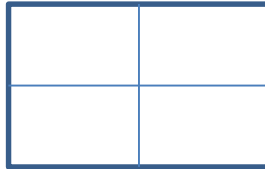
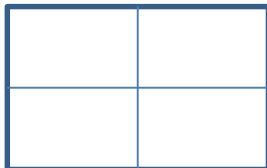
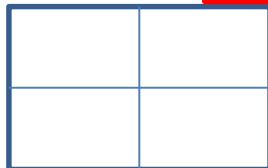

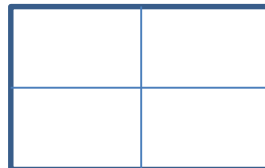
**Question #2:** *What is the % of invasive plant cover in the forest at Lake Wilderness Arboretum?*

*Prediction Statement:* \_\_\_\_\_

**Please circle any of the following invasive plants present in the plot:**

English Ivy      English Holly      Himalayan Blackberry      Bindweed/Morning Glory      Cherry Laurel  
Scot's Broom      Knotweed      Lamium

**Directions:** Shade in each cell containing more than 50% invasive plant cover

<div style="border: 2px solid red; padding: 2px; display: inline-block;"><b>Transect Line: #2</b></div>			
			
Grid 1= #15	Grid 2= #24	Grid 3= #34	Grid 4= # 35
<div style="border: 2px solid red; padding: 2px; display: inline-block;"><b>Transect Line: #7</b></div>			
			
Grid 1= #2	Grid 2=#13	Grid 3= #18	Grid4=23
<div style="border: 2px solid red; padding: 2px; display: inline-block;"><b>Transect Line: #10</b></div>			
			
Grid 1=#3	Grid 2=#12	Grid 3= #14	Grid 4= #28

# Create Study Plots

37.2 foot rope  
1/10<sup>th</sup> of an Acre





**Question #2:** What is the % of invasive plant cover in the forest at Lake Wilderness Arboretum?

Prediction Statement: \_\_\_\_\_

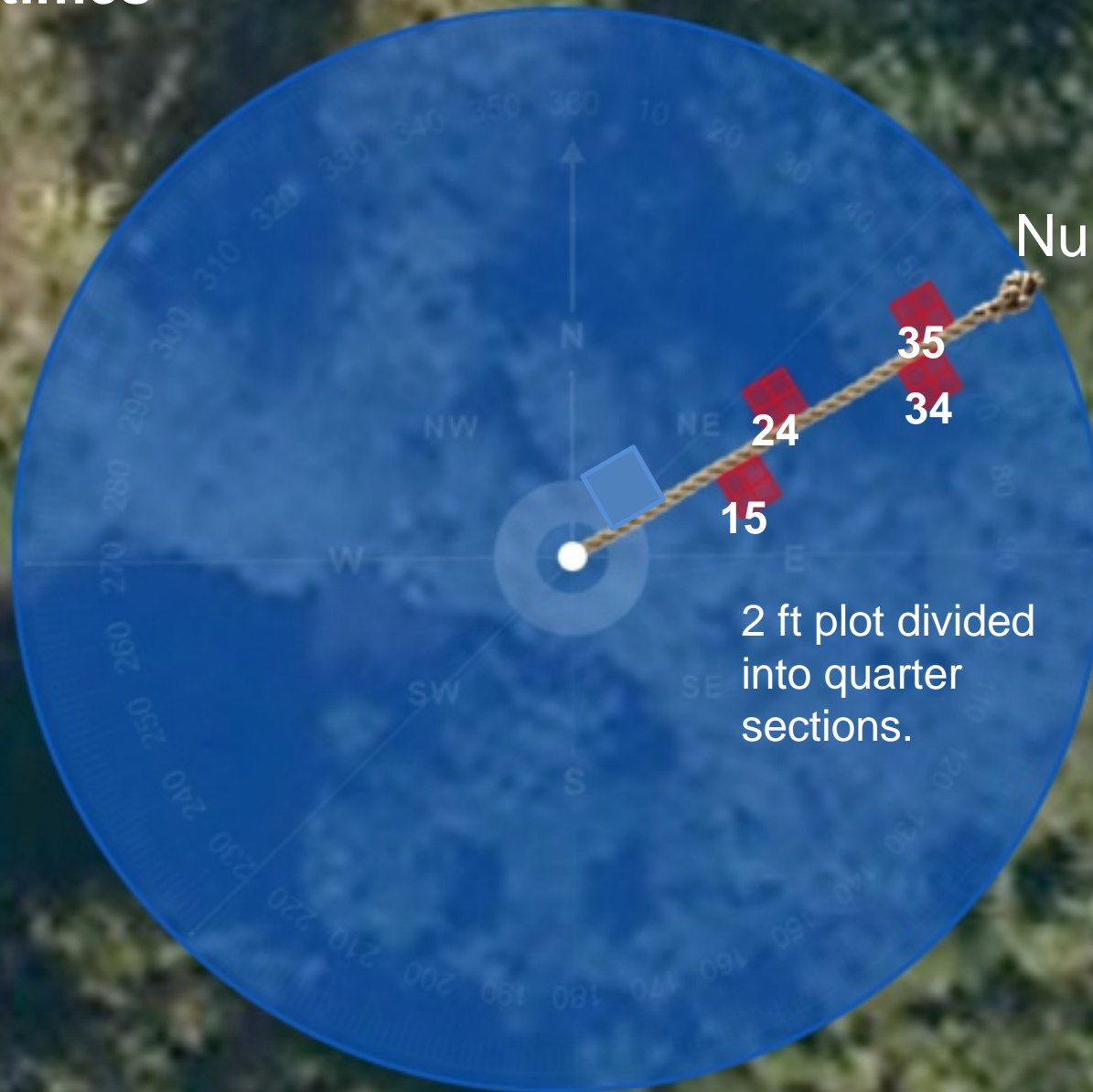
**Please circle any of the following invasive plants present in the plot:**

English Ivy      English Holly      Himalayan Blackberry      Bindweed/Morning Glory      Cherry Laurel  
Scot's Broom      Knotweed      Lamium

**Directions:** Shade in each cell containing more than 50% invasive plant cover

Transect Line: #2			
<div>Grid 1= #15</div>	<div>Grid 2= #24</div>	<div>Grid 3= #34</div>	<div>Grid 4= # 35</div>
Transect Line: #7			
<div>Grid 1= #2</div>	<div>Grid 2= #13</div>	<div>Grid 3= #18</div>	<div>Grid 4= # 23</div>
Transect Line: #10			
<div>Grid 1= #3</div>	<div>Grid 2= #12</div>	<div>Grid 3= #14</div>	<div>Grid 4= #28</div>

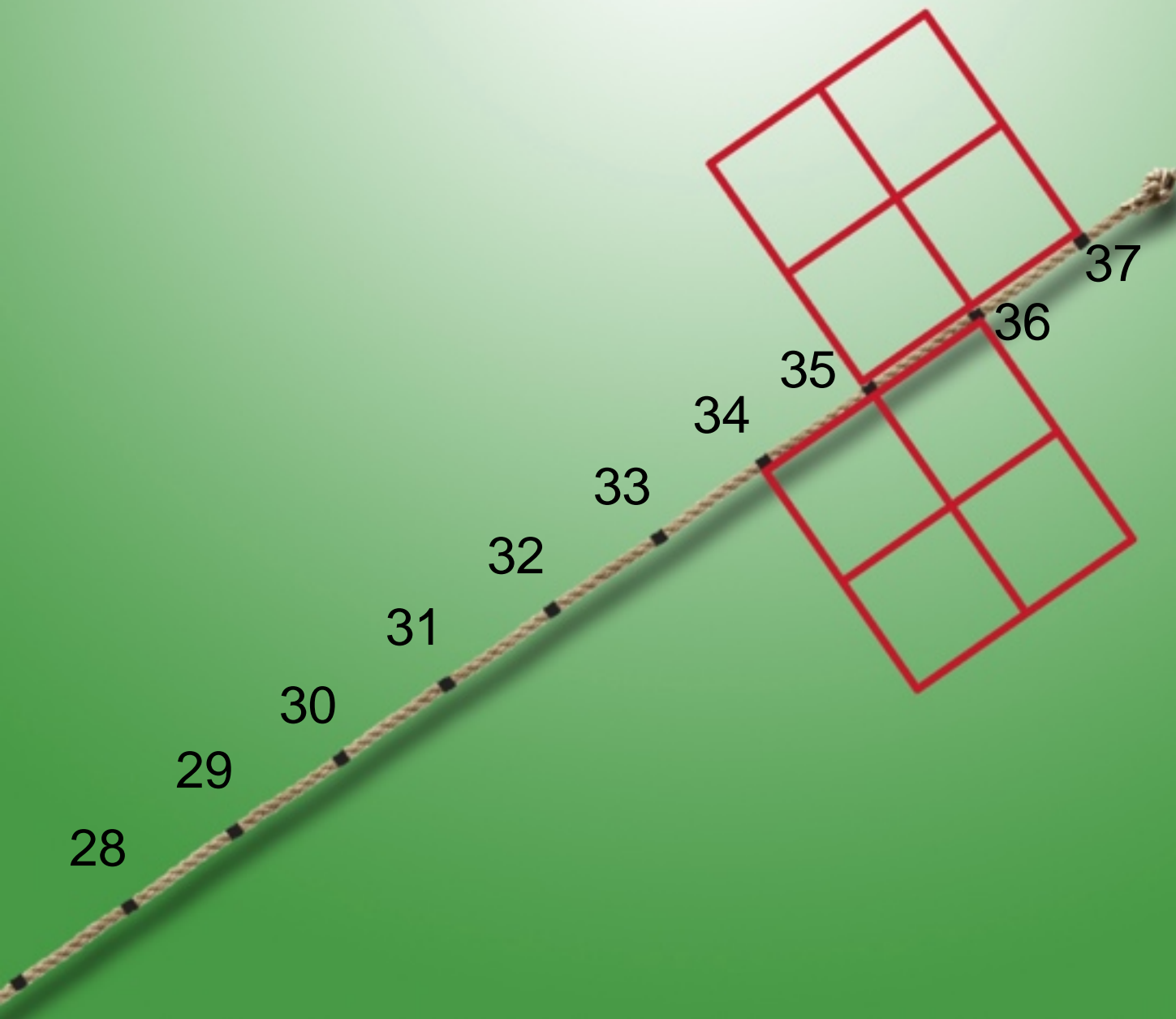
**Repeat 3 times**



**Number 2 flag**

**35**  
**34**  
**24**  
**15**

2 ft plot divided  
into quarter  
sections.







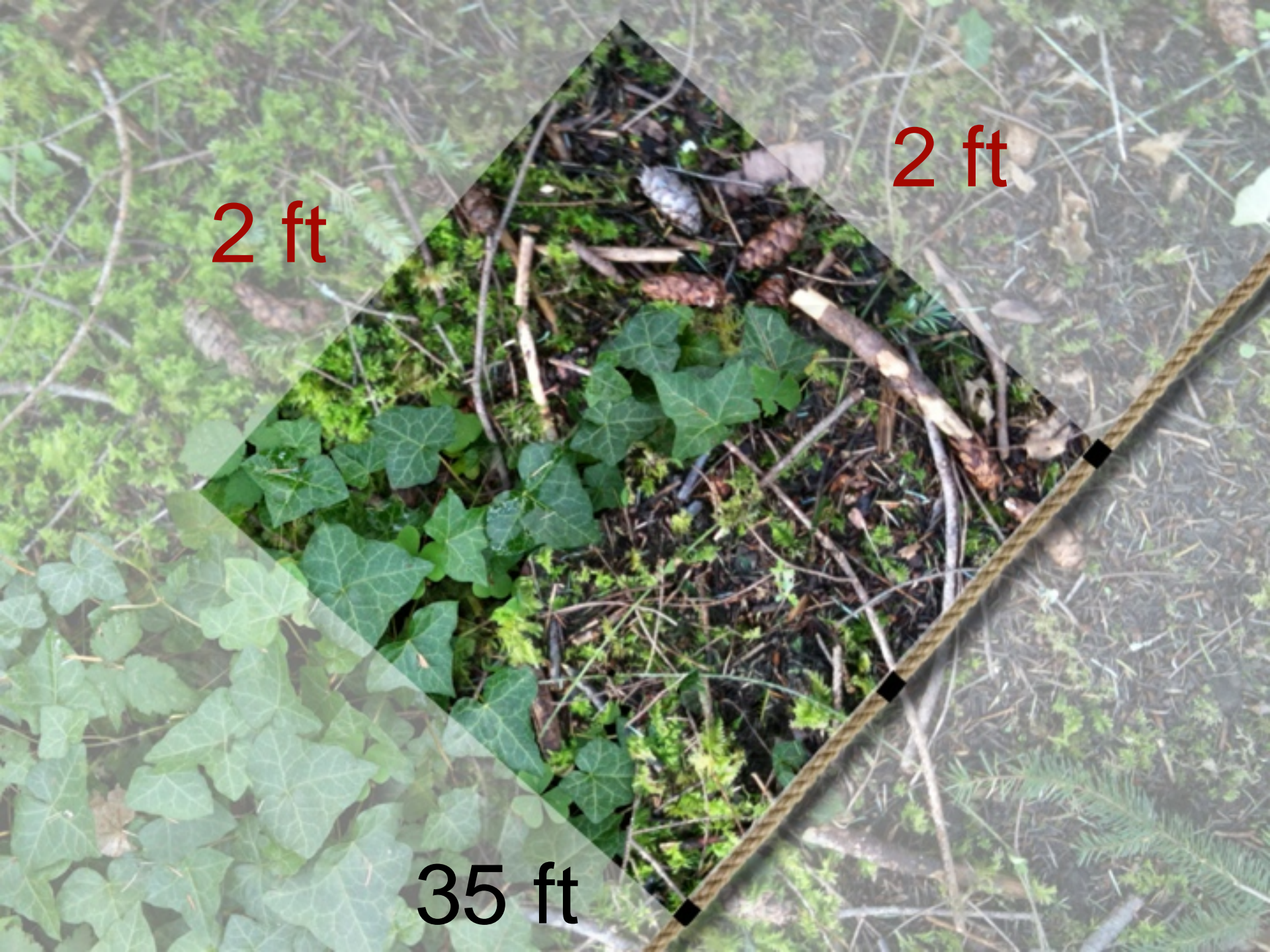
35 ft



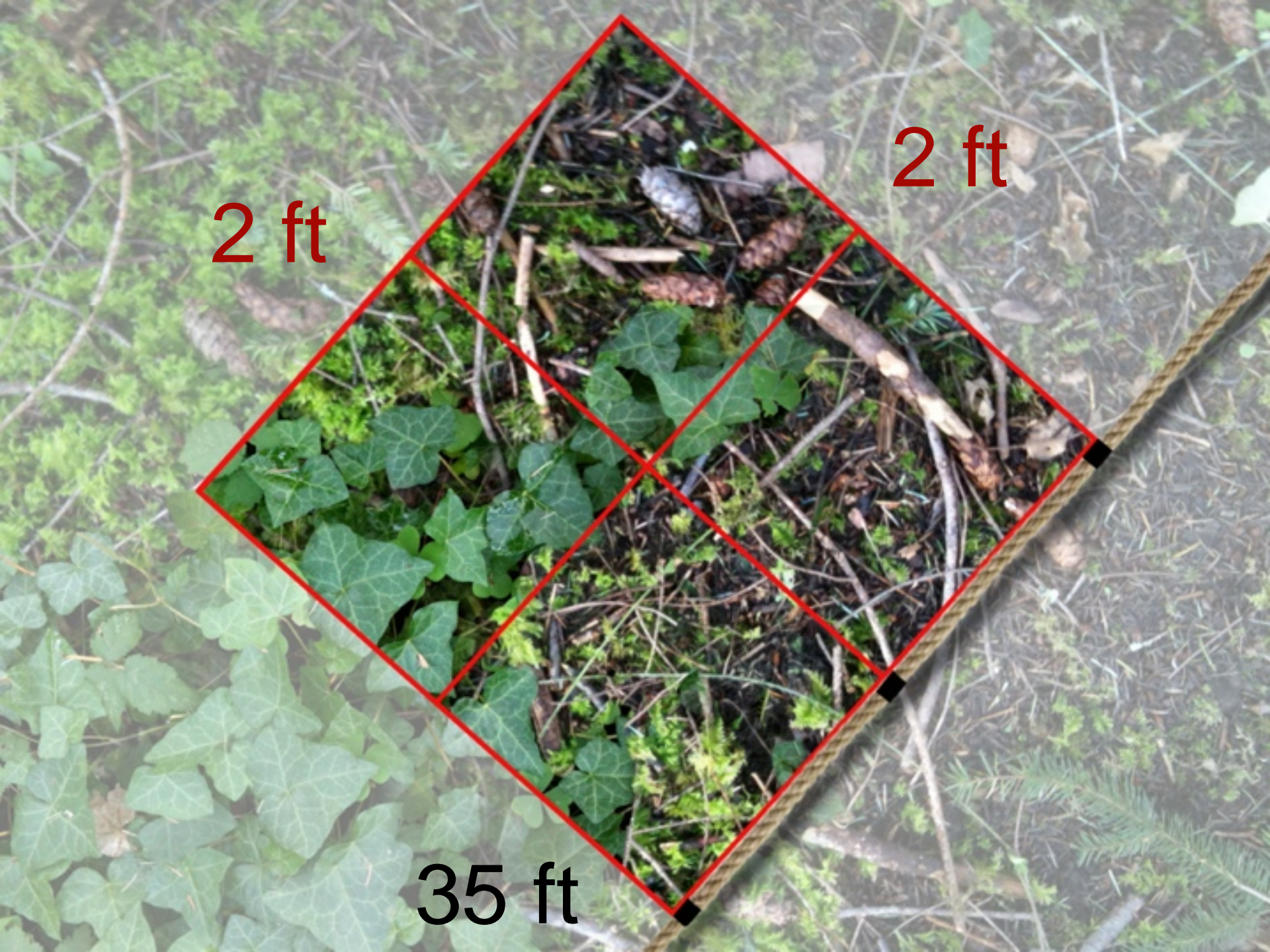
2 ft

2 ft

35 ft







2 ft

2 ft

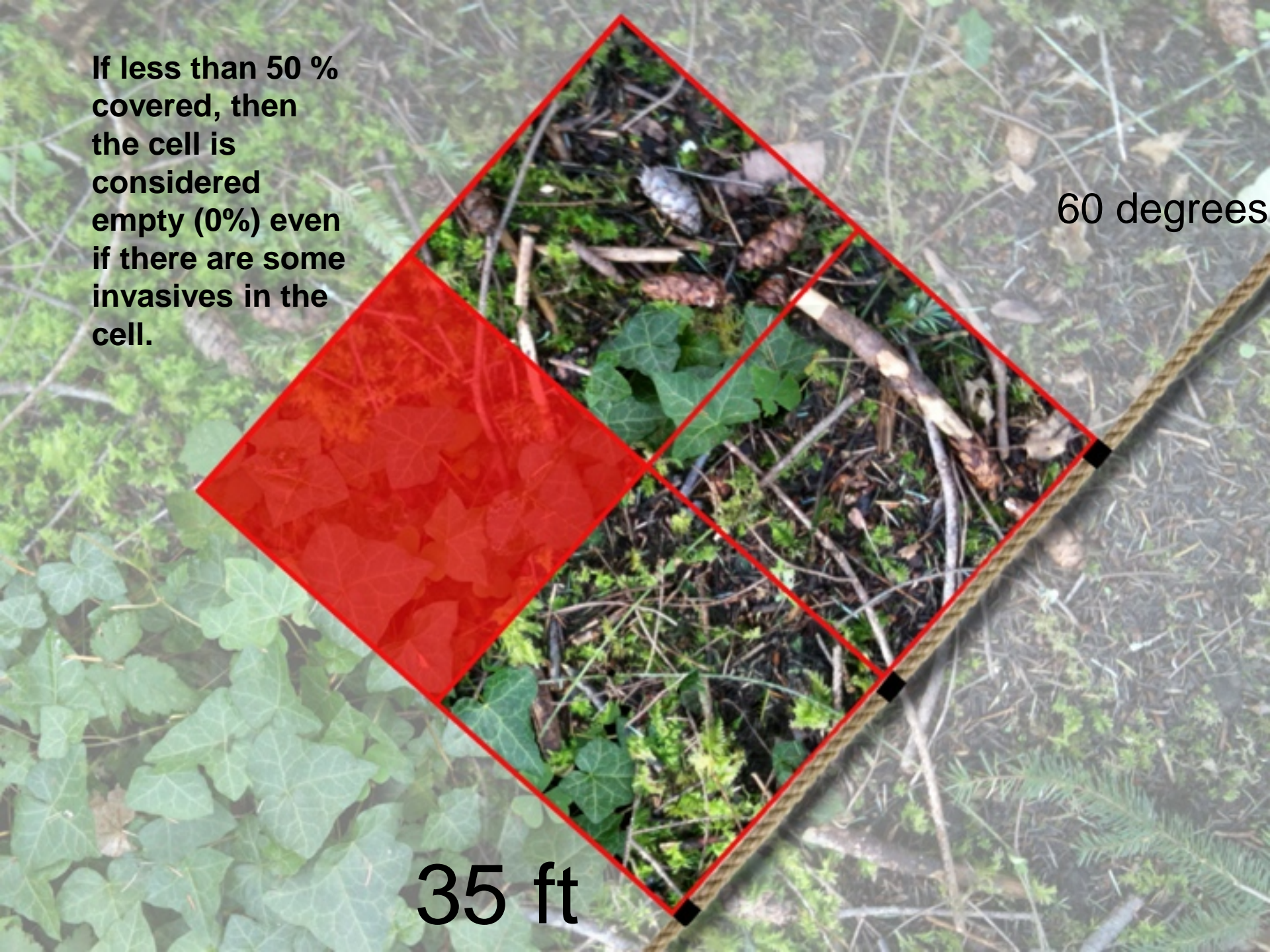
35 ft



**If less than 50 %  
covered, then  
the cell is  
considered  
empty (0%) even  
if there are some  
invasives in the  
cell.**

60 degrees

35 ft



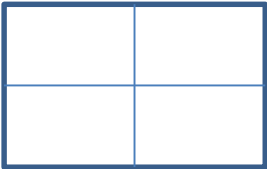



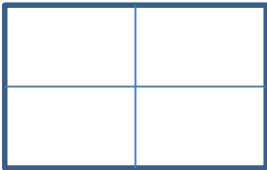
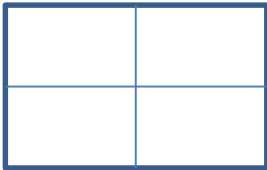
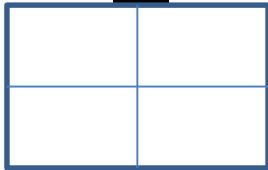
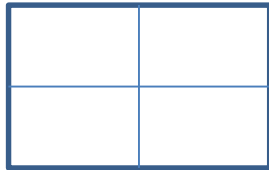
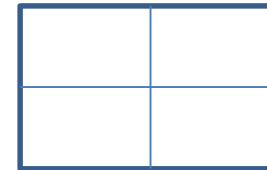
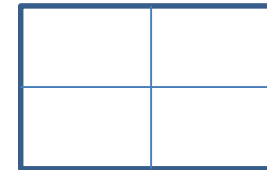

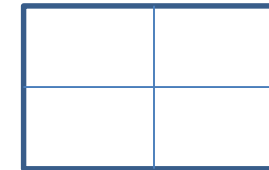
**Question #2:** What is the % of invasive plant cover in the forest at Lake Wilderness Arboretum?

Prediction Statement: \_\_\_\_\_

**Please circle any of the following invasive plants present in the plot:**

English Ivy      English Holly      Himalayan Blackberry      Bindweed/Morning Glory      Cherry Laurel  
Scot's Broom      Knotweed      Lamium

**Directions:** Shade in each cell containing more than 50% invasive plant cover

<b><u>Transect Line: #2</u></b>			
			
Grid 1= #15	Grid 2= #24	Grid 3= #34	<b><u>Grid 4= # 35</u></b>
<b><u>Transect Line: #7</u></b>			
			
Grid 1= #2	Grid 2= #13	Grid 3= #18	Grid 4= # 23
<b><u>Transect Line: #10</u></b>			
			
Grid 1= #3	Grid 2= #12	Grid 3= #14	Grid 4= #28







# Investigation 3

What tree type (Evergreen or Deciduous) is more abundant in the forest?

We will also collect circumference data at the same time.



## Type of Tree Abundance

### Data Collection Sheet

**Question #3:** Which tree type, evergreen or deciduous, is more abundant in the forest in Lake Wilderness Arboretum?

**Prediction:** \_\_\_\_\_.

Recorder's Name: \_\_\_\_\_ Date: \_\_\_\_\_

Team Member's Names: \_\_\_\_\_, \_\_\_\_\_,

\_\_\_\_\_, \_\_\_\_\_,

Plot Location: \_\_\_\_\_ Teacher's Name: \_\_\_\_\_

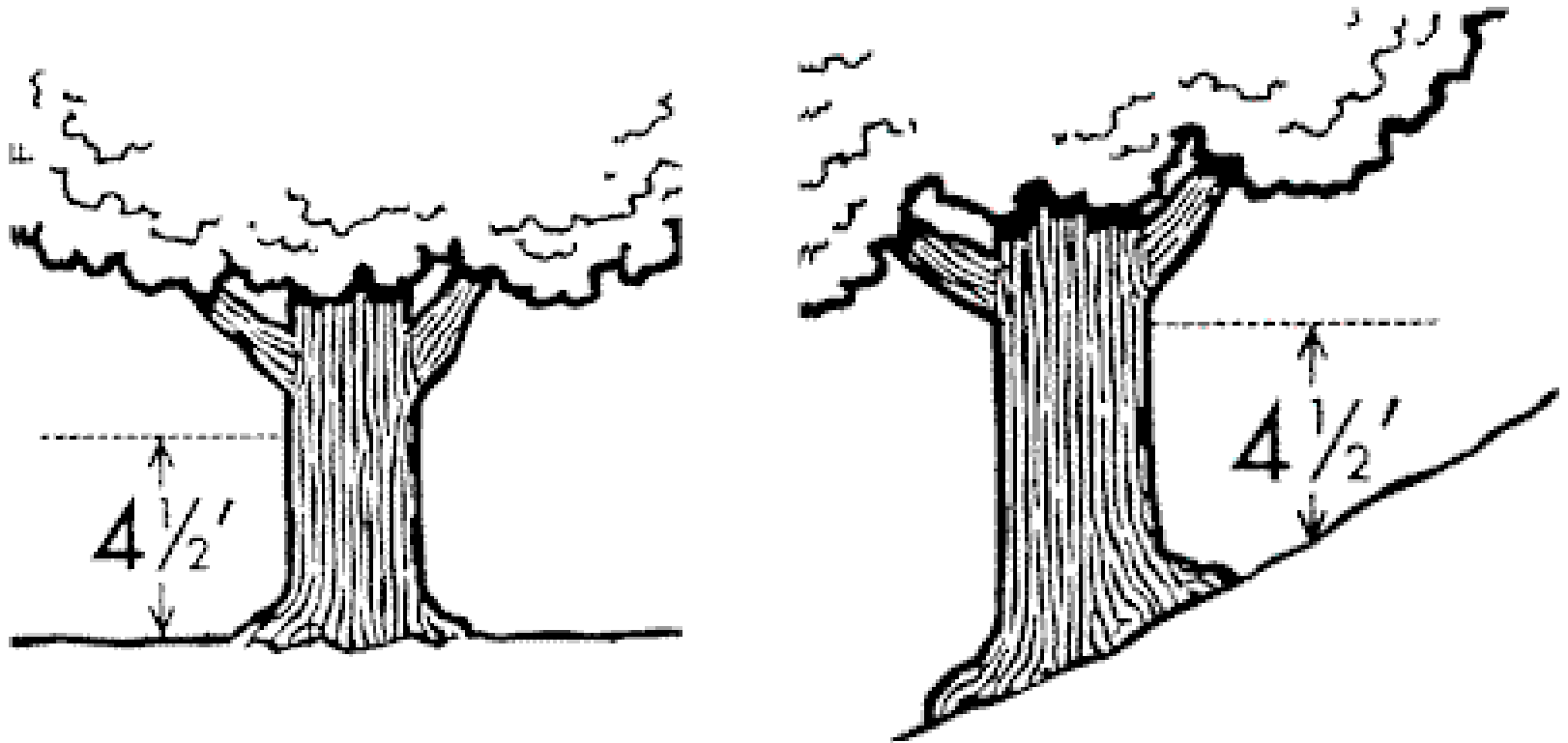
Number	Type of Tree	Evergreen (E) or Deciduous (D)	Circumference	Diameter
1				
2				
3				
4				
5				
6				
7				
8				
9				
10				
11				
12				
13				
14				
15				
16				
17				
18				
19				



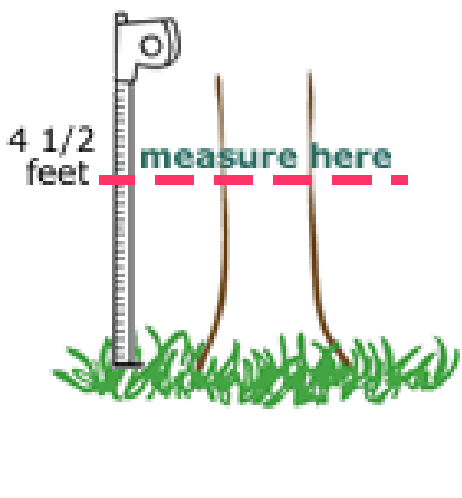




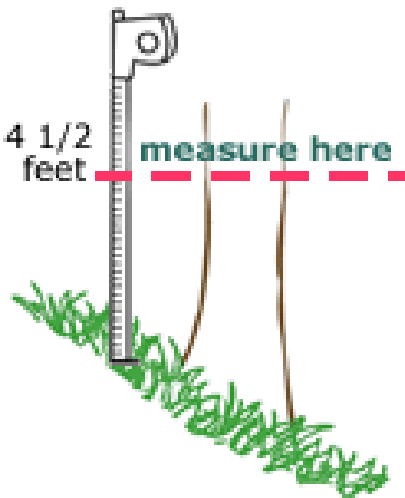
Measure Circumference at 4.5 feet  
from the ground



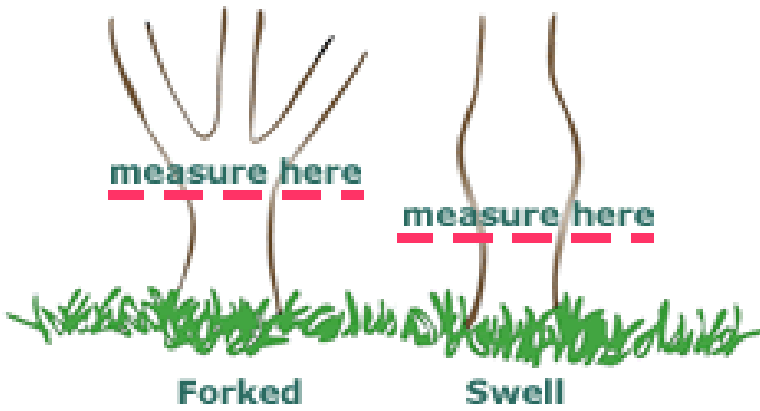
**Circumference at 4 1/2 ft**



**On a Slope**



If fork or swell occurs at 4 1/2 ft, measure below.



## Type of Tree Abundance

### Data Collection Sheet

**Question #3:** Which tree type, evergreen or deciduous, is more abundant in the forest in Lake Wilderness Arboretum?

**Prediction:** \_\_\_\_\_.

Recorder's Name: \_\_\_\_\_ Date: \_\_\_\_\_

Team Member's Names: \_\_\_\_\_, \_\_\_\_\_,

\_\_\_\_\_, \_\_\_\_\_

Plot Number: \_\_\_\_\_ Teacher's Name: \_\_\_\_\_

Number	Type of Tree	Evergreen (E) or Deciduous (D)	Circumference	Diameter
1	Douglas-Fir	E	23.5	
2	Big Leaf Maple	D	34	
3				
4				
5				
6				
7				
8				
9				
10				
11				
12				
13				
14				
15				
16				
17				
18				
19				



# Lesson 5-Data Analysis



# Processing and analyzing data Student pages

## 1. Is canopy cover greater than 25%?

Write a short sentence answering the question:

Canopy cover for 4 - 5 sample plots at Lake Wilderness Arboretum

Plot 1	Plot 2	Plot 3	Plot 4	Plot 5

Give data as a percentage of plots over 25% or a proportion

Note: If 2 plots over 25% and 2 plots equal to or less than 25%  
treat as separate groups.

## 2. What percentage of the forest is covered in invasive plants at Lake Wilderness Arboretum Forest?

Circle all the invasive plant species observed at the Arboretum:

- English Ivy
- English Holly
- Himalayan Blackberry
- Bindweed/Morning Glory
- Cherry Laurel
- Scot's Broom
- Knotweed
- Lamium

Write a summary of the results including types of invasive plants observed in plots and average percentage found in plots:

Percent of sample squares (% of 48 total) which had invasive plants

Plot 1	Plot 2	Plot 3	Plot 4	Plot 5	Average %



### 3. Which type of tree (evergreen or deciduous) is more abundant in the forest at Lake Wilderness Arboretum?

Write a conclusion that answers the question. Be sure to include:

- 1.Summary what the study was about
- 2.Limit the conclusion to date, time, and place
- 3.Answer the investigative question
- 4.Give supporting data
- 5.Explain how the data and the answer are connected- or say whether their predictions were correct

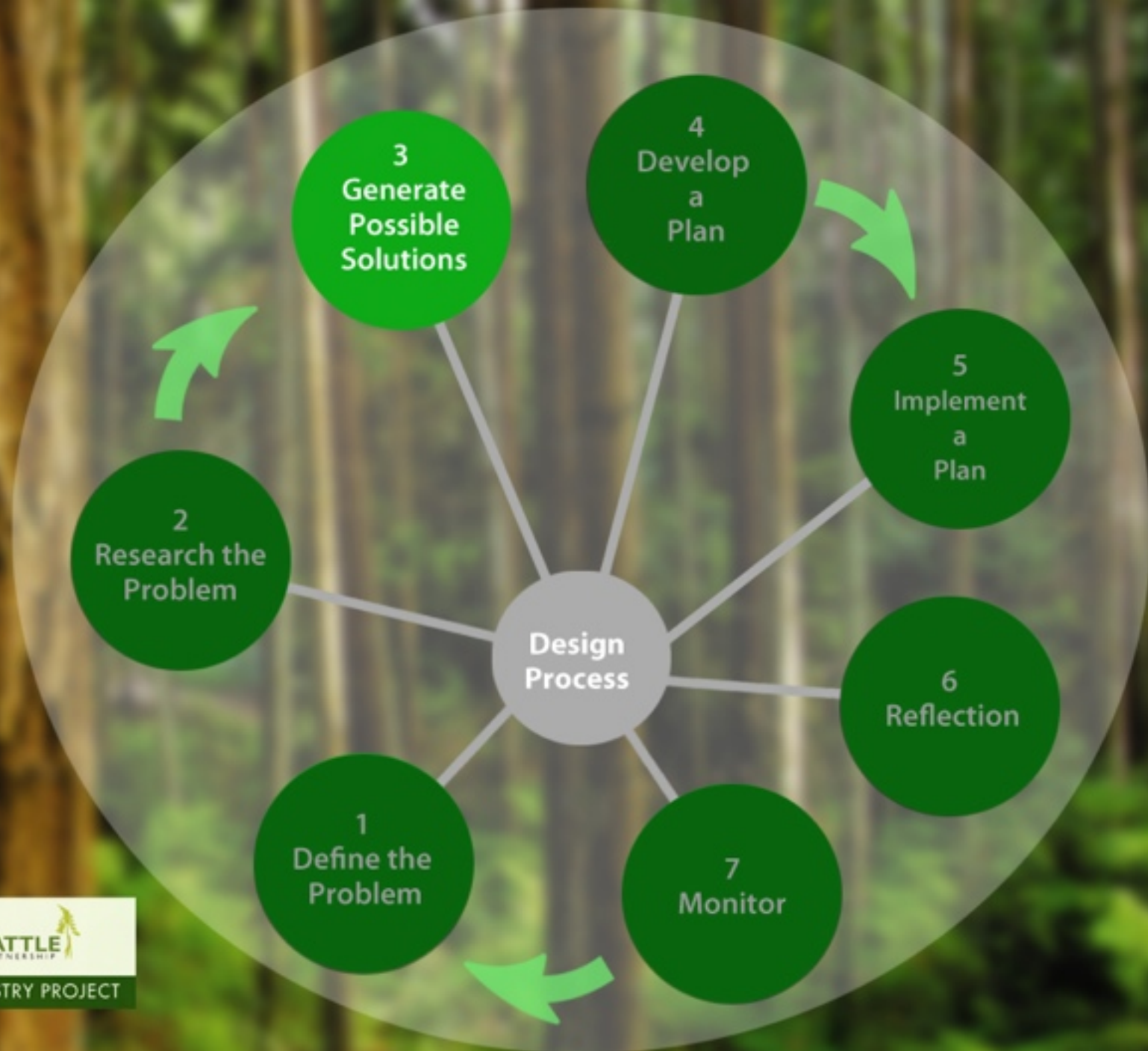
Percent of evergreens in each sample plot					
Plot 1	Plot 2	Plot 3	Plot 4	Plot 5	Average % evergreens



# Lesson 6 Tree-iage

URBAN FORESTRY PROJECT







3

## Generate Possible Solutions

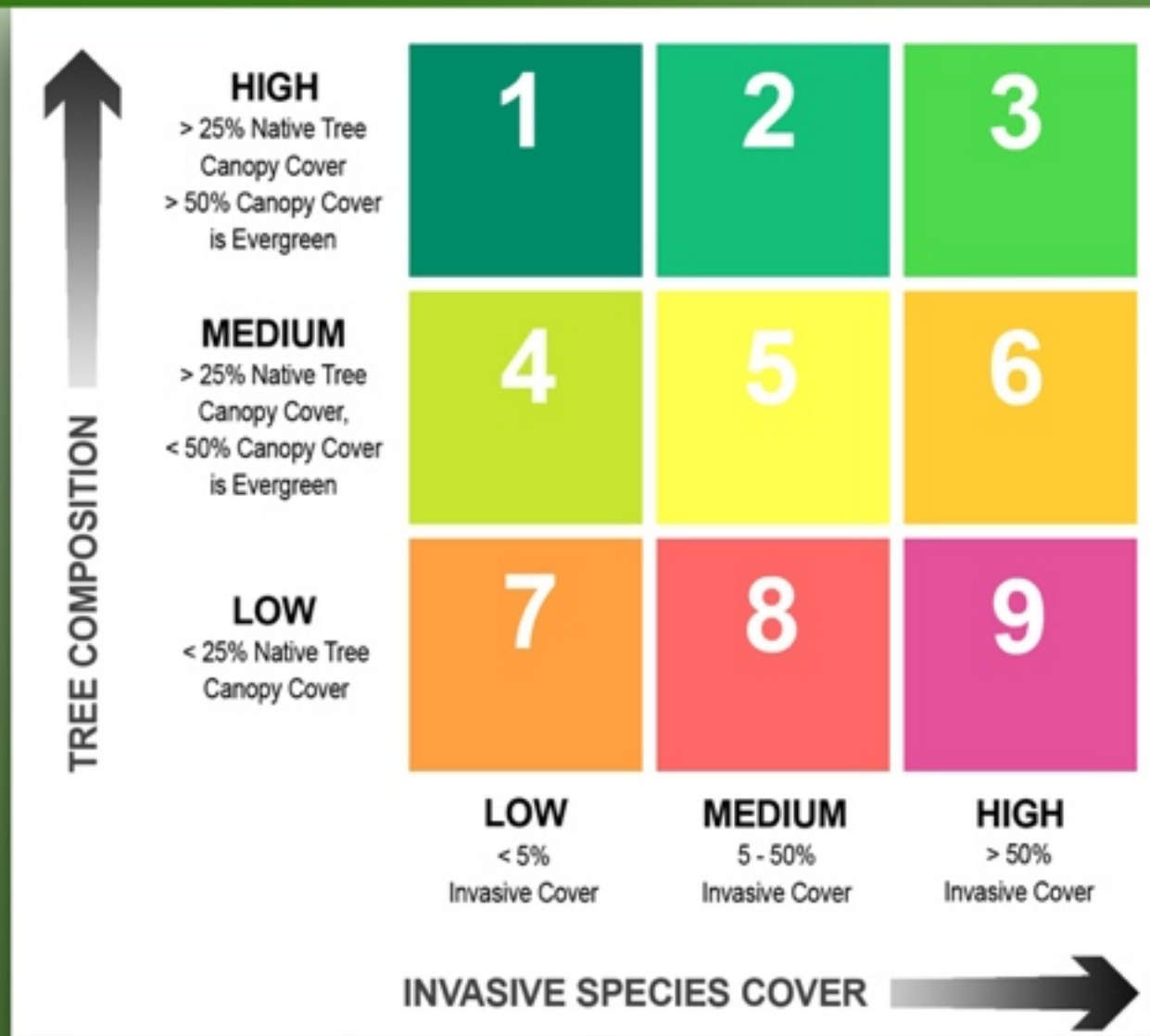


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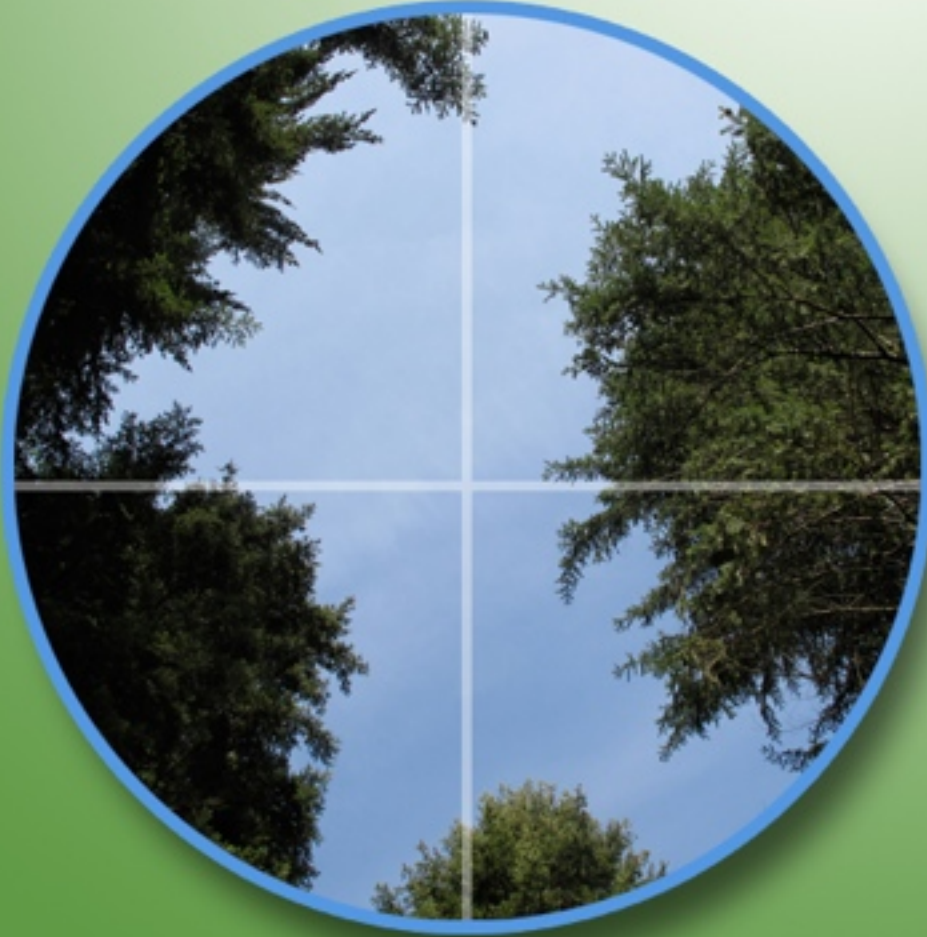
URBAN FORESTRY PROJECT

# GSP Tree-age Matrix





# Tree-image Generator



Greater than 25%



Less than 25%



# Tree-iage Generator

✓ Greater than 25% Canopy Cover



Greater than 50% Evergreen



Less than 50% Evergreen

# Tree-age Generator

- ✓ Greater than 25% Canopy Cover
- ✓ Greater than 50% Evergreen



Less than 5%  
Invasive Cover



5-50%  
Invasive Cover



Great than 50% Invasive  
Cover



# Tree-iage Generator

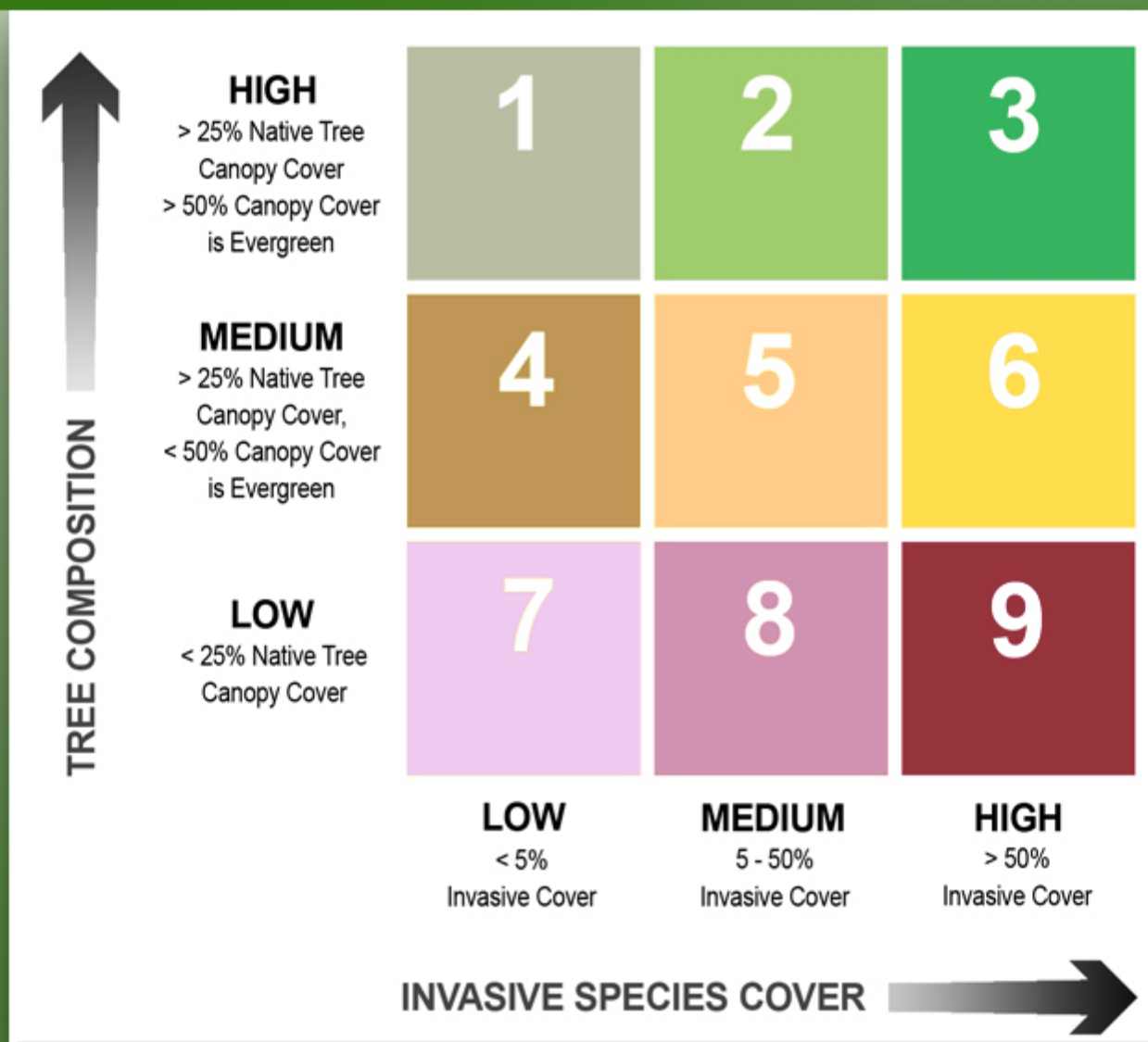
- ✓ Greater than 25% Canopy Cover
- ✓ Greater than 50% Evergreen
- ✓ 5-50% Invasive Cover



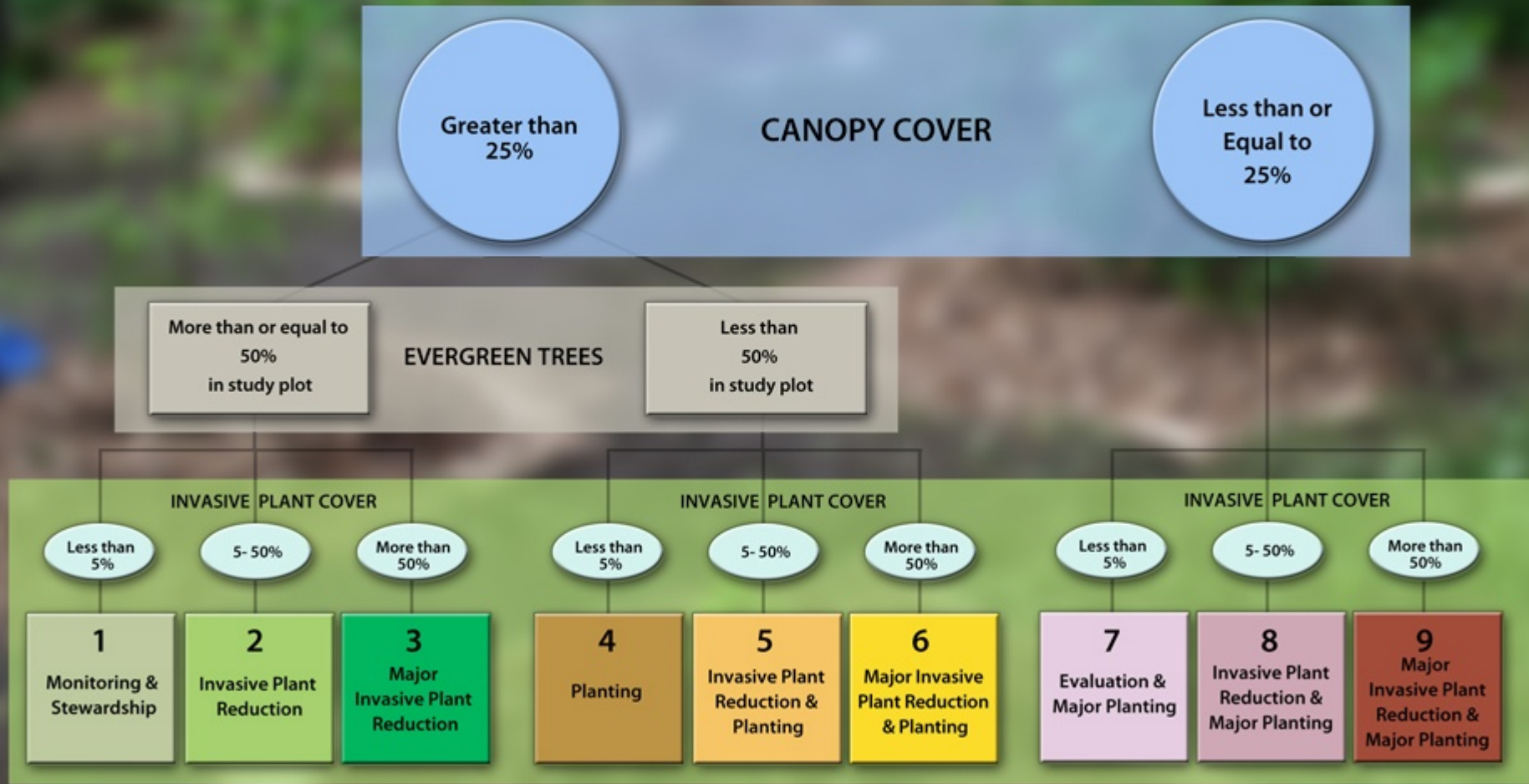
Recommended Treatment: Invasive Plant Reduction



# GSP Tree-age Matrix



# Tree-iage Generator Flow Chart





# From the Tree-iage Analysis

*What is the recommended solution?*

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# Presentation Components

- Describe why urban forests are important
- Data analysis:
  1. Was the canopy cover greater than 25%
  2. What type of invasive plants were present?
  3. What was the percentage of invasive cover within the sample area?
  4. What was the % of evergreen trees present in the sample area?
- Recommended strategy from Tree-i-age



# Lesson 8: Tree Benefits



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### Average Tree diameter per plot Data

Name of Tree	Average diameter of trees in plot (Inches)					
	Plot 1	Plot 2	Plot 3	Plot 4	Plot 5	Class Average
Douglas-fir						
Western Red Cedar						
Western Hemlock						
Madronna						
Big Leaf Maple						
Red Alder						



## Average number of trees per plot Data

Name of Tree	Average number of trees in each plot (1/10 acre)						Ave. number of trees/acre
	Plot 1	Plot 2	Plot 3	Plot 4	Plot 5	Class Average	Class ave x 10
Douglas-fir							
Western Red Cedar							
Western Hemlock							
Madronna							
Big Leaf Maple							
Red Alder							

## Estimated Amount of Water intercepted by 6 tree species at the Lake Wilderness Arboretum

	A	B	C	D	E	F
	Tree Species	Average Diameter	Amount (gal) of Water Intercepted by average diameter tree (from Website)	Average number of trees per acre	Forested acres at the Arboretum	Estimated Total Amount of Water intercepted
1	Douglas-Fir					
2	Western Hemlock					
3	Western Red Cedar					
4	Madronna					
5	Big Leaf Maple					
6	Red Alder					
	Total amount of water intercepted by 6 tree species at the Lake Wilderness Arboretum					

# Lesson 8: Tree Benefits

Questions for discussion?



# Monitor Your Forest

Monitoring your local urban forest can make the difference between success and failure!



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# Monitoring & Stewardship

We will monitor our restoration efforts over time in order to ensure that our local forest stays healthy and sustainable!



# Why Monitor Your Forest?

## Values

Create Rich Tree Composition

Remove Invasive Species

Increase Dense Canopy Cover

Enhance Species Diversity

Support Wildlife

Promote Geographic/Social Equity

Sustain Community Involvement

## Threats

Poor Tree Composition

High Invasive Species

Low Canopy Cover

Non-Varied Species

Poor Wildlife Habitat

Poorly Distributed Tree Canopy

Community Not Interested



General: Annual; 6" tall



Form: Weak, spreading



Flowers: Whitish-green, inconspicuous

#### Management Strategies

- Fibrous roots: remove major
- Primary spread: Seed



Check with parks department or school district for proper disposal.

WPGS: 140

## Creeping Knotweed

*Polygonum arenastrum*

A Non-native Plant

© Starflower Foundation 2006

General: Annual; 6" tall



Form: Weak, spreading



Flowers: Whitish-green, inconspicuous

#### Management Strategies

- Fibrous roots: remove major
- Primary spread: Seed



Check with parks department or school district for proper disposal.

WPGS: 140

## Creeping Knotweed

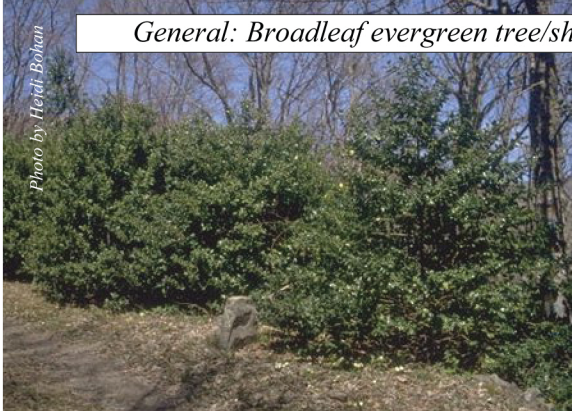
*Polygonum arenastrum*

A Non-native Plant

© Starflower Foundation 2006



*General: Broadleaf evergreen tree/shrub, 15 to 50 feet tall, 15 feet wide or more*



*Form: Large, dense, slow-growing, evergreen tree or shrub. Can grow as either a single-trunked tree or a multi-stemmed thicket*

### Management Strategies:

- Holly is categorized as a “weed of concern” by the King County Noxious Weed Control Program.
- Removal is recommended
- DO NOT simply cut down
- Small plants can be pulled or dug up when soil is moist.
- Applying herbicide with the cut stump or frilling method is most effective. Foliar herbicide treatment is not very effective due to the thick, waxy leaves.
- *Check with parks department for proper disposal*



*Flowers are small, whitish, inconspicuous, sweetly scented. Bunches of red, yellow or orange berries, poisonous to people but not to birds, borne on female trees in winter*



*Form: Leaves are thick, glossy, dark green and wavy, 1-3 inches, with spines  
Grows in shade or sun in well drained soil  
Creates deep shade under its canopy  
Roots: Mature trees have deep and extensive roots*

## English Holly

*Ilex aquifolium*  
**A Non-native Plant**



General: Evergreen woody perennial; up to 40' vines



Seedlings



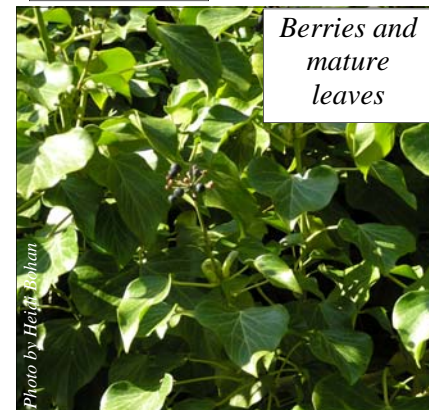
Young leaves



Form:  
Spreading  
and climbing  
vines



Vines engulfing a tree



Berries and  
mature  
leaves

### Management Strategies

- Non-designated noxious weed
- Always remove
- Thick roots and stolons: remove all fragments; cut large roots at base of trees
- Primary spread: Stolons, roots, seed
- Note: Aggressive strong root system, tolerates deep shade, will dominate and kill large trees



Check with parks department or school district for proper disposal

WPGS: 130

## English Ivy *Hedera helix*

A Non-native Plant

© Starflower Foundation 2006

General: Evergreen woody perennial; up to 40' vines



Seedlings



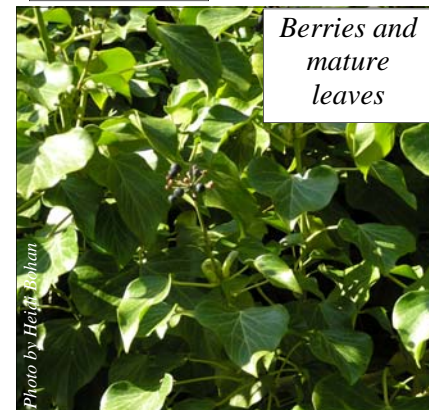
Young leaves



Form:  
Spreading  
and climbing  
vines



Vines engulfing a tree



Berries and  
mature  
leaves

### Management Strategies

- Non-designated noxious weed
- Always remove
- Thick roots and stolons: remove all fragments; cut large roots at base of trees
- Primary spread: Stolons, roots, seed
- Note: Aggressive strong root system, tolerates deep shade, will dominate and kill large trees



Check with parks department or school district for proper disposal

WPGS: 130

## English Ivy *Hedera helix*

A Non-native Plant

© Starflower Foundation 2006



General: Woody perennial; mostly evergreen; 4'-30' vines



Young growth



Himalayan blackberry can root by cane tip touching soil.



Flowers: White-pinkish



Evergreen blackberry has 5 deeply toothed leaflets



Himalayan blackberry

Seedling



Photo by Heidi Bohan

Form: Erect, arching and trailing; forming thickets



3-5 leaflets with whitish undersides

Himalayan blackberry

## Himalayan Blackberry

*Rubus armeniicus* (*R. procerus*, *R. discolor*)

## Evergreen Blackberry

*Rubus lanciniatus*

### Management Strategies

- Weed of Concern
- Always remove
- Thickened root balls and rhizomatous roots: Remove all
- Primary spread: Rhizomes, roots, and seed



Check with parks department or school district for proper disposal.

WPGS:134

A Non-native Plant

### Native Look-alike

**Dewberry or Trailing Blackberry, *R. ursinus*,** has weak trailing, lime green stems, with curved unflattened prickles, and deciduous leaves with 3 leaflets.



Photo by Heidi Bohan



Photo by Heidi Bohan

© Starflower Foundation 2006

General: Woody perennial; mostly evergreen; 4'-30' vines



Young growth



Himalayan blackberry can root by cane tip touching soil.



Flowers: White-pinkish



Evergreen blackberry has 5 deeply toothed leaflets



Himalayan blackberry

Seedling



Photo by Heidi Bohan

Form: Erect, arching and trailing; forming thickets



3-5 leaflets with whitish undersides

Himalayan blackberry

## Himalayan Blackberry

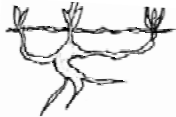
*Rubus armeniicus* (*R. procerus*, *R. discolor*)

## Evergreen Blackberry

*Rubus lanciniatus*

### Management Strategies

- Weed of Concern
- Always remove
- Thickened root balls and rhizomatous roots: Remove all
- Primary spread: Rhizomes, roots, and seed



Check with parks department or school district for proper disposal.

WPGS:134

A Non-native Plant

### Native Look-alike

**Dewberry or Trailing Blackberry, *R. ursinus*,** has weak trailing, lime green stems, with curved unflattened prickles, and deciduous leaves with 3 leaflets.



Photo by Heidi Bohan



Photo by Heidi Bohan

© Starflower Foundation 2006

White

White



*General:* Tall, dense, spreading thicket-forming, evergreen shrub/small tree.

White



Photo by Heidi Bohan

Photo by Richard Old, www.xtra-voices.com

*Small white flowers in upright clusters. Produces small, purplish-black, cone-shaped, cherry-type fruits, also in clusters.*

*Twigs green and smooth*

*Evergreen leaves are dark green on top and pale underneath, thick, shiny, large, oblong*



*Primary invasive growth: Reproduces through seeds, suckering and layering*

*Roots: Mature laurel trees have deep and extensive roots*

### Management strategies

- Considered a “weed of concern” by King County Noxious Weed Control Program
- DO NOT simply cut down
- Small young plants hand-pulled or weed wrenched
- Applying herbicide with the cut stump or frilling method is most effective.
- *Check with parks department for proper disposal*

## Cherry Laurel

*Prunus laurocerasus*

**A Non-native Plant**

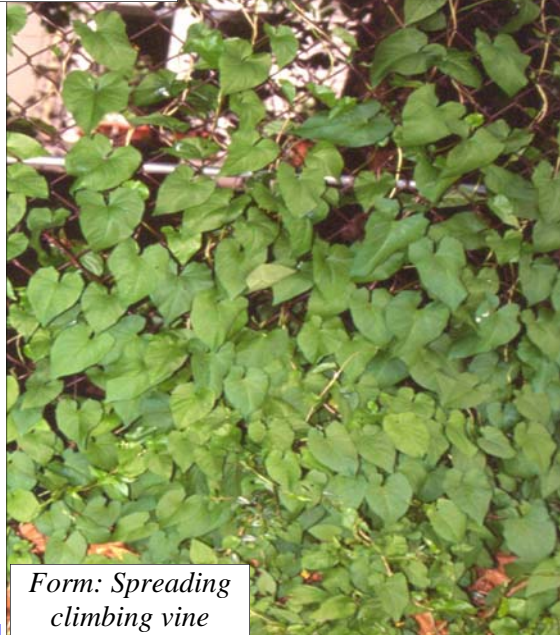




General: Deciduous perennial; 6'-30' long vines



Heart-shaped leaves  
appear in spring



Form: Spreading  
climbing vine

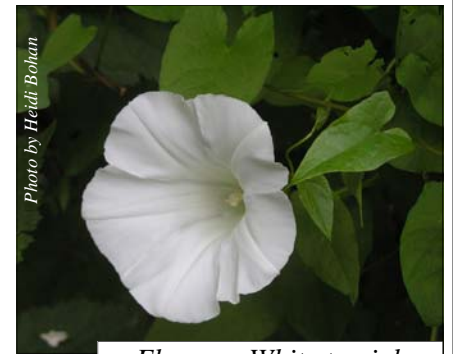
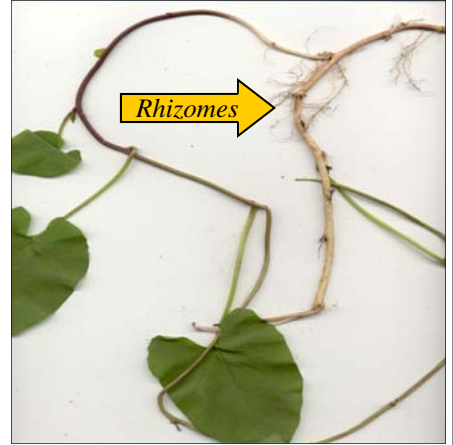


Photo by Heidi Bohan

Flowers: White to pink



### Management Strategies

- Non-designated noxious weed
- Always remove
- Extensive rhizomatous roots
- Primary spread: Seed, rhizomes

Note: Rhizomes are very persistent. If needed, lift native plants while dormant and remove weed rhizomes from their roots.

Check with parks department or school district for proper disposal.



WPGS: 250

**Bindweed**  
*Convolvulus arvensis*  
**Morning-glory**  
*Calystegia sepium*  
**A Non-native Plant**

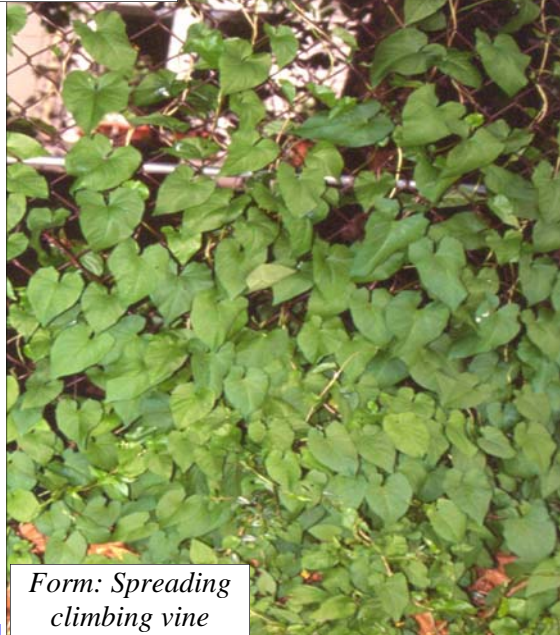
© Starflower Foundation 2006

White

General: Deciduous perennial; 6'-30' long vines



Heart-shaped leaves  
appear in spring

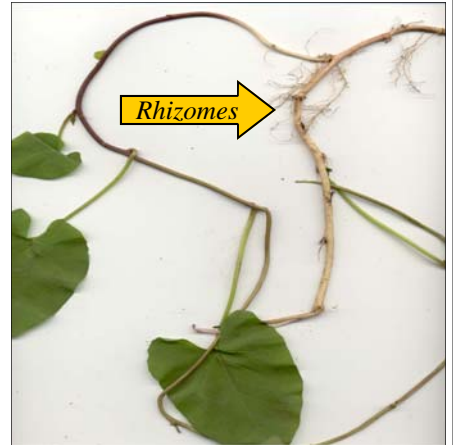


Form: Spreading  
climbing vine



Photo by Heidi Bohan

Flowers: White to pink



### Management Strategies

- Non-designated noxious weed
- Always remove
- Extensive rhizomatous roots
- Primary spread: Seed, rhizomes

Note: Rhizomes are very persistent. If needed, lift native plants while dormant and remove weed rhizomes from their roots.

Check with parks department or school district for proper disposal.



WPGS: 250

**Bindweed**  
*Convolvulus arvensis*  
**Morning-glory**  
*Calystegia sepium*  
**A Non-native Plant**

© Starflower Foundation 2006

White



General: Partially evergreen, short-lived perennial; 6'-12' tall



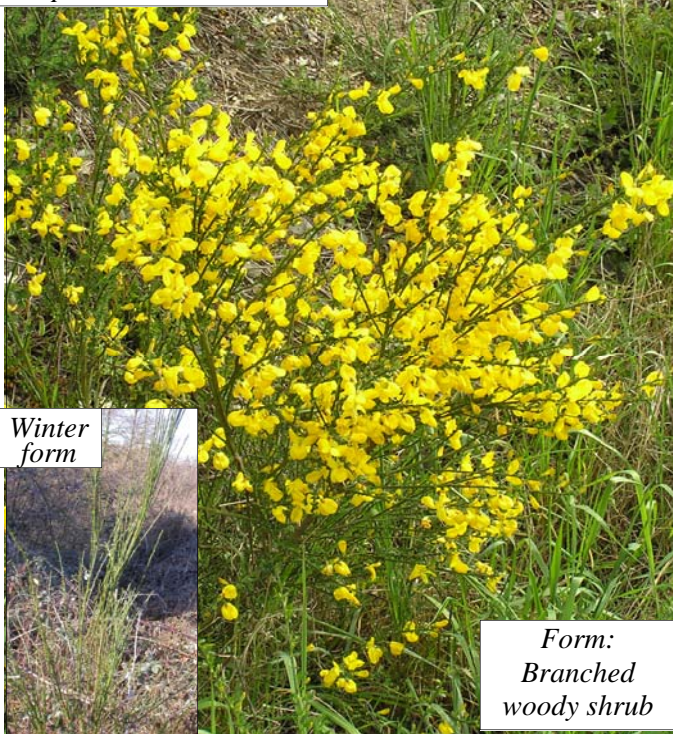
Leafy stems



Young plant



Winter form



Form:  
Branched  
woody shrub



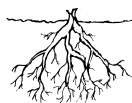
Yellow, pea-like  
flowers and black  
seedpods.



Photo by Heidi Bohan

### Management Strategies

- Non-designated noxious weed
- Always remove
- Thickened roots: Remove all major
- Primary spread: Seed



Check with parks department or school district for proper disposal.

## Scotch Broom

*Cytisus scoparius*

A Non-native Plant

WPGS: 120

© Starflower Foundation 2006

General: Partially evergreen, short-lived perennial; 6'-12' tall



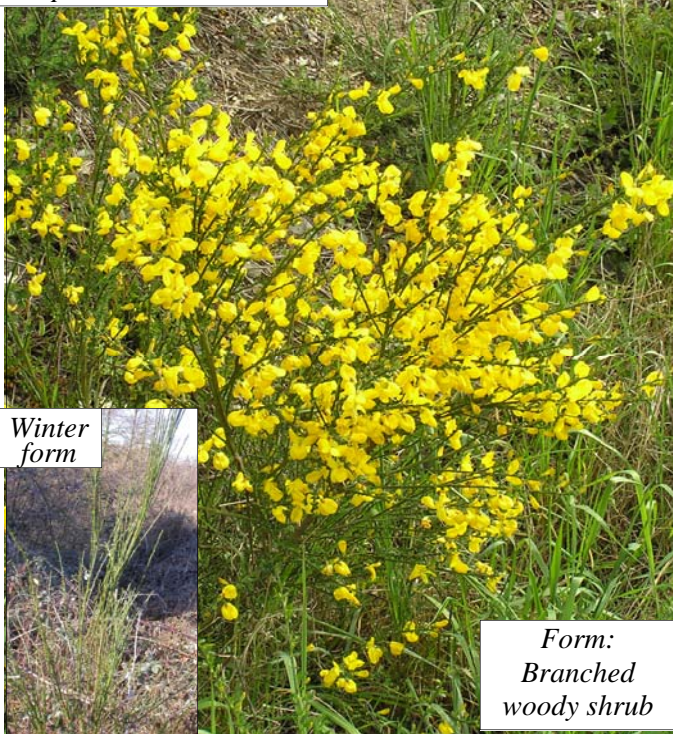
Leafy stems



Young plant



Winter form



Form:  
Branched  
woody shrub



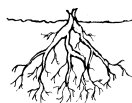
Yellow, pea-like  
flowers and black  
seedpods.



Photo by Heidi Bohan

### Management Strategies

- Non-designated noxious weed
- Always remove
- Thickened roots: Remove all major
- Primary spread: Seed



Check with parks department or school district for proper disposal.

## Scotch Broom

*Cytisus scoparius*

A Non-native Plant

WPGS: 120

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