5TH-8TH GRADE UNIT

LESSON 3
Management Decisions and Biodiversity

NUTSHELL

In this lesson, students participate in a group discussion that defines urban forest management and how different situations require different management. Students then learn about the impact of biodiversity on an urban forest using a map-reading and data-manipulation exercise. Students learn about potential management problems caused by invasive species and plot where exotic species come from on a world map. Finally, students present their opinions to the class in a group presentation, explaining if and how the problems of urban forests are problems in rural forests.

BIG IDEAS

- Trees from all over the world with the ability to tolerate climate, soils, and maintenance regimes are being planted in Wisconsin's urban forests. (Subconcept 5)
- Urban forest management is the use of planning and science-based techniques (e.g., planting, mulching, pruning, removal, monitoring, evaluation) to meet desired outcomes. (Subconcept 10)
- Urban forests are managed for both individual trees and as groups of trees for the impact they have on the community. (Subconcept 12)
- Invasive plant and animal species, pests, diseases, and damaging weather events can create problems in urban forests; management attempts to control these. (Subconcept 16)
- Biodiversity, in terms of canopy cover, diameter and species distribution, richness, evenness, and genetic diversity, can help decrease the impact of invasive species, pests, diseases, and damaging weather events. (Subconcept 20)

OBJECTIVES

Upon completion of this lesson, students will be able to:

- Define urban forest management.
- Explain that urban forests are managed for individual trees and groups of trees.
- Define biodiversity.
- Describe the benefits of biodiversity.
- Compare and contrast invasive species, exotic species, and native species.
- Explain that trees from all over the world that can adapt to Wisconsin conditions are being planted in urban forests.

SUBJECT AREAS

Mathematics, Science, Social Studies

LESSON/ACTIVITY TIME

- Total Lesson Time: 125 minutes
- Time Breakdown:

Introduction	15 minutes
Activity 1	45 minutes
Activity 2	35 minutes
Conclusion	30 minutes

TEACHING SITE

Classroom

BACKGROUND

Trees from all over the world are being planted in Wisconsin's urban forests. Trees can survive in places outside their natural range as long as those places have similar soil and climate. That means that trees from Europe and Asia are able to survive here if all other basic needs are met. This offers many opportunities for people who manage urban forests. Urban trees sometimes face harsh growing conditions, lack of growing space, and poor soils. By using trees from other parts of the world that can tolerate the conditions present, the diversity of species that can be

MATERIALS LIST

FOR EACH STUDENT

- Copy of Student Pages **1A-B**, *Tree Data Collection*
- Copy of Student Page **2**, *Tree Data*
- Calculator

FOR THE TEACHER

- Teacher Pages **1A-B**, *Tree Data Key*
- Copy of Teacher Pages **2A-D**, *Species Cards (cut out; a color version is also available on the LEAF website at **www.uwsp.edu/leaf**)*
- Overhead transparency of Teacher Page **3**, *World Map* OR locate a large world map to use
- Two different colored overhead transparency markers
- Teacher Page **4**, *Species Cards Key*

planted is greatly expanded. This can have positive benefits because of the increase in biodiversity. However, planting these species can create some challenges too.

VOCABULARY

Arboriculture: The planting, care, and scientific cultivation of trees on an individual plant basis.

Biodiversity: The variety and complexity of all life on earth.

Exotic Species: A species from a specific geographic region that has been introduced into an area outside of that region.

Invasive Species: A species that enters an area and causes harm by outcompeting species that are already there.

Native Species: A species that exists within its natural range.

Urban Forest Management: The use of planning and science-based techniques (e.g., planting, mulching, pruning, removal, monitoring, evaluation) to meet desired outcomes.

NATIVE/EXOTIC/INVASIVE SPECIES

There are important definitions to know to understand this subject. They are native species, exotic species, and invasive species. A native species is a species that lives within its normal range. An exotic species is any species living outside its normal range. It could be from another continent or another part of North America. By strict definition, an invasive species is an exotic species that successfully outcompetes native plants. This definition is sometimes modified to include plants that are native and competitive. For the purposes of this lesson, we will stick to the idea that invasive species are exotic. It is important to note, however, that even though invasive species are exotic, exotic species are not always invasive. It is also important to remember that "species" refers to plants, animals, and insects.

As mentioned earlier, using exotic species can help urban forest managers by giving them more options of species. These added species may be valuable resources because they may be better able to deal with the management challenges in urban forests. Problems can arise, however, when the exotic species is invasive.

These invasive species can outcompete other species in wooded parks and river ways in cities and towns. They can reduce the ability of native plants to survive and make the area less diverse. (A discussion of biodiversity can be found in the right column.) Exotic invasive species also come in the form of damaging insects and disease. They can have large negative impacts on urban forests. In addition to the impact invasive species can have in an urban forest, they can also impact rural forests. Many problem species in rural forests were introduced to the area through their use in urban forests.

URBAN FOREST MANAGEMENT

Urban forest management is the use of planning and science-based techniques to meet desired outcomes. In that basic definition, it is very similar to traditional forest management. The big difference comes when we consider the techniques urban forest managers use to do their jobs and the qualities of the resource they are managing. With fewer trees per acre in an urban forest, the job of pruning, mulching, monitoring, removing, and evaluating individual trees is much more feasible. The number of owners, and therefore management objectives, is much higher in an urban forest.

Although individual tree management (also known as arboriculture) is a big contrast to traditional forestry, it is important to remember that urban forestry deals with trees both individually, such as in a yard, as well as in groups, such as a series of street trees or trees in a park. Different techniques are used in different situations.

The problems that trees in urban areas face can include air pollution, soil compaction, lack of space, and vandalism; these don't happen regularly in rural forests. The problems that do impact rural forests such as insects, disease, weather-related damage, and invasive species, also affect urban forests.

BIODIVERSITY

One way for urban foresters to help address these potential threats is to increase biodiversity. Biodiversity is the variety and complexity of life on earth. It is measured in different ways. The broad categories of biodiversity often used are ecosystem diversity (how many different ecosystems there are), species diversity (how many species there are), and genetic diversity (how many different variations in genes there are in a population). Urban forests have additional important measures of diversity. The diversity of canopy cover (percentage of cover and type), diameter and species distribution (the size of the trees and where they are), and richness and evenness (how many species and their proportion).

With increased biodiversity, the impact of a pest or disease that targets a single species decreases. A wind or ice storm that can easily break large, weak-wooded trees will not have such a major impact if different trees of different ages are present. Young trees may be more susceptible to a drought, but older trees can survive it. A specific genetic strain of a species may tolerate a disease when another can't. Having biodiversity on many levels can increase the overall health of an urban forest.

PROCEDURE

INTRODUCTION (↑↓)

NOTE: If students have not completed Lesson 1, define and explain what an urban forest is prior to beginning this lesson.

1. Ask students what they would have to know and do if they were planning a party for a few people. Write their suggestions in a list on the board. *(How many people are coming? Who is coming? When and where can you have the party? What activities are you going to do at the party? Will you have any help with the party? How much will it cost? Where will the money come from?)*

2. Using the questions below, list on the board what needs to be considered if you are managing trees in a yard.

   - How many trees do you have?
   - What kinds are they?
   - How much money do you have to take care of them?
   - How many people do you have available to help take care of them?
   - Where are existing trees and where can more be planted?

3. Explain that planning a party has things in common with planning for trees in a yard. As a class, draw lines connecting the things on the party planning list to the things on the yard tree planning list that are similar and discuss. *(Connections could be made from all the things on the yard tree planning list to similar things on the party planning list.)*

4. Read and discuss the definition of urban forest management. *(Urban forest management is the use of planning and science-based techniques [e.g., planting, mulching, pruning, removal, monitoring, evaluation] to meet desired outcomes.)* Explain that trees in an urban forest are sometimes managed individually, such as in a yard, and sometimes managed as groups, such as in a park.

5. Tell the students that now, instead of planning a party for a few people, they are planning a party for 100 people. Would you need to answer the same questions as before? *(Yes.)* Will the way you handle the party be the same? *(No. You will need a larger space, more money, different activities, etc.)*

   Tell students that managing entire urban forests is different than managing trees in a yard. Although you still need to know the same information, what you do with it will change with the different answers. Discuss what might be different about managing a large park with lots of trees compared to managing a few trees along the street. *(There are more trees in the park, it will cost more to maintain more trees, fewer kinds of trees are able to grow along the street, it is probably all right if a tree in a park has messy fruit but not all right on a street, there are more places to plant trees in a park.)*

ACTIVITY 1 – ANALYZING BIODIVERSITY (↑↓)

Ask the class to tell you what they think of when they hear the word diversity. *(Diversity of cultures, thoughts, religion, etc.)* Ask them if they have heard of "biodiversity." Define biodiversity. *(The variety and complexity of all life on earth.)* Explain that there are different ways of thinking about how diverse a forest is. One way biodiversity is measured is by identifying how many different species there are. You can also consider the ages of trees. *(More ages are more diverse.)* Where trees grow is another way they are diverse. *(If all the trees in an urban forest are in people's yards, it isn't as diverse as if there were also trees in parks, along streets, along rivers, etc.)* Tell students they are going to look at how much biodiversity there is in an urban forest.

2. Hand out Student Pages **1A-B**, *Tree Data Collection* to each student. Explain to students that urban foresters collect and use data about their urban forest to decide how to manage it. (Remind students of this point made in the Introduction.) The data may include the number of trees, location, species, size, health, and other information. Sometimes this information is put onto a map and urban foresters use computers to locate and keep track of information. Explain to students that they will be using the map and symbols on Student Page **1B**, *Tree Data Collection Map* to collect the data needed to fill out the table on Student Page **1A**, *Tree Data Collection Tables*. Let students begin filling out the worksheet. Review the process of determining percentages if needed and have students write the formula they will be using on their sheets. *(Percent of total for each species = Number of trees for each species ÷ Total number of trees for all species. Move the decimal point two spaces to the right to get the percent.)*

3. After students have completed entering their data on the worksheet, hand out Student Page **2**, *Tree Data* to each student. Have students use the data on this sheet to answer the questions.

4. Lead a discussion with the class using Teacher Pages **1A-B**, *Tree Data Key*. The key includes answers to the questions on Student Page **1A**, *Tree Data Collection Tables*. It also includes discussion points for you to use. Discussion centers around comparing their map data to the whole city data and considering how the data indicate biodiversity.

   NOTE: Unless your students are ready for specific discussion of the types of biodiversity, leave that detail out of the wrap-up discussion for this activity.

ACTIVITY 2 – NATIVE, EXOTIC, AND INVASIVE SPECIES (↑)

1. Write the following definitions on the board: Native Species – A species that exists within its natural range; Exotic Species – A species from a specific geographic region that has been introduced into an area outside of that region; Invasive Species – A species that enters an area and causes harm by outcompeting species that are already there. Once students have a grasp of these terms, proceed to the next step.

2. Hand out cards made from Teacher Pages **2A-D**, *Species Cards*, one to each student or pair of students. Each card has an exotic tree, shrub, or pest name and a description on it. Some of the species listed on these cards can be problems in an urban forest, some are not.

   EXTENSION: For a more in-depth look at each species, assign students to use the internet to find out more. Tell students to type the scientific name into a search engine and investigate the websites that the search reveals.

3. Tell students that they need to decide if the species described on their card is invasive or noninvasive. The descriptions on the cards will give them the information they need to do this. Discuss the words and phrases from the descriptions that will indicate invasive species. *(Aggressive, outcompetes, spreads rapidly, grows quickly, etc.)* They should check either “invasive” or “noninvasive” on their cards.

4. Once students have read their card and checked the appropriate word, start a brief class discussion about why invasive species are significant. *(Invasive species are successful at competing with native plants. They reduce the numbers of native plants or eliminate them entirely. This disrupts the ecosystem. For instance, if invasive honeysuckle grows so densely in a forested area of a park that it shades out all the other plants, it reduces the food available for the animals that eat those plants. Without food, the animals can't survive and go elsewhere. In an urban forest, animals may not have another place to go because that area may have been the only one with those plants.)* Have some students with the invasive species cards share the name of their species. Ask students if they have seen or heard about any of these invasive species. Discuss what they have heard.

5. Put up Teacher Page **3**, *World Map* on the overhead projector. Ask students to come up, one at a time, and mark on the map with an "X" where their species originated. Use different colors for invasive and noninvasive. They should each tell the class where the species came from and if it is invasive. After all the species have been marked on the map, start a discussion about what the species that can grow in Wisconsin have in common. *(They are all from the northern hemisphere. They all grow in similar climates.)* Be sure to make the point that not all of the exotic species are invasive.

   NOTE: You may wish to use a large map of the world instead of the overhead. If so, use colored sticky notes to mark the countries the species originate in.

6. Remind the class what urban forest management is. (The use of planning and science-based techniques [e.g., planting, mulching, pruning, removal, monitoring, evaluation] to meet desired outcomes.) Tell students people use the techniques mentioned to either help or hinder certain species. As a group, brainstorm some of the things that could be done to manage the species they just learned about. Decide which species managers would want to hinder and which species they would encourage to grow.

CONCLUSION – BEYOND THE URBAN FOREST (↑↓)

VARIATION 1 (↓)

1. As needed, discuss with the class what a rural forest is like. Remind students what the definition of biodiversity is.

   NOTE: Pictures of urban and rural forests intended to aid in student discussion are available on the LEAF website. Go to **www.uwsp.edu/leaf** and navigate to the educator supplemental resources section.

2. Divide students into groups of two or three. Assign groups to design a PowerPoint, or use another presentation format to summarize what they think benefits and drawbacks of biodiversity are in rural forests.

3. Have groups present their PowerPoint to the class.

VARIATION 2 (↑)

1. As needed, discuss with the class what a rural forest is like. Review with students what makes an invasive species invasive. (Highly competitive, reproduces rapidly, outcompetes native species.) If needed, remind them that a noninvasive exotic will not be likely to reproduce, so it would have to be planted in a rural forest. Review the type of management techniques used in an urban forest.
2. Divide students into groups of two or three. Assign groups to design a PowerPoint, or use another presentation format.

   The group should address the following:

   a. Explain which of the species (from the species card they each have from the previous activity) might be a problem in a rural forest and why.
   b. Do they think it is possible to manage the problem in the same way in a rural forest as in an urban forest? What do they think the impact on biodiversity is?
3. Have groups present their PowerPoint to the class.

LEAF LINKS

The lessons listed below, for the *LEAF Wisconsin K-12 Forestry Education Lesson Guide*, contain possible enhancements, extensions, or replacements for *Urban Forest Lesson Guide: 5-8 Lesson 3*.

UNIT 5-6 LESSON 6: WHAT IS MANAGEMENT?

Students discover what's happened in Wisconsin's history that led us to modern forestry and about management techniques by creating a timeline and reading a "choose your own adventure" story.

Use the entire 5-6 Lesson 6 as a follow-up to Urban Forest Lesson Guide: 5-8 Lesson 3. The lesson will help students understand what the history, techniques, and results of rural forest management are.

UNIT 7-8 LESSON 2: BIODIVERSITY AND THE FOREST CONNECTION

Students analyze three ecosystems to determine their interconnections and create a Venn diagram. They also discuss the value of Wisconsin's forests in terms of biodiversity.

Use 7-8 Lesson 2 Activity 1, Activity 2, and Conclusion to extend Urban Forest Lesson Guide: 5-8 Lesson 3 Activity 1. The lesson examines biodiversity by comparing the interconnections between ecosystems. Add the urban forest to the list of ecosystems included in 7-8 Lesson 2 Activity 1.

UNIT 7-8 LESSON 3: HOW FORESTS ARE MANAGED

Students explore forest management plans, multiple use, and sustainability through a simulation, video, and game.

After completing Urban Forest Lesson Guide: 5-8 Lesson 3, use 7-8 Lesson 3 Introduction, Activity 1, Activity 3, and Conclusion to help students understand how management is used in rural forests.

TREE DATA KEY

SPECIES NAME	NUMBER OF TREES (FOR 2 BLOCKS)	% OF TOTAL (FOR 2 BLOCKS)
Red maple *(Acer rubrum)*	1	3.1
Norway maple *(Acer platanoides)*	7	21.9
Sugar maple *(Acer saccharum)*	3	9.4
Hackberry *(Celtis occidentalis)*	1	3.1
Green ash *(Fraxinus pennsylvanica)*	12	37.5
White oak *(Quercus alba)*	1	3.1
Pin oak *(Quercus palustris)*	1	3.1
Red oak *(Quercus rubra)*	1	3.1
American elm *(Ulmus americana)*	5	15.6
TOTAL	**32**	-

DIAMETER	NUMBER OF TREES (FOR 2 BLOCKS)	% OF TOTAL (FOR 2 BLOCKS)
2-inch	3	9.4
4-inch	-	-
6-inch	4	12.5
8-inch	-	-
10-inch	4	12.5
12-inch	8	25.0
14-inch	5	15.6
16-inch	3	9.3
18-inch	1	3.1
20-inch	2	6.2
22-inch	-	-
24-inch	1	3.1
26-inch	-	-
28-inch	-	-
30-inch	-	-
32-inch	-	-
34-inch	-	-
36-inch	1	3.1
38-inch	-	-
TOTAL	**32**	-

TREE DATA KEY

**THE QUESTIONS FROM THE WORKSHEET ARE LISTED FIRST.
QUESTIONS IN ITALICS ARE TO BE USED TO LEAD DISCUSSION WITH THE CLASS.
WORDS OR NUMBERS IN BOLD ARE THE ANSWERS.**

1. How many trees are there in the city? **8,961**

   - *Discussion Question: How many trees were in the two blocks on the map?* **32**

2. How many different species are there in the city (include miscellaneous hardwoods as one)? **28**

   - *Discussion Question: How many different species were there in the two blocks on the map?* **9**

3. What are the three species in the city that have the highest percentage? What is their total percentage? **Norway maple, white ash, and honeylocust. 63.6%**

   - *Discussion Question: What are the three species that have the highest percentage in the two blocks on the map? What is their total percentage?* ***Norway maple, green ash, and American elm. 75%***
   - *Discussion Question: Are the two blocks on the map more or less diverse in species than the city?* ***Less, because three species make up 75% of the total, but in the whole city three species only make up 63.6%.***

4. Which species is most common in the city? **Norway maple**

   - *Discussion Question: Which species is most common on the two block map?* ***Green ash***
   - *Discussion Question: If an insect that killed ash trees came to the blocks on the map, what would that do?* ***Kill all 12 ash trees on Wisconsin Street. (Reference the map.) If there were lots of ash trees in the whole city, it would have a very big impact.***

5. Are most of the trees in the city small (< 20 inches) or large (> 20 inches)? **Small**

   - *Discussion Question: Are most of the trees in the two blocks from the map large or small?* ***They are in the middle.***
   - *Discussion Question: Why do you think so many trees in the entire city are small?* ***They were planted at almost the same time. A big storm, disease, or pest might have killed a lot of trees at once and a lot of new trees were planted at the same time to replace them.***
   - *Discussion Question: Is it better to have all the trees the same size or all different sizes?* ***Different. Young trees are less susceptible to wind breakage; old trees can withstand drought better. A variety of sizes means that if a wind storm or disease comes, it will be less likely to damage or kill every tree. It also takes more time to take care of trees when they are young. If they are all young at once, it will be very expensive to maintain them.***

SPECIES CARDS

Copy and distribute one card to each student or pair of students. These cards are also available in color on the LEAF website at www.uwsp.edu/leaf.

NORWAY MAPLE *(Acer platanoides)*

☐ Invasive ☐ Noninvasive

This is a large deciduous tree from Europe. It is often planted in urban areas in yards and as a street tree. It produces seeds that are spread by wind and can sprout in suitable areas. Because it has the ability to survive in the shade of other trees, it can outcompete other plants in forests. It is often mistaken for the native sugar maple tree.

AMUR MAPLE *(Acer ginnala)*

☐ Invasive ☐ Noninvasive

This small tree is native to China and Japan. It is planted for decoration and to benefit wildlife. It produces many seeds and shades out other plants.

COMMON BUCKTHORN *(Rhamnus carthartica)*

☐ Invasive ☐ Noninvasive

This tall deciduous shrub is native to Europe and Asia. It is planted for wildlife food and as a decorative plant. It spreads easily by seeds contained in its fruit. It competes aggressively with other plants.

TARTARIAN HONEYSUCKLE *(Lonicera tatarica)*

☐ Invasive ☐ Noninvasive

This deciduous shrub is a native to Asia and western Europe. It was introduced in North America in 1752 as a decorative plant. It is also planted as a food supply for animals. Seeds from the plant are spread by birds that eat the fruit. Honeysuckle grows quickly and outcompetes many native plants.

JAPANESE BARBERRY *(Berberis thunbergii)*

☐ Invasive ☐ Noninvasive

This small deciduous shrub is native to Japan. It is commonly planted for decoration, wildlife food, and erosion control. The seeds in its fruit spread easily by birds and rabbits. It can also spread through its roots.

- Norway Maple, *Paul Wray,* Iowa State University www.forestryimages.org
- Amur Maple, *Paul Wray,* Iowa State University www.forestryimages.org
- Common Buckthorn, *Paul Wray,* Iowa State University www.forestryimages.org
- Tartarian Honeysuckle, *Patrick Breen,* Oregon State University www.forestryimages.org
- Japanese Barberry, *Jil M. Swearingen,* USDI National Park Service www.forestryimages.org

SPECIES CARDS

BURNING BUSH *(Euonymus alata)*

☐ Invasive ☐ Noninvasive

This deciduous shrub is native to northeast Asia and central China. It is planted for decoration because it has brilliant fall color. Its seeds are spread by birds.

SIBERIAN ELM *(Ulmus pumila)*

☐ Invasive ☐ Noninvasive

This is a small- to medium-size deciduous tree native to China and Siberia. This fast-growing tree reproduces easily from seed which is blown by the wind and grows quickly. It has also been planted in urban areas.

BLACK LOCUST *(Robinia pseudoacacia)*

☐ Invasive ☐ Noninvasive

This deciduous tree is native to the southern part of the Appalachian Mountains in the United States. It was planted in this part of the country to help control soil erosion in the early 1900s. It reproduces quickly from sprouts and can outcompete other plants.

EMERALD ASH BORER *(Agrilus planipennis)*

☐ Invasive ☐ Noninvasive

This small green beetle is native to Asia. Its larvae bore into ash trees and eat the tissue. Without that tissue, the trees can't move water and nutrients to the places that need them, so the tree dies. The emerald ash borer was recently found in the United States in 2002, but is moving quickly and killing all kinds of ash trees.

GYPSY MOTH *(Lymantria dispar)*

☐ Invasive ☐ Noninvasive

This insect is native to Europe and Asia. It was introduced to the United States in 1869. The caterpillars of the moth eat leaves of more than 500 kinds of plants, but prefer oak trees. The caterpillars do not kill the tree because new leaves grow back, but the tree is weak afterward and other insects or disease can kill the tree more easily.

- Burning Bush, *James H. Miller,* USDA Forest Service www.forestryimages.org
- Siberian Elm, *Patrick Breen,* Oregon State University www.forestryimages.org
- Black Locust, *Charles T. Bryson,* USDA Agricultural Research Service www.forestryimages.org
- Emerald Ash Borer, *David Cappaert* www.forestryimages.org
- Gypsy Moth, *David Mohn,* Critters Page (Creatures Great and Small) www.forestryimages.org

SPECIES CARDS

GINKGO *(Ginkgo biloba)*

☐ Invasive ☐ Noninvasive

This deciduous tree is native to China. It is planted in urban areas because it can tolerate poor soils and pollution. Ginkgo has both male trees and female trees and both must be present for trees to reproduce. Because the female trees produce fruits that smell and make a mess, they are not planted so it does not spread by seed.

EUROPEAN MOUNTAIN ASH *(Sorbus aucuparia)*

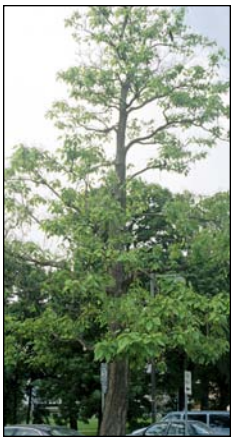
☐ Invasive ☐ Noninvasive

This deciduous tree is planted for decoration. It is native to Europe. Although it has berries that birds eat, it does not spread by seed.

CATALPA *(Catalpa speciosa)*

☐ Invasive ☐ Noninvasive

This deciduous tree is native to the southern United States. It is planted in urban areas as a decorative tree. It does not spread quickly.



LILAC *(Syringa sp.)*

☐ Invasive ☐ Noninvasive

This shrub is native to Europe and Asia. It is planted as decoration because of its flowers. Although it forms dense clumps where it is planted, it does not spread aggressively beyond its immediate area.

- Gingko, *Paul Wray,* Iowa State University www.forestryimages.org
- European Mountain Ash, *Sarah Gilbert,* University of Wisconsin-Stevens Point, LEAF Program www.uwsp.edu/leaf
- Catalpa, *Joseph O'Brien,* USDA Forest Service www.forestryimages.org
- Lilac, *The Dow Gardens Archives,* Dow Gardens www.forestryimages.org

SPECIES CARDS

WEEPING WILLOW *(Salix babylonica)*

☐ Invasive ☐ Noninvasive

This deciduous tree is native to China. It is planted for decoration because of its graceful drooping branches. It does not spread quickly.

EUROPEAN BLACK PINE *(Pinus nigra)*

☐ Invasive ☐ Noninvasive

This pine tree is native to Europe. It is planted in urban areas as a decorative tree. It does not spread readily by seed.

NORWAY SPRUCE *(Picea abies)*

☐ Invasive ☐ Noninvasive

This coniferous tree is native to Europe. It is planted as decoration because of its drooping branches. It produces seed, but does not spread by it.

LITTLE-LEAF LINDEN *(Tilia cordata)*

☐ Invasive ☐ Noninvasive

This deciduous tree is native to Europe. It is related to native basswood trees and is planted in urban areas as a shade tree. It does not spread readily by seed.

- Weeping Willow, *The Dow Gardens Archives,* Dow Gardens www.forestryimages.org
- European Black Pine, *Bill Cook,* Michigan State University www.forestryimages.org
- Norway Spruce, *Bill Cook,* Michigan State University www.forestryimages.org
- Little Leaf Linden, *Zelimir Borzan,* University of Zagreb www.forestryimages.org

WORLD MAP

SPECIES CARDS KEY

INVASIVE SPECIES AND ORIGIN

Siberian elm *(Ulmus pumila)* .....Siberia and China
Norway maple *(Acer platanoides)* .....Europe
Amur maple *(Acer ginnala)* .....China and Japan
Common buckthorn *(Rhamnus carthartica)*.....Europe and Asia
Tartarian honeysuckle *(Lonicera tatarica)* .....Asia and Western Europe
Japanese barberry *(Berberis thunbergii)*.....Japan
Burning bush *(Euonymus alata)* .....Northeast Asia and Central China
Emerald ash borer *(Agrilus planipennis)* .....Asia
Gypsy moth *(Lymantria dispar)* .....Europe and Asia
Black locust *(Robinia pseudoacacia)* .....Southern Appalachian Mountains

NONINVASIVE SPECIES AND ORIGIN

Gingko *(Ginkgo biloba)* .....China
Weeping willow *(Salix babylonica)*.....China
European black pine *(Pinus nigra)* .....Europe
Norway spruce *(Picea abies)*.....Europe
European mountain ash *(Sorbus aucuparia)*.....Europe
Catalpa *(Catalpa speciosa)* .....Southern United States
Lilac *(Syringa sp.)* .....Europe and Asia
Little-leaf linden *(Tilia cordata)* .....Europe

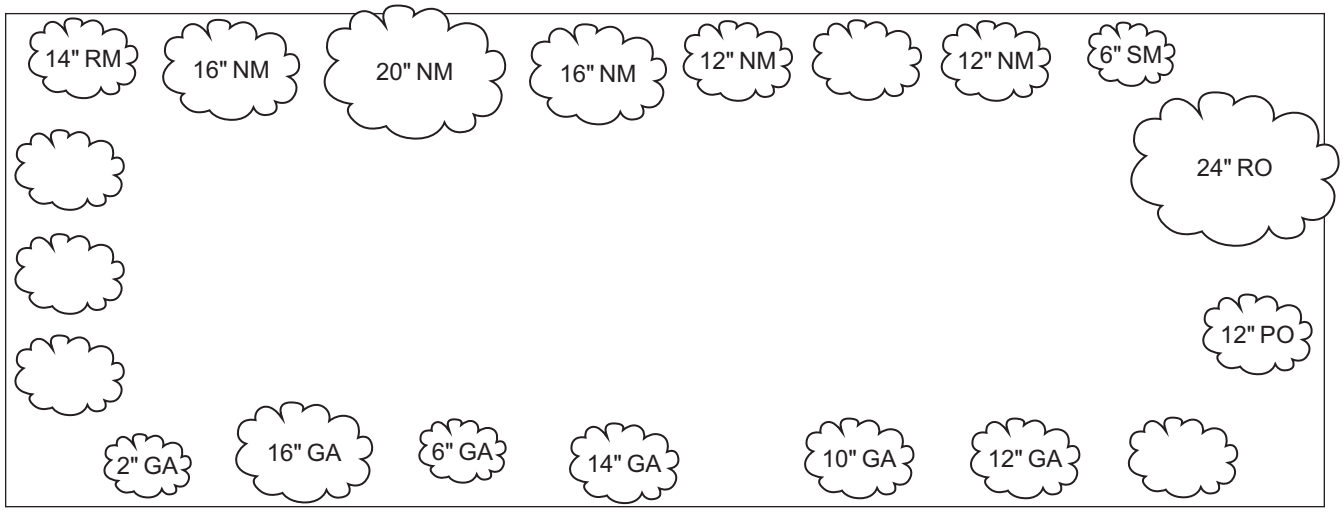
TREE DATA COLLECTION TABLES

SPECIES NAME	**NUMBER OF TREES** (FOR 2 BLOCKS)	**% OF TOTAL** (FOR 2 BLOCKS)
Red maple *(Acer rubrum)*		
Norway maple *(Acer platanoides)*		
Sugar maple *(Acer saccharum)*		
Hackberry *(Celtis occidentalis)*		
Green ash *(Fraxinus pennsylvanica)*		
White oak *(Quercus alba)*		
Pin oak *(Quercus palustris)*		
Red oak *(Quercus rubra)*		
American elm *(Ulmus americana)*		
TOTAL		

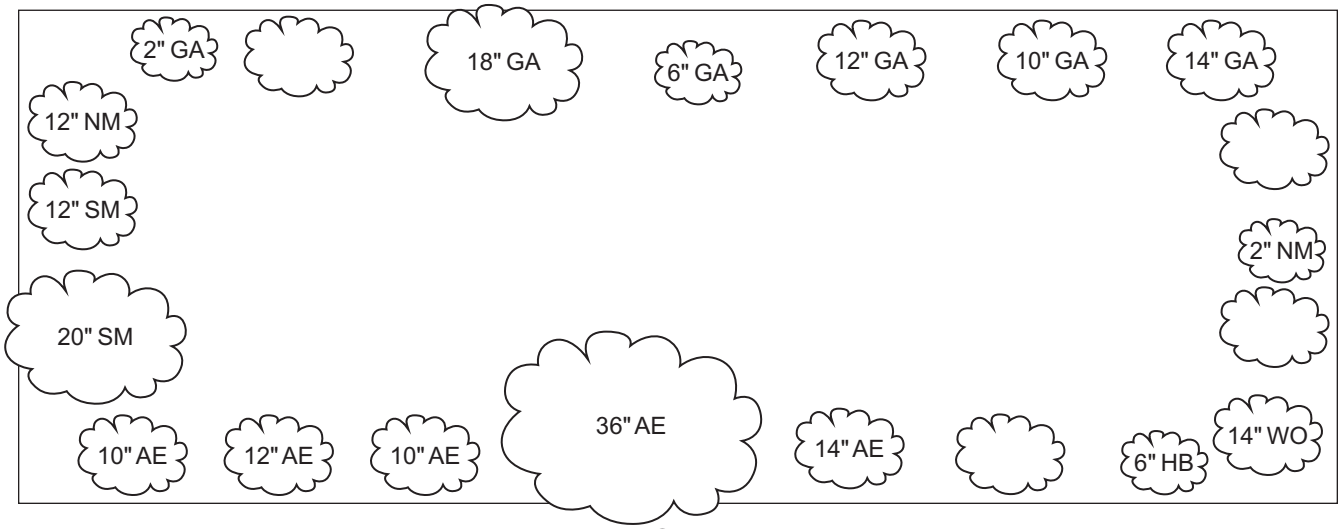
DIAMETER	**NUMBER OF TREES** (FOR 2 BLOCKS)	**% OF TOTAL** (FOR 2 BLOCKS)
2-inch		
4-inch		
6-inch		
8-inch		
10-inch		
12-inch		
14-inch		
16-inch		
18-inch		
20-inch		
22-inch		
24-inch		
26-inch		
28-inch		
30-inch		
32-inch		
34-inch		
36-inch		
38-inch		
TOTAL		

TREE DATA COLLECTION MAP

JEFFERSON STREET



WISCONSIN STREET



ELM STREET

TREE DATA COLLECTION MAP KEY

RM .....Red maple *(Acer rubrum)*
NM .....Norway maple *(Acer platanoides)*
SM.....Sugar maple *(Acer saccharum)*
HB .....Hackberry *(Celtis occidentalis)*
GA.....Green ash *(Fraxinus pennsylvanica)*
WO.....White oak *(Quercus alba)*
PO.....Pin oak *(Quercus palustris)*
RO.....Red oak *(Quercus rubra)*
AE .....American elm *(Ulmus americana)*

Empty Planting Space

2" RM Existing Diameter and Tree Species

TREE DATA

SPECIES NAME	NUMBER OF TREES	% OF CITY
Boxelder *(Acer negundo)*	16	0.2
Norway maple *(Acer platanoides)*	3,556	40.0
Red maple *(Acer rubrum)*	4	< 0.1
Silver maple *(Acer saccharinum)*	376	4.2
Sugar maple *(Acer saccharum)*	345	3.8
Buckeye *(Aesculus glabra)*	5	< 0.1
Horsechestnut *(Aesculus hippocastanum)*	40	0.4
Tree of heaven *(Ailanthus altissima)*	2	< 0.1
Catalpa *(Catalpa speciosa)*	167	1.9
Hackberry *(Celtis occidentalis)*	62	0.7
White ash *(Fraxinus Americana)*	1,277	14.2
Green ash *(Fraxinus pennsylvanica)*	566	6.3
Ginkgo *(Ginkgo biloba)*	10	0.1
Honeylocust *(Gleditsia tricanthos)*	1,113	12.4
Crabapple *(Malus sp.)*	1	< 0.1
Miscellaneous hardwoods	21	0.2
Sycamore *(Platanus occidentalis)*	8	< 0.1
Poplar species *(Populus sp.)*	49	0.6
Callery pear *(Pyrus sp.)*	8	< 0.1
White oak *(Quercus alba)*	15	0.2
Bur oak *(Quercus macrocarpa)*	34	0.4
Pin oak *(Quercus palustris)*	4	< 0.1
Red oak *(Quercus rubra)*	12	0.1
Basswood *(Tilia Americana)*	259	2.9
Little-leaf linden *(Tilia cordata)*	412	4.6
American elm *(Ulmus Americana)*	570	6.4
Siberian elm *(Ulmus pumila)*	28	0.3
Willow species *(Salix sp.)*	1	< 0.1
TOTAL TREES	8,961	

DIAMETER	NUMBER OF TREES	% OF TOTAL
2-inch	3,065	34.2
4-inch	2,147	24.0
6-inch	1,119	12.5
8-inch	435	4.8
10-inch	307	3.4
12-inch	254	2.8
14-inch	224	2.5
16-inch	206	2.3
18-inch	232	2.6
20-inch	229	2.6
22-inch	220	2.4
24-inch	185	2.1
26-inch	150	1.7
28-inch	90	1.0
30-inch	52	0.6
32-inch	19	0.2
34-inch	15	0.2
36-inch	10	0.1
38-inch	2	< 0.1

ANSWER THE FOLLOWING QUESTIONS:

1. How many trees are there in the city?
2. How many different species are there in the city (include miscellaneous hardwoods as one)?
3. What are the three species in the city that have the highest percentage? What is their total percentage?
4. Which species is most common?
5. Are most of the trees in the city small (< 20 inches) or large (> 20 inches)?