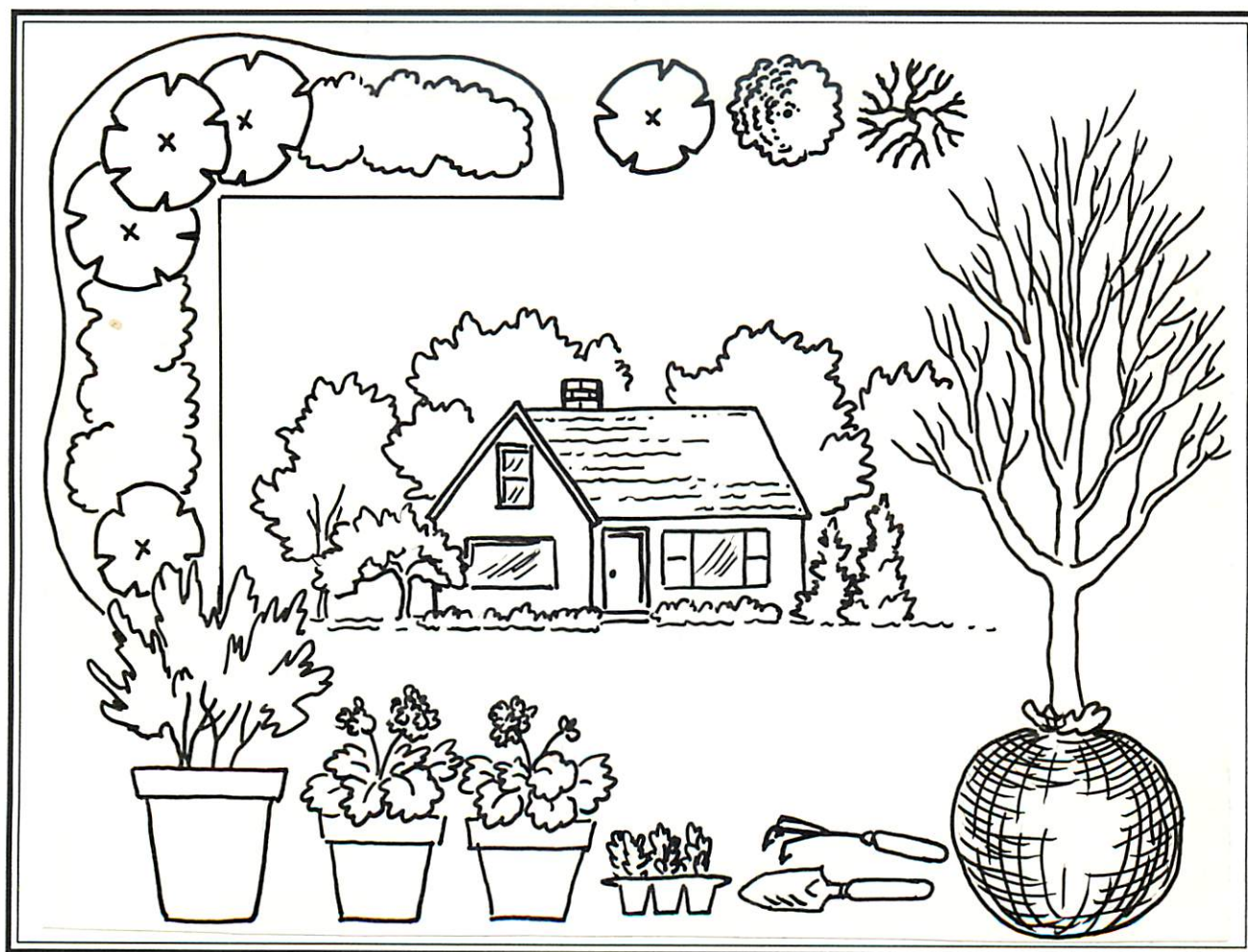


# Landscaping and Turf Management



## Instructor Guide

In cooperation with  
Agricultural Education  
Department of Practical Arts  
and Vocational-Technical Education  
College of Education and College of Agriculture  
University of Missouri-Columbia



In cooperation with  
Agricultural Education Section  
Division of Vocational and Adult Education  
Department of  
Elementary and Secondary Education  
Jefferson City, Missouri

# LANDSCAPING AND TURF MANAGEMENT

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[www.iml.coe.missouri.edu](http://www.iml.coe.missouri.edu)

Volume 22  
Number 2

Catalog Number: 10-2706-I  
December 1990

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The activity which is the subject of this project was supported in whole or in part by funds from the Department of Elementary and Secondary Education, Division of Vocational and Adult Education. However, the opinions expressed herein do not necessarily reflect the position or policies of the Missouri Department of Elementary and Secondary Education or the Division of Vocational and Adult Education, and no official endorsement should be inferred.

## ACKNOWLEDGMENTS

Recognition is given to advisory committee members for providing their valuable time and suggestions in developing this unit. The committee consisted of Ralph Ball, Jim Bellis, Harry Bertrand, Stephen Bryant, Jon Ellis, Alan Harrell, Jim Lee, Richard Linhardt, Delbert Lund, Jim MacLean, Richard McConnell, David Minner, Ramona Schescke, Hubert Shuler, David Stokely, Leon Snyder, Donald Ward, and Jim Wine.

Special recognition is given to Carol Anderson of Osage Beach, Missouri, for illustrating this guide. Appreciation is expressed to Jan Bass of Springfield, Missouri, for providing editorial assistance. Recognition is given to Clark Harris for providing technical assistance on selected lessons.

Appreciation is expressed to the following staff members of the Instructional Materials Laboratory for their efforts in producing this material: Harley Schlichting, Director; Amon Herd, Associate Director; Phyllis Miller, Assistant Director; Dan Stapleton, Assistant Director; Sharon Dyer, Graphic Designer; Lori Holliday, Word Processor; Barbara Tidquist, Graduate Technical Assistant; and Janece Seward and Wutti Leenam, Editorial Assistants.

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## FOREWORD

The development of the Landscaping and Turf Management guide is the result of suggestions by the MVATA Teaching Aids Committee. The Landscaping and Turf Management Advisory Committee suggested the topics to be discussed and reviewed the materials.

This instructor guide and the corresponding student reference contain 12 units, which cover a wide range of topics including: opportunities in the landscaping and turfgrass industries; how plants grow; hand and power tools; installation and maintenance of trees, shrubs, bedding plants, and ground covers; turfgrass; site analysis and evaluation; plant identification and selection; design elements; and cost estimates. See the table of contents for a detailed listing. This material is designed to be taught to juniors and seniors as a one-year course. Transparency masters, job sheets, and assignment sheets have been included where appropriate. Plant identification and selection tables are located only in the student reference.

During the summer of 1981, the Missouri State Board of Education formally adopted the concept of "Instructional Management Systems" (IMS) as a priority for the 1981-82 school year. The Missouri Commissioner of Education described the IMS concept as a practical way of "organizing for excellence" in education. To meet the demand for greater productivity and accountability, Dr. Frank Drake, Director of Vocational Education, applied the elements of IMS to form the Vocational Instructional Management System (VIMS). The VIMS process provides a framework to use in planning and organizing to assure excellence in Missouri's vocational education system by focusing greater attention on the management of teaching and learning.

This guide incorporates the needed component parts to aid agriculture teachers in the implementation of VIMS. For ease of use, performance objectives and competencies have been included at the beginning of the guide, as well as being incorporated within each lesson. A competency profile has been provided for convenient record keeping.

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# LANDSCAPING AND TURF MANAGEMENT

## TABLE OF CONTENTS

ACKNOWLEDGMENTS .....	ii
FOREWORD .....	iii
COMPETENCY PROFILE .....	xiv
UNIT I - EVALUATING OPPORTUNITIES IN THE LANDSCAPE AND TURFGRASS INDUSTRIES	
Lesson 1--The Importance of Landscaping .....	I-1
Lesson 2--Careers and Professional Organizations in the landscape and Turfgrass Industries .....	I-7
UNIT II - HOW PLANTS GROW	
Lesson 1--Plant Growth and Development .....	II-1
WS 1.1: Monocot and Dicot Plant Structure	
Lesson 2--Environmental Factors Below Ground that Affect Plant Growth .....	II-11
TM 2.1: Textural Triangle	
TM 2.2: Nutrient Availability	
WS 2.1: Using the Textural Triangle	
WS 2.2: Solving pH Problems	
Lesson 3--Environmental Factors Above Ground that Affect Plant Growth .....	II-29
WS 3.1: Factors Above Ground that Affect Plant Growth	
UNIT III - IDENTIFICATION	
Lesson 1--Identifying Characteristics of Trees and Shrubs .....	III-1
Lesson 2--Identifying Characteristics of Narrow-Leaf Evergreens .....	III-9
Lesson 3--Identifying Trees .....	III-17
WS 3.1: Leaf Identification	
Lesson 4--Identifying Shrubs .....	III-25
WS 4.1: Shrub Identification	
Lesson 5--Identifying Vines, Ground Covers, and Perennials .....	III-31
WS 5.1: Vine, Ground Cover, and Perennial Identification	
Lesson 6--Identifying Characteristics of Grasses .....	III-37
Lesson 7--Identifying Grasses .....	III-45
UNIT IV - TOOL IDENTIFICATION AND MAINTENANCE	
Lesson 1--Hand Tools and Equipment .....	IV-1
JS 1.1: Restoration of Wooden Handles	
JS 1.2: Restoration of Metal Surfaces	
Lesson 2--Power Tools .....	IV-11
DS 2.1: Winterization of a Lawn Mower	
UNIT V - PESTICIDES	
Lesson 1--General Pesticide Information .....	V-1
Lesson 2--Interpreting Pesticide Labels .....	V-9
WS 2.1: Reading Pesticide Label	

<b>Lesson 3—Using Pesticides Safely</b> .....	V-19
<b>UNIT VI - INSTALLATION AND MAINTENANCE OF TREES AND SHRUBS</b>	
<b>Lesson 1—Installing Trees and Shrubs</b> .....	VI-1
JS 1.1: Transplanting a Tree or Shrub	
JS 1.2: Planting Bare-Root Trees or Shrubs	
JS 1.3: Planting Container-Grown Trees or Shrubs	
JS 1.4: Planting Balled and Burlapped Trees or Shrubs	
<b>Lesson 2—Post-Transplant Care</b> .....	VI-21
JS 2.1: Staking a Tree	
JS 2.2: Guying a Tree	
JS 2.3: Wrapping a Tree	
<b>Lesson 3—Pruning</b> .....	VI-35
WS 3.1: Pruning Cuts	
JS 3.1: Making Pruning Cuts	
<b>Lesson 4—Fertilizing</b> .....	VI-49
TM 4.1: Fertilizer Label	
WS 4.1: Fertilizer Calculations	
JS 4.1: Fertilizing a Tree Using the Soil Incorporation Method	
<b>Lesson 5—Irrigation and Drainage</b> .....	VI-65
JS 5.1: Determining the Amount of Water Applied by a Sprinkler	
<b>Lesson 6—Disease and Pest Control</b> .....	VI-75
WS 6.1: Identifying Plant Insects	
WS 6.2: Identifying Plant Diseases	
<b>UNIT VII - INSTALLATION AND MAINTENANCE OF BEDDING PLANTS AND GROUND COVERS</b>	
<b>Lesson 1—Transplanting Bedding Plants and Ground Covers</b> .....	VII-1
WS 1.1: Determining Plant Spacing	
JS 1.1: Preparing the Flower Bed	
JS 1.2: Transplanting Bedding Plants	
<b>Lesson 2—Maintaining Bedding Plants and Ground Covers</b> .....	VII-15
<b>UNIT VIII - TURFGRASS</b>	
<b>Lesson 1—Turfgrass Growth and Classification</b> .....	VIII-1
<b>Lesson 2—Turfgrass Establishment</b> .....	VIII-9
WS 2.1: Figuring Area	
WS 2.2: Determining Seed and Sod Requirements for Lawn Areas	
<b>Lesson 3—Turfgrass Maintenance</b> .....	VIII-23
WS 3.1: Figuring Area for Fertilizer Applications	
WS 3.1: Calculating Lawn Areas for Fertilizer Requirements	
JS 3.1: Spreader Calibrations	
<b>Lesson 4—Lawn Cultivation and Renovation</b> .....	VIII-37
<b>Lesson 5—Pest Identification and Control</b> .....	VIII-43
<b>UNIT IX - SITE ANALYSIS AND EVALUATION</b>	
<b>Lesson 1—Introduction to Landscape Design</b> .....	IX-1
WS 1.1: Calculating Slope	
JS 1.1: Site Analysis and Family Needs Checklist	
<b>Lesson 2—Drawing a Base Map</b> .....	IX-13
JS 2.1: Measuring a Site	
JS 2.2: Drawing a Base Map	
<b>Lesson 3—Interpreting a Landscape Plan</b> .....	IX-23
WS 3.1: Title Blocks	

<b>UNIT X - SELECTING AND USING PLANTS IN THE LANDSCAPE</b>	
<b>Lesson 1—Selecting Trees for the Landscape</b> .....	<b>X-1</b>
<b>Lesson 2—Selecting Shrubs and Hedges for the Landscape</b> .....	<b>X-9</b>
<b>Lesson 3—Selecting Ground Covers and Vines</b> .....	<b>X-17</b>
<b>Lesson 4—Selecting Flowers</b> .....	<b>X-25</b>
<b>Lesson 5—Selecting Turfgrasses</b> .....	<b>X-33</b>
<b>UNIT XI - LANDSCAPE DESIGNING</b>	
<b>Lesson 1—Design Elements</b> .....	<b>XI-1</b>
<b>Lesson 2—Landscape Enrichments</b> .....	<b>XI-7</b>
WS 2.1: Landscape Enrichments	
<b>Lesson 3—Principles of Design</b> .....	<b>XI-17</b>
WS 3.1: Balance	
<b>Lesson 4—Applying Design Elements and Principles</b> .....	<b>XI-25</b>
WS 4.1: Designing a Corner Planting	
WS 4.2: Designing a Line Planting	
WS 4.3: Designing the Public Area	
WS 4.4: Designing the Public Area	
WS 4.5: Designing the Private/Service Area	
<b>Lesson 5—Developing a Landscape Plan</b> .....	<b>XI-41</b>
WS 5.1: Developing a Landscape Plan	
WS 5.2: Developing a Landscape Plan	
<b>UNIT XII - DEVELOPING COST ESTIMATES</b>	
<b>Lesson 1—Pricing the Design</b> .....	<b>XII-1</b>
TM 1.1: Cost Estimate Sheet	
WS 1.1: Figuring Volume	
WS 1.2: Cost Estimate Sheet	
<b>Lesson 2—Pricing Landscape Maintenance</b> .....	<b>XII-13</b>
WS 2.1: Labor Costs	

## OBJECTIVES

### UNIT I - EVALUATING OPPORTUNITIES IN THE LANDSCAPING AND TURFGRASS INDUSTRIES

1. The student will be able to explain the importance of landscape and turfgrass industries today and in the future.
2. The student will be able to describe the common jobs in the landscape and turfgrass industries.

### UNIT II - HOW PLANTS GROW

1. The student will be able to demonstrate knowledge of the difference between monocot and dicot plants and how they differ in growth patterns.
2. The student will be able to demonstrate knowledge of the soil factors affecting plant growth, and how to improve the soil.
3. The student will be able to describe environmental climatic factors that affect plants.

### UNIT III - IDENTIFICATION

1. The student will be able to demonstrate a knowledge of the characteristics of plants which will aid in plant identification.
2. The student will be able to describe the identifying characteristics of narrow-leaf evergreens.
3. The student will be able to identify selected shade, flowering, and evergreen trees.
4. The student will be able to identify selected flowering and evergreen shrubs.

5. The student will be able to identify selected vines, ground covers, and perennials commonly used in the landscape.
6. The student will be able to identify the characteristics of grasses used in identification.
7. The student will be able to identify the six major turfgrasses used in Missouri.

#### **UNIT IV - TOOL IDENTIFICATION AND MAINTENANCE**

1. The student will be able to identify and maintain the common hand tools used in the landscape and turfgrass industries.
2. The student will be able to identify and maintain common power tools used in the landscape and turfgrass industries.

#### **UNIT V - PESTICIDES**

1. The student will be able to describe how various types of pesticides work.
2. The student will be able to accurately read and interpret pesticide labels.
3. The student will be able to identify safety precautions that should be followed when mixing, applying, storing, and disposing of pesticides.

#### **UNIT VI - INSTALLATION AND MAINTENANCE OF TREES AND SHRUBS**

1. The student will be able to describe procedures for planting and transplanting balled and burlapped, container-grown, and bare-root trees, and shrubs.
2. The student will be able to describe procedures to care for newly-transplanted trees and shrubs.
3. The student will be able to prune evergreens, deciduous trees, shrubs, hedges, and roses.
4. The student will be able to explain how to determine the nutrients needed by plants, their function in plants, symptoms of deficiency, and how to use a fertilizer label.
5. The student will be able to determine when and how much to irrigate and what methods to use.
6. The student will be able to recognize and know control methods for common and destructive insects and diseases.

#### **UNIT VII - INSTALLATION AND MAINTENANCE OF BEDDING PLANTS AND GROUND COVERS**

1. The student will be able to transplant bedding plants and ground covers.
2. The student will be able to maintain bedding plants and ground covers.

#### **UNIT VIII - TURFGRASS**

1. The student will be able to explain the growth habits of turfgrass, its seasons of growth, and advantages and disadvantages of different turfgrasses.
2. The student will be able to describe the procedure for installing a lawn.
3. The student will be able to successfully water, fertilize, and mow turfgrass.
4. The student will be able to explain how to take a failing, established lawn and either cultivate or renovate it.
5. The student will be able to identify common weeds, insects, and diseases that damage the turf; and explain how these pests are controlled.

#### **UNIT IX - SITE ANALYSIS AND EVALUATION**

1. The student will be able to analyze a landscape site.
2. The student will be able to accurately measure a landscape site and draw a base map to scale.
3. The student will be able to effectively use symbols on a landscape plan.

#### **UNIT X - SELECTING AND USING PLANTS IN THE LANDSCAPE**

1. The student will be able to describe the purposes of trees in the landscape and factors considered in selecting trees.
2. The student will be able to select shrubs or hedges to fulfill desired purposes in a landscape plan.
3. The student will be able to select vines and ground covers for effective use in a landscape.

4. The student will be able to describe the purposes of flowers and how to select flowers for the landscape.
5. The student will be able to describe the purpose of turfgrass in landscaping and the criteria to consider when selecting a turfgrass.

#### **UNIT XI - LANDSCAPE DESIGNING**

1. The student will be able to identify and explain the four elements of landscape design.
2. The student will be able to implement the use of natural and manufactured materials in a landscape plan.
3. The student will be able to identify the five principles of design.
4. The student will be able to combine design elements and principles to create a landscape plan.
5. The student will be able to develop a complete landscape plan.

#### **UNIT XII - DEVELOPING COST ESTIMATES**

1. The student will be able to figure a cost analysis.
2. The student will be able to price the various components of landscape maintenance.

**NOTE:** Percent of accuracy should be set by instructors to reflect passing grades within their school systems.

### **COMPETENCIES**

#### **UNIT I - EVALUATING OPPORTUNITIES IN THE LANDSCAPING AND TURFGRASS INDUSTRIES**

1. Explain the importance of landscaping and turfgrass industries today and in the future.
2. Identify and describe landscape and turfgrass jobs.

#### **UNIT II - HOW PLANTS GROW**

1. Label plant parts and structures correctly and identify the differing growth patterns of monocot and dicot plants.
2. Demonstrate knowledge of soil properties and how soil quality relates to plant growth; assess the soil at a planting site and determine how to improve it, if needed.
3. Describe environmental factors that should be considered before selecting a plant for the landscape.

#### **UNIT III - IDENTIFICATION**

1. Identify the basic structural features of trees and shrubs.
2. Identify the distinguishing characteristics for common narrow-leaf evergreens.
3. Identify selected trees.
4. Identify selected shrubs.
5. Identify ground covers, vines, and perennials.
6. Identify characteristics of grasses.
7. Identify the six major turfgrasses used in Missouri.

#### **UNIT IV - TOOL IDENTIFICATION AND MAINTENANCE**

1. Identify and maintain hand tools and equipment.
2. Identify, maintain, and safely use power tools.

#### **UNIT V - PESTICIDES**

1. Describe how various types of pesticides work.
2. Accurately interpret a pesticide label for information about use, effectiveness, and safe handling.
3. Identify safety precautions that should be followed when using pesticides.

#### **UNIT VI - INSTALLATION AND MAINTENANCE OF TREES AND SHRUBS**

1. Transplant a tree or shrub and properly plant a bare-root, container-grown, or B and B tree or shrub.
2. Stake and guy a newly-planted tree; wrap, prune, and apply anti-transpirants to young tree.
3. Prune trees, shrubs, hedges, and roses.
4. Fertilize trees and shrubs.
5. Determine the best methods of irrigation in various situations.
6. Recognize common insects and diseases, the type of damage or symptoms they cause, and recommended control methods.

#### **UNIT VII - INSTALLATION AND MAINTENANCE OF BEDDING PLANTS AND GROUND COVERS**

1. Prepare the soil of a flower bed, determine the number of plants to use, and transplant bedding plants and ground covers.
2. Maintain bedding plants and ground covers.

#### **UNIT VIII - TURFGRASS**

1. List advantages and disadvantages of the six major turfgrasses grown in Missouri.
2. Describe the procedure for installing a lawn.
3. Maintain turf by properly fertilizing, watering, and mowing.
4. Explain how to successfully cultivate or renovate a lawn.
5. Identify common pests in turfgrass and explain how to control these pests.

#### **UNIT IX - SITE ANALYSIS AND EVALUATION**

1. Analyze a landscape site.
2. Draw a base map to scale.
3. Effectively use design symbols in a landscape plan.

#### **UNIT X - SELECTING AND USING PLANTS IN THE LANDSCAPE**

1. Select trees for specific purposes in the landscape.
2. Select effective shrubs and hedges for landscape.
3. Describe the uses of vines and ground covers and select the species to suit the location to be planted.
4. Select a location and plants for a perennial bed or border.
5. Select a turfgrass for a specific growing site.

#### **UNIT XI - LANDSCAPE DESIGNING**

1. Identify and explain the four elements of landscape design.
2. Implement the use of natural and manufactured enrichments in a landscape plan.
3. Identify the five principles of design.
4. Apply both the principles and elements of design to create a landscape plan.

#### **UNIT XII - DEVELOPING COST ESTIMATES**

1. Calculate the price of a landscape design.
2. Price various components of landscape maintenance.

#### **MOTIVATIONAL TECHNIQUE OR INTEREST APPROACH**

1. Invite an owner of a landscape business to bring in samples of completed designs. Ask the individual to demonstrate drawing techniques used on the plan. If possible, ask the individual to display several projects in various stages of completion.



2. Tour a few well-landscaped lawns of homes or businesses in the area. Point out to the students that they will be studying many of the techniques required in landscaping.
3. If possible, display a model for a future home or business. Point out how planning is the first step in building anything, including the landscape. (A landscape business in the area may have models.)

## EVALUATION

1. Give short, objective tests following each lesson and a more indepth objective test at the conclusion of the unit.
2. Observe the changes in behavior as evidence of an improved ability of students to deal with problems in this unit using background information acquired from earlier units.
3. Observe students' attempts to solve similar problems in their supervised agricultural experience programs.

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b. Audiovisuals  
(Available from the Missouri Vocational Resource Center, University of Missouri-Columbia, 8 London Hall, Columbia, MO 65211)

- 1) Ground Covers. video. Morris Video.
- 2) Growing Beautiful Lawns. video. Ortho.
- 3) Elements of Pruning. video. Vocational Education Productions
- 4) Ornamental Annual Plants and Their Uses. slides with script. Ohio Agricultural Education Curriculum Materials Service.
- 5) Selected Landscape Plants. slides with script. Ohio Agricultural Education Curriculum Materials Service.

c. Audiovisuals  
(Available from the Instructional Materials Laboratory, 10 London Hall, Columbia, MO 65211.)

- 1) Diseases of Landscape Ornamentals. slides with script. Ohio Agricultural Education Materials Service.
- 2) Landscape Design. slides with script. Ohio Agricultural Materials Service.
- 3) Nursery/Landscaping Identification. slides with tape. Instructional Materials Laboratory.

## LANDSCAPING AND TURF MANAGEMENT

### Major Competency Profile

**Directions:** Evaluate the student by checking the appropriate number or letter to indicate the degree of competency. The rating for each task should reflect **employability readiness** rather than the grades given in class.

**Rating Scale: 3 Mastered** - can work independently with no supervision

**2 Requires Supervision** - can perform job completely with limited supervision

**1 Not Mastered** - requires instruction and close supervision

**N No Exposure** - no experience or knowledge in this area

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## Unit I - Evaluating Opportunities in the Landscaping and Turfgrass Industries

1. Explain the importance of landscaping and turfgrass industries today and in the future.
2. Identify and describe landscape and turfgrass jobs.

## Unit II - How Plants Grow

1. Label plant parts and structures correctly and identify the differing growth patterns of monocot and dicot plants.
2. Demonstrate knowledge of soil properties and how soil quality relates to plant growth; assess the soil at a planting site and determine how to improve it, if needed.
3. Describe environmental factors that should be considered before selecting a plant for the landscape.

### Unit III - Identification

1. Identify the basic structural features of trees and shrubs.
2. Identify the distinguishing characteristics for common narrow-leaf evergreens.
3. Identify selected trees.
4. Identify selected shrubs.
5. Identify ground covers, vines, and perennials.
6. Identify characteristics of grasses.
7. Identify the six major turfgrasses used in Missouri.

## Unit IV - Tool Identification and Maintenance

1. Identify and maintain hand tools and equipment.
2. Identify, maintain, and safely use power tools.

## Unit V - Pesticides

1. Describe how various types of pesticides work.
2. Accurately interpret a pesticide label for information about use, effectiveness, and safe handling.
3. Identify safety precautions that should be followed when using pesticides.

## Unit VI - Installation and Maintenance of Trees and Shrubs

1. Transplant a tree or shrub and properly plant a bare-root, container-grown, or B and B tree or shrub.
2. Stake and guy a newly-planted tree; wrap, prune, and apply anti-transpirants to young trees.
3. Prune trees, shrubs, hedges, and roses.
4. Fertilize trees and shrubs.
5. Determine the best methods of irrigation in various situations.
6. Recognize common insects and diseases, the type of damage or symptoms they cause, and recommended control methods.

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## Unit VII - Installation and Maintenance of Bedding Plants and Ground Covers

1. Prepare the soil of a flower bed, determine the number of plants to use, and transplant bedding plants and ground covers.
2. Maintain bedding plants and ground covers.

## Unit VIII - Turfgrass

1. List advantages and disadvantages of the six major turfgrasses grown in Missouri
2. Describe the procedure for installing a lawn.
3. Maintain turf by properly fertilizing, watering, and mowing.
4. Explain how to successfully cultivate or renovate a lawn.
5. Identify common pests in turfgrass and explain how to control these pests.

## Unit IX - Site Analysis and Evaluation

1. Analyze a landscape site.
2. Draw a base map to scale.
3. Effectively use design symbols in a landscape plan.

## Unit X - Selecting and Using Plants in the Landscape

1. Select trees for specific purposes in the landscape.
2. Select effective shrubs and hedges for landscape.
3. Describe the uses of vines and ground covers and select the species to suit the location to be planted.
4. Select a location and plants for a perennial bed or border.
5. Select a turfgrass for a specific growing site.

## Unit XI - Landscape Designing

1. Identify and explain the four elements of landscape design.
2. Implement the use of natural and manufactured enrichments in a landscape plan.
3. Identify the five principles of design.
4. Apply both the principles and elements of design to create a landscape plan.

## Unit XII - Developing Cost Estimates

1. Calculate the price of a landscape design.
2. Price various components of landscape maintenance.

**Class/Section:**

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1. Transplant a tree or shrub and properly plant a bare-root, container-grown, or B and B tree or shrub.
2. Stake and guy a newly-planted tree; wrap, prune, and apply anti-transpirants to young trees.
3. Prune trees, shrubs, hedges, and roses.
4. Fertilize trees and shrubs.
5. Determine the best methods of irrigation in various situations.
6. Recognize common insects and diseases, the type of damage or symptoms they cause, and recommended control methods.





## UNIT I - EVALUATING OPPORTUNITIES IN THE LANDSCAPE AND TURFGRASS INDUSTRIES

### Lesson 1: The Importance of Landscaping

**Objective:** The student will be able to explain the importance of landscape and turfgrass industries today and in the future.

#### Study Questions

- 1. How do plants affect people and their environment?**
- 2. What effect does landscaping have on property values?**
- 3. What is the economic value of the landscape and turfgrass industries to the nation?**
- 4. What determines the future of the landscape and turfgrass industries?**

#### Reference

1. Landscaping and Turf Management (Student Reference). University of Missouri-Columbia: Instructional Materials Laboratory, 1990.

## UNIT I - EVALUATING OPPORTUNITIES IN THE LANDSCAPE AND TURFGRASS INDUSTRIES

### Lesson 1: The Importance of Landscaping

#### TEACHING PROCEDURES

##### A. Introduction

Landscape and turfgrass industries are growing and will continue to grow as their services remain in high demand. More individuals, communities, cities, and states are turning to the landscape and turfgrass industries to improve the appearance of as well as to increase the economic value of their environments.

##### B. Motivation

Jobs in landscape design, landscape maintenance, and turf management will be in higher demand in the future.

##### C. Assignment

##### D. Supervised study

##### E. Discussion

1. Ask students if they notice homes and buildings that are landscaped and those that are not landscaped.

##### **How do plants affect people and their environment?**

Plants may cause psychologically uplifting effects on people, as well as create long-range improvements in the environment.

2. Ask students to compare the appearance of a home that is not landscaped to a similar home that is landscaped.

##### **What effect does landscaping have on property values?**

- a) Increases the beauty of the property
- b) Adds security to the property
- c) Is a capital investment
- d) May help save energy in home heating and cooling

3. Ask students if they think landscaping has had an economic effect on the nation.

##### **What is the economic value of the landscape and turfgrass industries to the nation?**

- a) It has been increasing steadily since the 1960's.
- b) It has generated from under one billion dollars to over seven billion dollars within the past seven years.

4. Ask students if their parents have time to maintain their yards. If their parents do not have time, do they hire someone to do the job? Ask students if they have computers at home and how computers might benefit landscape and turfgrass industries in the future.

**What determines the future of the landscape and turfgrass industries?**

- a) More people will be working from their homes with the increase of electronics, computers, and telecommunication.
- b) More retirement homes will be needed.
- c) More condominiums are being built for a growing, single adult population.
- d) Theme parks, shopping centers, and malls will require increased services from landscape and turfgrass industries.

**F. Other activities**

1. Invite a guest speaker in to talk about landscape and turfgrass industries.
2. Take students on a field trip to tour a landscape or turfgrass industry.

**G. Conclusion**

Landscape and turfgrass industries are important service industries today, and will continue to expand in the future.

**H. Competency**

Explain the importance of landscape and turfgrass industries today and in the future.

**I. Answers to Evaluation**

1. b
2. b
3. b
4. c
5. Answers should contain three of the following:
  - a. Relaxation
  - b. Psychologically uplifting
  - c. Give feeling of pride
  - d. Place of refuge
  - e. Place for entertaining

**UNIT I - EVALUATING OPPORTUNITIES IN THE LANDSCAPE  
AND TURFGRASS INDUSTRIES**

Name \_\_\_\_\_

Date \_\_\_\_\_

**Lesson 1: The Importance of Landscaping**

**EVALUATION**

**Circle the letter that corresponds to the best answer.**

1. Landscaping adds approximately what percentage to property value?
  - a. 0-5
  - b. 10-15
  - c. 20-25
  - d. 30-35
2. How can landscaping increase property value?
  - a. Securing the family dog behind a fence
  - b. Adding security through screening and fencing
  - c. Blocking neighbor's view
  - d. Making the house appear smaller
3. What do recent surveys claim about landscaping?
  - a. A field of the past
  - b. An important field of the future
  - c. Not an important field of the past
  - d. Not an important field of the future
4. Which describes growth of the economic value of the landscape and turfgrass industries?
  - a. Increasing slowly
  - b. Decreasing slowly
  - c. Increasing steadily
  - d. Decreasing steadily

**Complete the following short answer question.**

5. What are three effects that plants can have on people and their environments?
  - a.
  - b.
  - c.

## UNIT I - EVALUATING OPPORTUNITIES IN THE LANDSCAPE AND TURFGRASS INDUSTRIES

### Lesson 2: Careers and Professional Organizations in the Landscape and Turfgrass Industries

**Objective:** The student will be able to describe the common jobs in the landscape and turfgrass industries.

#### Study Questions

- 1. What are some common jobs in the landscape and turfgrass industries?**
- 2. How can a landscape or turfgrass job be found?**
- 3. What are some possible SAEP's for landscaping and turf management?**
- 4. What are some benefits of professional organizations?**
- 5. Why is it important to subscribe to trade publications?**

#### Reference

1. Landscaping and Turf Management (Student Reference). University of Missouri-Columbia: Instructional Materials Laboratory, 1990.



## UNIT I - EVALUATING OPPORTUNITIES IN THE LANDSCAPE AND TURFGRASS INDUSTRIES

### Lesson 2: Careers and Professional Organizations in the Landscape and Turfgrass Industries

#### TEACHING PROCEDURE

**A. Review**

Review previous lesson.

**B. Motivation**

Explain that many future jobs will be service jobs. Landscape and turfgrass industries will be expanding because they provide service jobs which will be in high demand.

**C. Assignment**

**D. Supervised study**

**E. Discussion**

1. Ask students to list all the jobs they think could be included in the landscape and/or turfgrass industries. Ask students to discuss those jobs listed in which they might like to be employed and why.

**What are some common jobs in the landscape and turfgrass industries?**

- a) Landscape architect/designer
- b) Landscape maintenance
- c) Golf course employee
- d) Landscape gardener
- e) Garden center employee
- f) Horticulture teacher
- g) Parks system foreman
- h) Tree maintenance foreman
- i) Horticulture extension agent
- j) Research specialist
- k) Plant breeder

2. Ask students how they would find a place, such as a restaurant, where they have never been.

**How can a landscape or turfgrass job be found?**

- a) Yellow pages
- b) Newspaper advertisements
- c) Trade journals
- d) Word-of-mouth
- e) Employment agencies
- f) School guidance or placement
- g) Horticulture teacher
- h) Friends and relatives
- i) Horticulture firms and businesses

3. Ask students why hands-on experiences would be an effective way to learn landscaping and turf management skills.

**What are some possible SAEP's for landscaping and turf management?**

- a) Mowing and other summer maintenance jobs
  - b) Creating and implementing landscape designs
  - c) Raking leaves in fall and other maintenance jobs for winterization of plants
  - d) Maintaining lawn equipment for individuals in the community
  - e) "Lawn sitting" for homeowners on vacation
  - f) Performing jobs at a local nursery, garden center, or golf course
  - g) Snow plowing and shoveling during winter
4. Ask students what kinds of benefits they might receive from being a member of 4-H, a football team, a pep club, an honor society, or a band.

**What are some benefits of belonging to professional organizations?**

- a) Up-to-date information
  - b) Group insurance programs
  - c) Business contacts
  - d) Aid in funding research projects
5. Ask students why they purchase certain magazines such as Seventeen, Sports Illustrated, or TV Guide.

**Why is it important to subscribe to trade publications?**

- a) Information about job openings
- b) Information about courses, seminars, or trips
- c) Information about new equipment to update a business
- d) Information about current research

**F. Other activities**

1. Ask someone from the landscape and/or turfgrass industry to be a guest speaker and share information about this field.
2. Have students read an article from a trade publication and list the information it provides.
3. Invite someone from a horticultural, professional organization to come in and speak about the organization.

**G. Conclusion**

There are many types of landscape and turfgrass industry jobs. Some industries will hire employees right out of high school while others require a two-to-four year college education. Once employed, it is good to become a member of a professional organization as well as subscribe to trade publication.

**H. Competency**

Identify and describe landscape and turfgrass jobs.

**I. Answers to Evaluation**

- 1. a**
- 2. d**
- 3. Answers should contain four of the following: tell friends and relatives, tell horticulture teacher, look in the classified section of newspaper, look in yellow pages for businesses, check with employment agencies, check with school guidance and placement services, place ad in newspaper.**
- 4. Answers should contain four of the following: mowing grass, raking leaves, snow plowing, being employed by business, repairing equipment, "lawnsitting."**

**UNIT I - EVALUATING OPPORTUNITIES IN THE  
LANDSCAPE AND TURFGRASS INDUSTRIES**

Name \_\_\_\_\_

Date \_\_\_\_\_

**Lesson 2: Careers and Professional Organizations in the Landscape and Turfgrass Industries**

**EVALUATION**

**Circle the letter that corresponds to the best answer.**

1. Which qualifies as an entry-level job requiring high school/vocational training?
  - a) Garden center employee
  - b) Landscape architect
  - c) Horticulture teacher
  - d) Plant breeder
  
2. Which is not a benefit of belonging to a professional organization?
  - a) Possible provisions of group insurance programs
  - b) Up-to-date information in their field
  - c) Opportunities to meet new business contacts
  - d) Reduced tuition at universities

**Complete the following short answer questions.**

3. What are four possible ideas that might help in looking for a job?
  - a.
  - b.
  - c.
  - d.
  
4. What are four possible SAEP's for landscape and turfgrass?
  - a.
  - b.
  - c.
  - d.

## UNIT II - HOW PLANTS GROW

### Lesson 1: Plant Growth and Development

**Objective:** The student will be able to demonstrate knowledge of the difference between monocot and dicot plants and how they differ in growth patterns.

#### Study Questions

- 1. How does the structure of monocot and dicot plants differ?**
- 2. How do monocot and dicot plants grow in diameter?**
- 3. How does the location of the meristems in monocot and dicot plants determine the growing points?**

#### References

1. Landscaping and Turf Management (Student Reference). University of Missouri-Columbia: Instructional Materials Laboratory, 1990.
2. Work Sheet
  - a) WS 1.1: Monocot and Dicot Plant Structure

## UNIT II - HOW PLANTS GROW

### Lesson 1: Plant Growth and Development

#### TEACHING PROCEDURES

##### A. Introduction

It is important to know basic differences in plant growth in order to be successful in selecting, installing, and maintaining plants in a landscape. Knowing how the growth patterns of monocot and dicot plants differ, helps a landscaper use each plant for a unique purpose. Review curriculum in Plant Science I or Greenhouse Operation and Management Curriculum (photosynthesis, respiration, and transpiration processes).

##### B. Motivation

Knowing how a plant grows, its parts, structure, and functions help us to understand the purpose of each plant in the environment.

##### C. Assignment

##### D. Supervised study

##### E. Discussion

1. Ask the students to give some examples of monocot and dicot plants. Ask them to tell how the plants look different.

#### **How does the structure of monocot and dicot plants differ?**

- a) Monocots
  - 1) External structure
    - (a) One cotyledon leaf
    - (b) Narrow leaves with parallel venation
    - (c) Flower petals in threes or sets of three
  - 2) Internal structure
    - (a) Vascular bundles scattered randomly throughout stem
    - (b) No vascular cambium
- b) Dicots
  - 1) External structure
    - (a) Two cotyledon leaves
    - (b) Leaves vary in shape and have netted venation
    - (c) Flower petals in groups of four or five
  - 2) Internal structure
    - (a) Vascular bundles arranged in cylindrical form
    - (b) Vascular cambium

2. Ask the students to explain how plants get larger in diameter.

#### **How do monocot and dicot plants grow in diameter?**

- a) Monocot - grow in diameter by expansion of existing cells
- b) Dicots - grow in diameter by cell division in cambium layer



3. Ask the students to locate the points at which plants grow.

**How does the location of the meristems in monocot and dicot plants determine the growing points?**

- a) Monocot meristems
  - 1) Located in tips of roots
  - 2) Located in intercalary meristem above node
  - 3) Cause growth in height
- b) Dicot meristems
  - 1) Located in tips of roots
  - 2) Located in tips of stems
  - 3) Cause growth in height

**F. Other activities**

1. Practice labeling schematic diagrams and cross sections of plants, internal stem structures, growing points, and meristem tissues.
2. Bring in different monocot and dicot plants. Allow students to observe vascular systems in a cross-sectional cut.
3. Sow a monocot seed (corn) and a dicot seed (bean). Note that monocot seeds have one cotyledon while dicot seeds have two cotyledons.

**G. Conclusion**

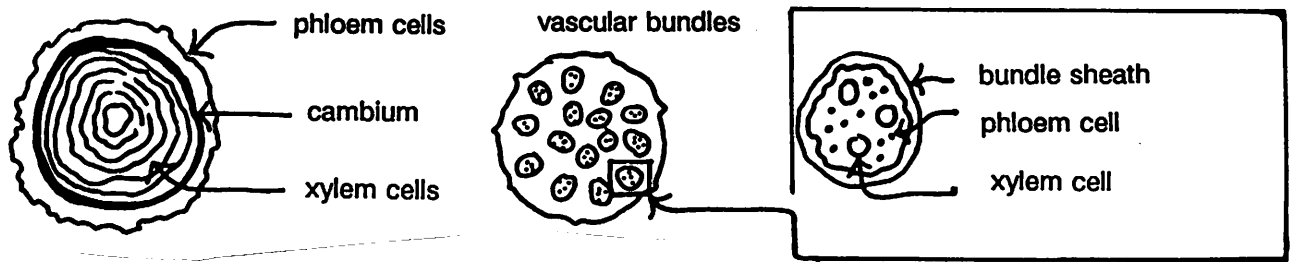
The major differences between monocot and dicot plants are that dicot plants have a vascular cambium, netted venation, and cylindrically arranged vascular bundles. Dicot plants grow in height at the apical meristem and in width at the vascular cambium. Monocot plants have no vascular cambium, parallel venation, and scattered vascular bundles. Monocot plants grow in height at the intercalary meristem and in width by expansion of cells. It is essential to know these basic differences in plant growth before one can be successful in selecting, installing, and maintaining landscape plants.

**H. Competency**

Label plant parts and structures correctly and identify the differing growth patterns of monocot and dicot plants.

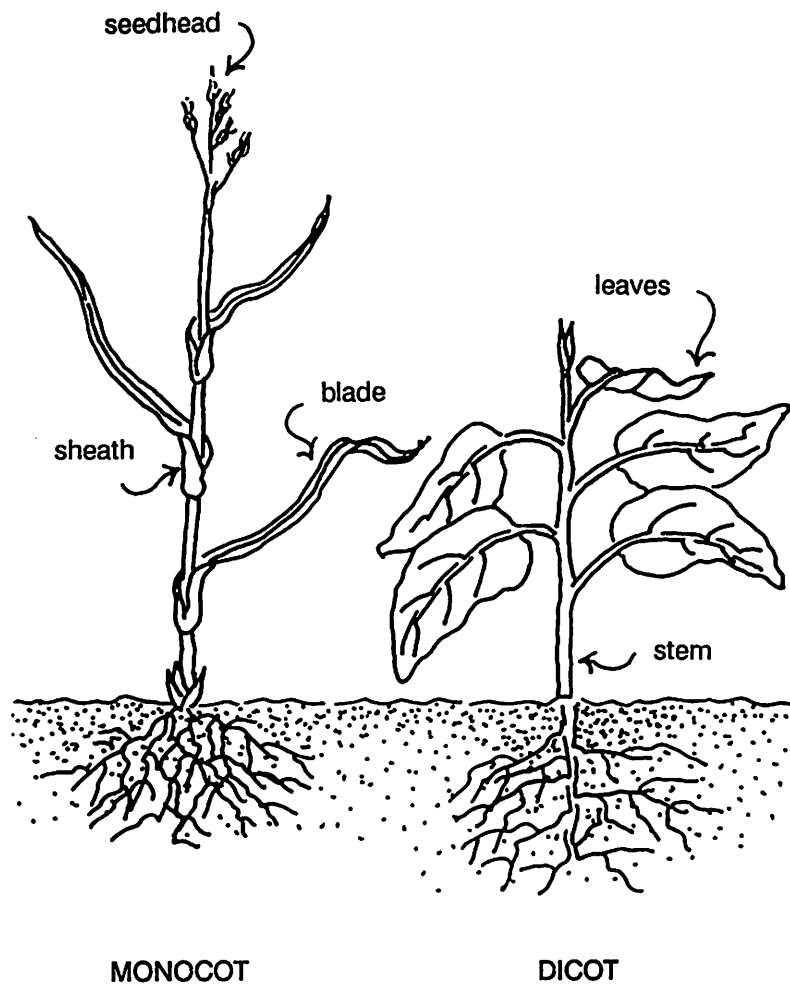
**I. Answers to Evaluation**

1. c
2. d
3. b
4. d
5. d
6. a
7. a
8. c



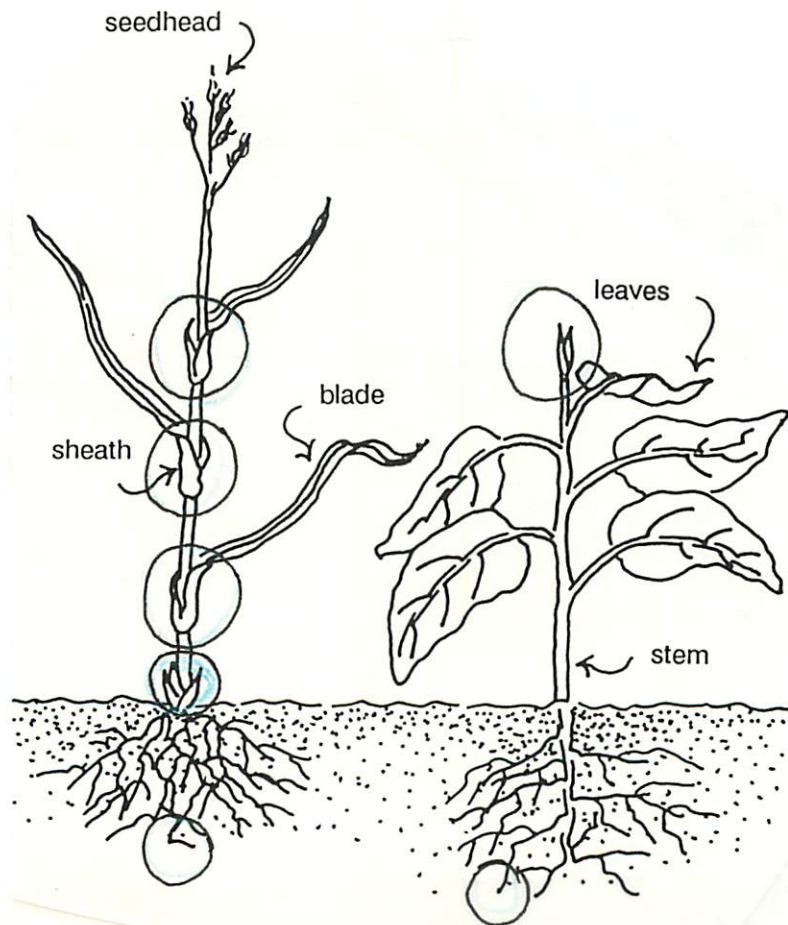
9. Monocot: phloem - carries food to roots  
 xylem - carries water upward  
 Dicot: phloem - carries food to roots  
 xylem - carries water upward  
 cambium - separates phloem and xylem and area of new cell division

10.



J. Answers to work sheet

Work Sheet 1.1 - Monocot and Dicot Plant Structure



EVALUATION

Circle the letter that corresponds to the best answer.

1. What are the external characteristics of a monocot plant?
  - a. Netted venation, two cotyledons, and flower petals in sets of three
  - b. Parallel venation, one cotyledon, and flower petals in sets of four or five
  - c. Parallel venation, one cotyledon, and flower petals in threes or sets of three
  - d. Parallel venation, two cotyledons, and flower petals in threes or sets of three
2. What are included in the internal characteristics of monocot plants?
  - a. Scattered vascular bundles, vascular cambium, phloem and xylem
  - b. Cylindrical arrangement of vascular bundles, cambium, phloem, and xylem
  - c. Scattered vascular bundles, phloem, xylem, and internodes
  - d. Scattered vascular bundles, phloem, xylem, and bundle sheath
3. What is the growing point on a monocot plant that causes growth in height?
  - a. Terminal bud
  - b. Intercalary meristem above the node at the lower part of the plant
  - c. Tip of the blade
  - d. Axillary bud
4. How does a monocot plant grow in diameter?
  - a. By cell division in the cambium layer
  - b. By the apical meristem
  - c. By the intercalary meristem
  - d. By expansion of existing cells
5. What do dicot plants have that cause them to differ from monocot plants?
  - a. Netted venation
  - b. Scattered vascular bundles
  - c. Vascular cambium
  - d. a. and c.
6. What are included in the internal structure of dicot plants?
  - a. Cylindrical arrangement of vascular bundles, vascular cambium, xylem, and phloem
  - b. Scattered vascular bundles, phloem, xylem, and bundle sheath
  - c. Axillary bud, cylindrical arrangement of vascular bundle, and vascular cambium
  - d. Scattered vascular bundles, phloem, xylem, and internodes

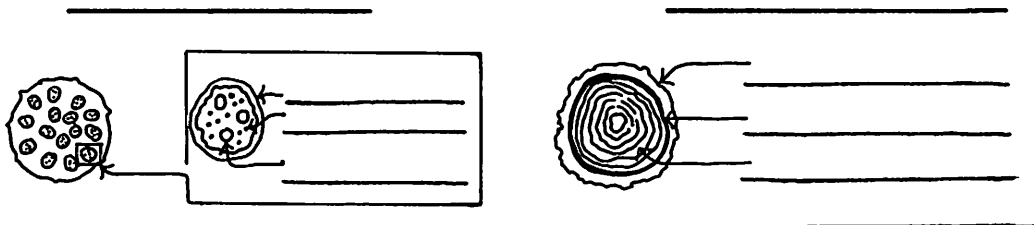
7. At what part do dicot plants grow in height?

- a. Apical meristem
- b. Intercalary meristem
- c. Internode
- d. Root cup

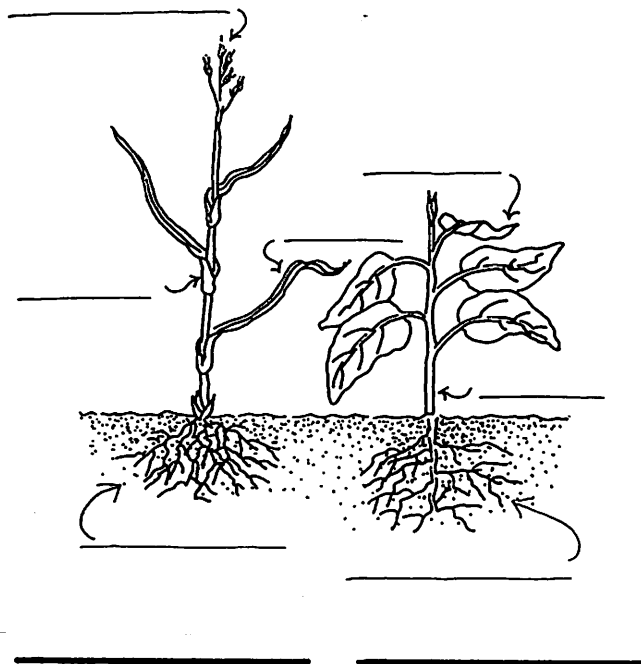
8. Where does growth in diameter take place in dicot plants?

- a. In the apical meristem
- b. By expansion of existing cells
- c. By cell division in the cambium layer
- d. In the intercalary meristem

9. In these cross-sectional diagrams, which is a monocot and which is a dicot? Label the internal structures of each stem cross section.



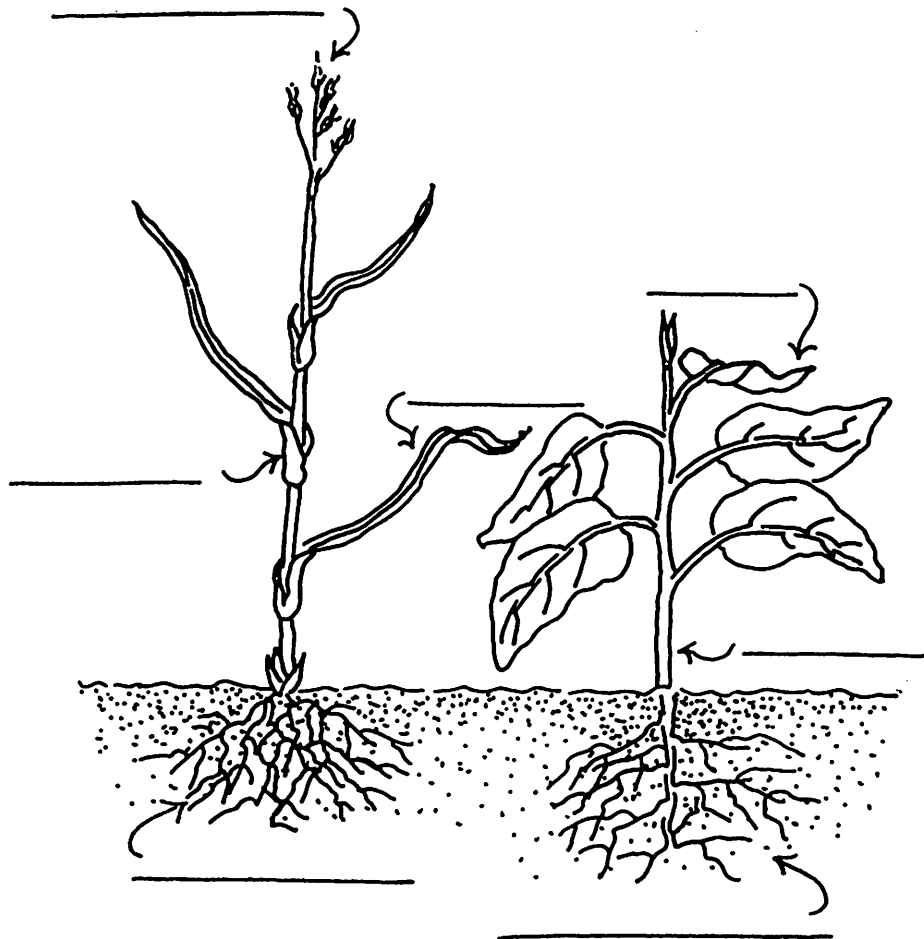
10. Identify which plant is a monocot and which is a dicot. Label the indicated parts.



Lesson 1: Plant Growth and Development

Work Sheet 1.1: Monocot and Dicot Plant Structures

Label the following diagrams. Circle the areas where the apical and intercalary meristems are located.



## UNIT II - HOW PLANTS GROW

### Lesson 2: Environmental Factors Below Ground that Affect Plant Growth

**Objective:** The student will be able to demonstrate knowledge of the soil factors affecting plant growth, and how to improve the soil.

#### Study Questions

- 1. What are the components of soil and how are they formed?**
- 2. What are the six environmental factors below ground that affect plant growth?**
- 3. How do soil structure and texture affect plant growth?**
- 4. How does the balance between air and water in the soil affect plant growth?**
- 5. How does soil fertility and pH affect plant growth?**
- 6. How can soil be improved?**

#### References

1. Landscaping and Turf Management (Student Reference). University of Missouri-Columbia: Instructional Materials Laboratory, 1990.
2. Transparency Masters
  - a) TM 2.1: Textural Triangle
  - b) TM 2.2: Nutrient Availability
3. "Soil Samples" from the Instructional Materials Laboratory, University of Missouri-Columbia, 10 London Hall, Columbia, MO 65211.
4. University Extension guides
  - a) Submitting a Soil Sample, #9109
  - b) Sampling Your Soil for Testing, #9110
  - c) Using Your Soil Test Results, #9111
5. Work Sheets
  - a) WS 2.1: Using the Textural Triangle
  - b) WS 2.2: Solving pH Problems

## UNIT II - HOW PLANTS GROW

### Lesson 2: Environmental Factors Below Ground That Affect Plant Growth

#### TEACHING PROCEDURES

##### A. Review

Review previous lesson.

##### B. Motivation

The components of soil as well as the effects of environmental factors on soil are important to successful plant growth. Therefore, a landscaper needs to understand these factors, as well as how to improve soil when necessary.

##### C. Assignment

##### D. Supervised study

##### E. Discussion

1. Ask students to think of things a plant needs from the environment in order to grow. Soil is the most commonly overlooked factor. Point out the importance of soil to plant growth.

**What are the components of soil and how are they formed?**

- a) Soil Profile
  - 1) Bedrock
  - 2) Subsoil
  - 3) Topsoil
- b) Components of an Ideal Soil
  - 1) 45% particle matter
  - 2) 5% organic matter
  - 3) 25% water
  - 4) 25% air
  - 5) Microorganisms
- c) Weathering - breaks down bedrock
  - 1) Wind
  - 2) Freezing and thawing
  - 3) Water movement
  - 4) Roots
  - 5) Microbe activity
- d) Soil movement
  - 1) Alluvial soils - by water
  - 2) Glacial till - pushed by glaciers
  - 3) Loess - blown by the wind

2. Ask the students for the six underground factors that determine how plants grow.

**What are the six environmental factors below ground that affect plant growth?**

- a) Texture



- b) Structure
- c) Air
- d) Water
- e) Fertility
- f) pH

3. Ask the students to define texture and structure. Write their definitions on the board. Consider showing the filmstrip, "Soil Texture" and/or "Soil is Soil...Isn't It?" Hand out UMC Guides, #9109, #9110, and #9111. Use TM 2.1.

### **How do soil structure and texture affect plant growth?**

- a) Texture - size and distribution of particles
  - 1) Soil name
    - (a) Textural triangle - particle percentages determines name
    - (b) Loam soils - best for landscaping use
  - 2) Sand - largest
    - (a) Best drainage
    - (b) Low water holding
    - (c) Much air space - porosity
    - (d) No nutrient benefit
  - 3) Silt - middle
    - (a) Drains fairly well
    - (b) Some water holding
    - (c) Some air space
    - (d) Some nutrient benefit
  - 4) Clay - smallest
    - (a) Does not drain well
    - (b) High water holding (sometimes too much)
    - (c) Very little air space
    - (d) Offers many nutrients
- b) Structure - arrangement of soil particles (aggregates)
  - 1) Kinds of aggregates
    - (a) Granular - best for horticultural use, many air spaces
    - (b) Plate
    - (c) Block
    - (d) Prismatic
  - 2) Improved by adding organic matter
  - 3) Tilth destroyed by
    - (a) Compaction
    - (b) Digging soil when too wet
- c) Texture and structure provide pores for
  - 1) Air
  - 2) Water
  - 3) Roots
- d) Soil color
  - 1) Dark
  - 2) Uniformly colored
  - 3) Yellowish or reddish
  - 4) Whitish
  - 5) Bluish or grayish
- e) Soil depth

4. Ask two students to try to stand in the same spot. Stress that no two objects can occupy the same space at the same time, nor can air and water occupy the same space in the soil.

**How does the balance between air and water in the soil affect plant growth?**

- a) Air and water balance
    - 1) 25% of each
    - 3) As one increases the other decreases
    - 4) Excess of either air or water causes problems
  - b) Pore spaces
    - 1) Determined by texture and structure
    - 2) Larger in sand for drainage and aeration
    - 3) Smaller in clay, which retains water
  - c) Water movement
    - 1) Determined by the size and quantity of pore spaces
    - 2) Types
      - (a) Non-capillary - gravitational water
      - (b) Capillarity - capillary water
      - (c) Hygroscopic water
    - 3) Available water - between field capacity and permanent wilting point
    - 4) Perched water table - layering of soil textures
5. Ask for student ideas about fertility and pH. (Use TM 2.2.)

**How does fertility and pH affect plant growth?**

- a) Fertility - ability of soil surface particles to absorb nutrients
  - 1) Forms of nutrients
    - (a) Weathered rock minerals
    - (b) Organic matter
    - (c) Fertilizer
  - 2) Must be in soil solution to be available to plant roots
  - 3) Held by clay and organic matter
  - 4) CEC (Cation Exchange Capacity)
    - (a) Ability to attract and exchange cations
    - (b) Higher CEC in soil higher in organic matter or clay
  - 5) Soil test for soluble salts
    - (a) Range - 0.1-3.5
    - (b) Best - 1.0-1.5
    - (c) Nutrient deficiency - growth stunting and starvation
    - (d) Toxic - wilting and nutrient deficiency symptoms
- b) Soil reaction - pH
  - 1) pH scale
    - (a) Acidic - 4.0
    - (b) Alkaline - 14.0
    - (c) Neutral - 7.0
    - (d) Sour soils, 0-7
    - (e) Sweet soils, 7-14
  - 2) pH too high or too low
    - (a) Ties up some nutrients
    - (b) Makes others toxic
  - 3) Adjusting pH
    - (a) Too acidic - add lime to raise pH
    - (b) Too alkaline - add sulphur to lower pH

6. Ask the students if they know what they can do to improve poor soils.

**How can the soil be improved?**

- a) Adding organic matter improves soil.
  - 1) Texture
  - 2) Structure
  - 3) Fertility
  - 4) Permeability
- b) Tilling improves the soil's ability to hold water and air.

**F. Other activities**

1. Demonstrate how to use the textural triangle.
2. Demonstrate how to take a soil sample.
3. Have students practice finding the names of different soils.
4. Have students take a soil sample. The soil sample taken for this unit for testing should be from a school site that can be used for planting landscape plants (trees, shrubs, or annuals). Preparing and planting the site will be done in future activities. Prepare the soil sample to send to the County Extension Agent for testing. If testing equipment is available at your school, test the pH and soluble salt levels.
5. Demonstrate the movement of water by using a sponge.
6. Use the sponge to demonstrate a perched water table.
7. Demonstrate a perched water table by placing a fine-textured soil over a coarse-textured soil in a small glass box. Pour water into the top. Watch as the water fills the entire layer of fine-textured soil before it enters into the coarse-textured soil (or gravel).
8. In cooperation with a local nursery, visit a planting site. Ask the landscaper what is done to evaluate the soil and to improve the soil, if needed.

**G. Conclusion**

The textural and structural condition of the soil, the air and water movement, and the pH and fertility of the soil are all essential to healthy plants. If any of these factors are found to be deficient, they must be improved. Adding organic matter will help the texture, structure, air and water movement, and fertility. Adding fertilizer will also help the fertility. Adding lime or sulphur will alter the pH.

**H. Competency**

Demonstrate knowledge of soil properties and how soil quality relates to plant growth; assess the soil at a planting site and determine how to improve it, if needed.

I. Answers to Evaluation

1. j
2. k
3. a
4. b
5. m
6. n
7. g
8. c
9. d
10. e
11. f
12. l
13. o
14. h
15. i
16. a. Freezing and thawing  
b. Wind  
c. Plant roots  
d. Microbial activity  
Alternate: water movement
17. a. Particle matter - 45%  
b. Organic matter - 5%  
c. Air - 25%  
d. Water - 25%
18. a
19. d
20. b
21. a
22. d
23. b
24. b
25. a
26. c
27. b
28. c

J. Answers to work sheets

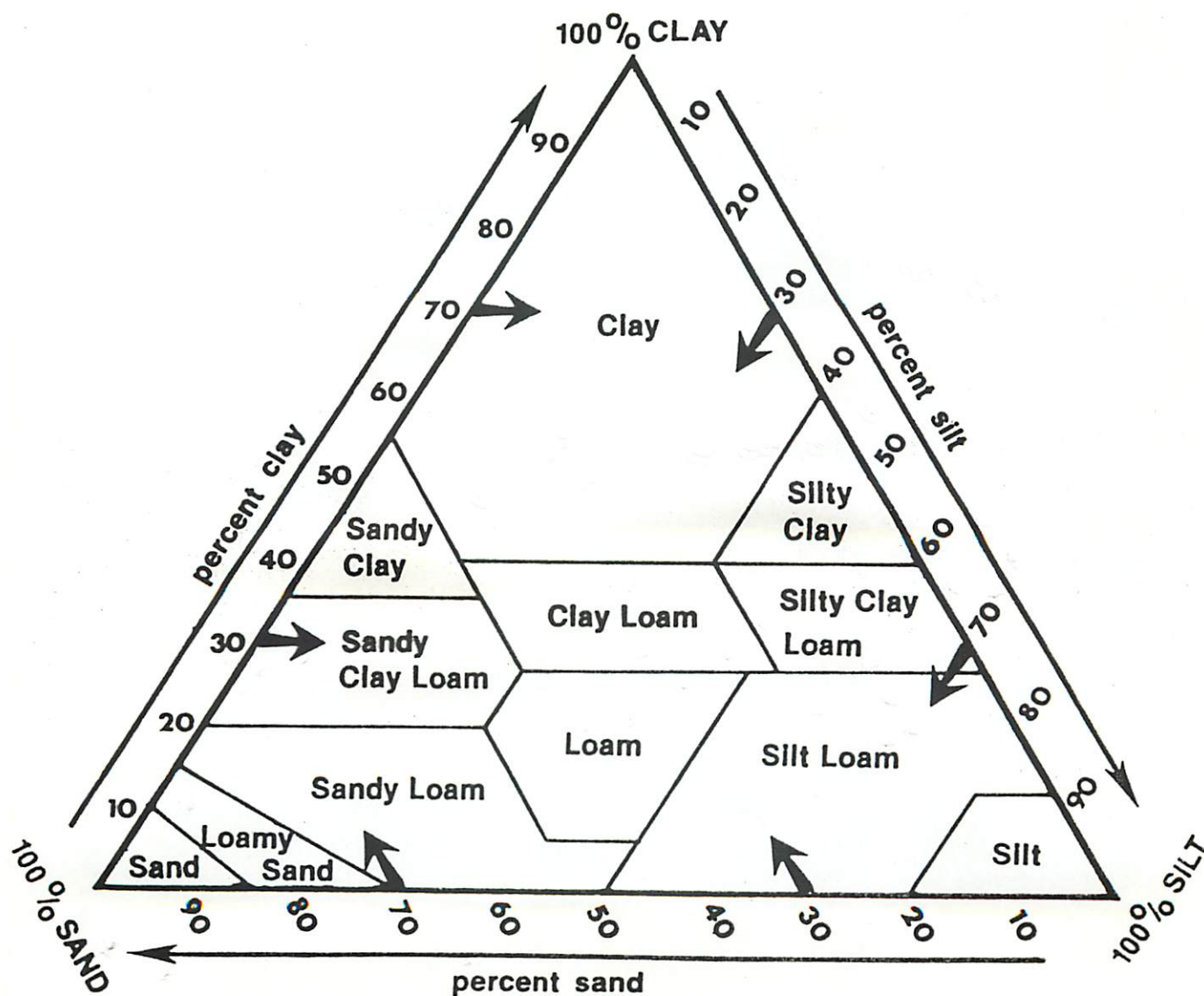
Work Sheet 2.1 - Using the Textural Triangle

1. Clay
2. Silt Loam
3. Loam
4. Clay
5. Loam
6. Clay loam
7. Clay loam
8. Sandy clay
9. Sandy loam
10. Sandy clay loam

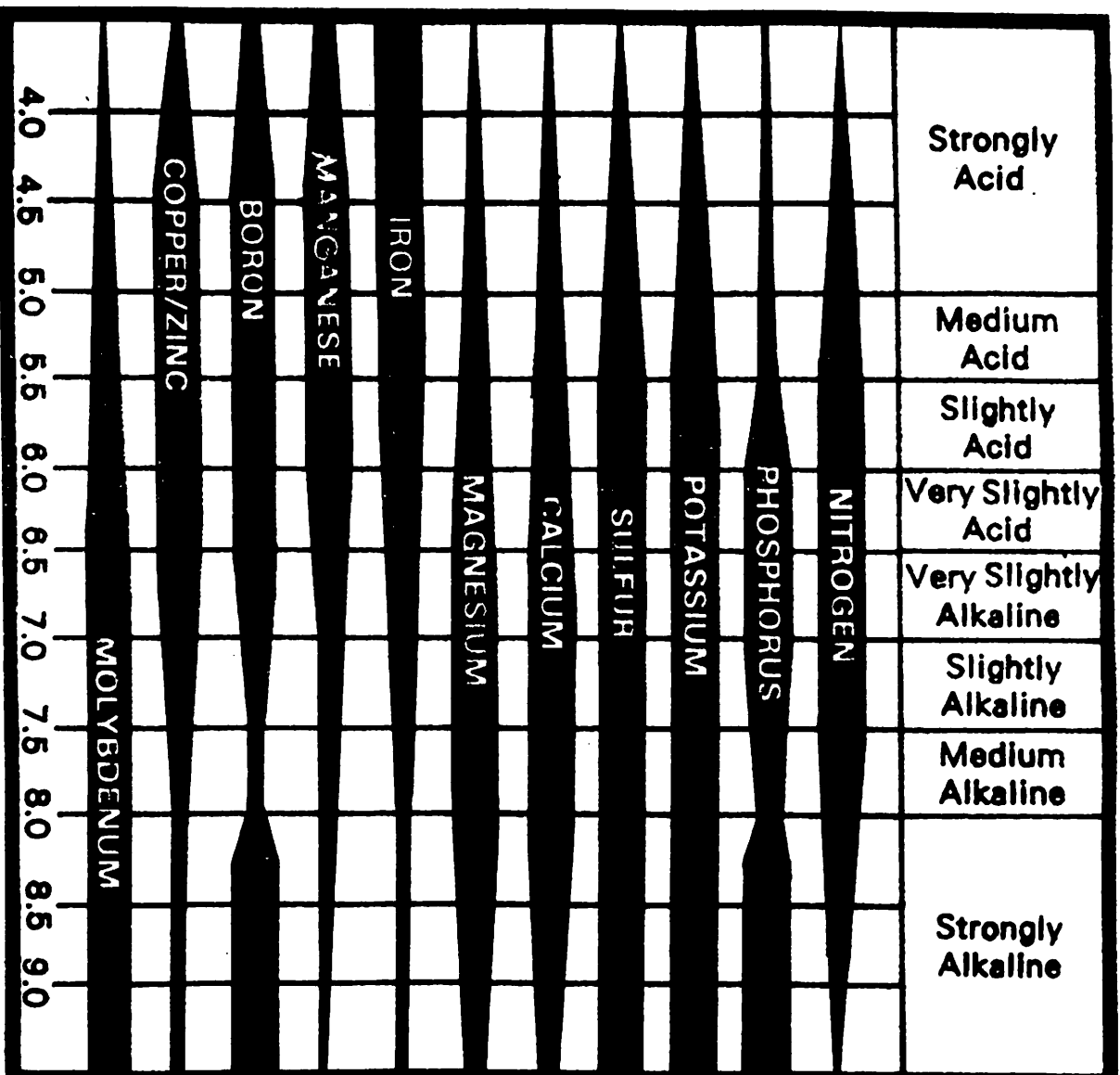
## Work Sheet 2.2 - Solving pH problems

1. Sulphur, aluminum sulphate
2. Agricultural lime, lime
3. Agricultural lime, lime
4. Sulphur, aluminum sulphate
5. 7.0
6. 0 to 7
7. 7 to 14

# Textural Triangle



# Nutrient Availability

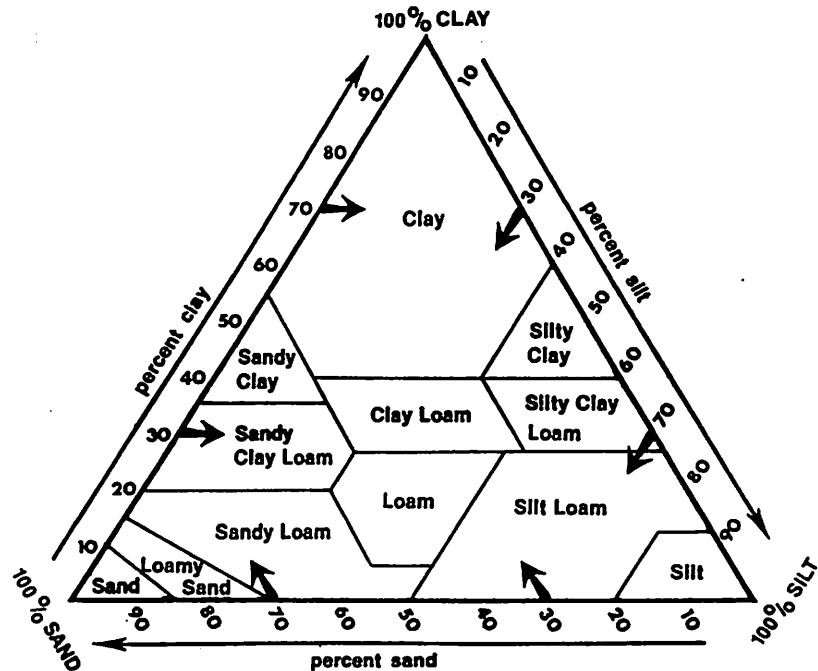


**Soil pH Governs Nutrient Release**  
**Acidity or alkalinity (pH) controls relative nutrient availability.**

## Lesson 2: Environmental Factors Below Ground that Affect Plant Growth

## Work Sheet 2.1: Using the Textural Triangle

Using the textural triangle, plot the percentages on the following page. Follow the procedure of the example given below.



Example: 35% clay, 45% silt, and 20% sand

- Plot the silt and clay points on the triangle.
- Using the clay point, draw a line into the triangle parallel to the sand line (line a).
- Using the silt point, draw a line parallel to the clay line (line b).
- The point where these two lines intersect determines the soil type; in this example, it is silty clay loam.



	% CLAY	% SILT	% SAND	SOIL TYPE
1.	60	30	10	_____
2.	25	55	20	_____
3.	25	30	45	_____
4.	80	10	10	_____
5.	20	35	45	_____
6.	30	40	30	_____
7.	30	45	25	_____
8.	40	10	50	_____
9.	10	30	60	_____
10.	30	25	45	_____

## Lesson 2: Environmental Factors Below Ground that Affect Plant Growth

## Work Sheet 2.2: Solving pH Problems

**An improper pH can damage or kill a plant. In case of a situation with too low or too high a pH, one must know what to do to remedy it. Answer the following questions, which provide practice for solving pH problems.**

1. A soil has a pH of 9.8. A pH of 7.0 is needed. What could be added to correct the problem?

\_\_\_\_\_

2. A soil has a pH of 4.5. A pH of 6.9 is needed. What could be added to correct the problem?

\_\_\_\_\_

3. A soil is too acidic. What could be added to correct the problem?

\_\_\_\_\_

4. A soil is too alkaline. What could be added to correct the problem?

\_\_\_\_\_

5. A soil is neutral. What is the pH? \_\_\_\_\_

6. A soil is sour. What is the pH range? \_\_\_\_\_ to \_\_\_\_\_

7. A soil is sweet. What is the pH range? \_\_\_\_\_ to \_\_\_\_\_

## UNIT II - HOW PLANTS GROW

### Lesson 3: Environmental Factors Above Ground that Affect Plant Growth

**Objective:** The student will be able to describe environmental factors that affect plants.

#### Study Questions

- 1. What are the three climatic types and the factors which influence them?**
- 2. How does temperature determine the plants that can be grown in the landscape?**
- 3. How does light affect plant growth?**
- 4. How do water and humidity affect plant growth?**
- 5. How do wind and air quality affect plant growth?**

#### References

1. Landscaping and Turf Management (Student Reference). University of Missouri-Columbia: Instructional Materials Laboratory, 1990.
2. Work Sheet
  - a) WS 3.1: Factors Above Ground That Affect Plant Growth

## UNIT II - HOW PLANTS GROW

### Lesson 3: Environmental Factors Below Ground that Affect Plant Growth

#### TEACHING PROCEDURES

##### A. Review

Review previous lesson.

##### B. Motivation

Landscapers may not be able to change factors of climate and weather, but they can understand them in order to use these factors to their advantage.

##### C. Assignment

##### D. Supervised study

##### E. Discussion

1. Ask the students to give examples of macroclimates, mesoclimates, and microclimates. Ask them what factors determine climate (light intensity, precipitation, temperature, humidity, air, and wind). This can be related to the school, with the campus representing the macroclimate, the classroom representing the mesoclimate, and an area in the classroom representing a microclimate. For example, a window ledge would be warmer and drier than a dark, secluded corner on the opposite side of the room.

**What are the three climatic types and the factors which influence them?**

- a) Macroclimate influenced by
    - 1) Mountains
    - 2) Oceans
    - 3) Elevation
    - 4) Seasons
    - 5) Forests
    - 6) Air masses
  - b) Mesoclimate influenced by
    - 1) Buildings
    - 2) Lakes
    - 3) Topography
  - c) Microclimate influenced by
    - 1) House
    - 2) Slopes and hills
    - 3) Trees
2. Ask the students if they know the plant hardiness zone they live in. Have them check the map if they do not know. Explain that plants are adapted to different locations. For example, house plants that come from tropical areas must be brought inside during the winter in the Midwest because they will not survive the cold temperatures. Landscapers must know the hardiness zone of their locations and hardiness zone listing of plants.

**How does temperature determine the plants that can be grown in the landscape?**

- a) Temperature affects
    - 1) Photosynthesis
    - 2) Transpiration
    - 3) Respiration
  - b) High temperature
    - 1) Increased transpiration
    - 2) More pests and disease
  - c) Hardiness Zone Map
  - d) Low temperature
    - 1) Freeze damage
    - 2) Spring frost damage
    - 3) Moisture deficiency
    - 4) Heaving
  - e) Warm-season, cool-season, and rest period crops
3. Ask the students why chrysanthemums only bloom in the fall. Point out that they need short days to bloom and will not bloom in the long days of summer. This is photoperiodism.

**How does light affect plant growth?**

- a) Color or wavelength
  - b) Intensity
    - 1) Effects on
      - (a) Height
      - (b) Internode length
      - (c) Color
    - 2) Effects of light intensity
  - c) Responses to light
    - 1) Phototropism
    - 2) Photoperiodism
      - (a) Long-day plants
      - (b) Short-day plants
      - (c) Day-neutral plants
4. Ask the students about the importance of water to plants. Ask the students if too much water can be damaging to plants, and if they know what relative humidity is.

**How do water and humidity affect plant growth?**

- a) Water status
  - 1) Turgid
  - 2) Wilted
  - 3) Temporarily wilted
- b) Water deficiency
  - 1) Effects
    - (a) Gray-green color on leaves
    - (b) Leaves rolled at the edges
    - (c) Wilted
    - (d) Fruit and vegetable damage
    - (e) Buds drop
- b) Effects of water excess
  - 1) Yellowed
  - 2) Wilted
  - 3) Diseased, damping off

- 4) Split fruits
- c) Humidity and its effects
  - 1) Definition of relative humidity
  - 2) High humidity - increasing disease
  - 4) Low humidity - damaging with a strong wind
- 5. There is much pollution in cities. The forests still standing help to remedy this problem, but they are located away from the pollution sources in cities. If every city dweller would plant a pollution-tolerant tree, in the city where pollution exists, air quality may be improved.

#### **How do wind and air quality affect plant growth?**

- a) Wind
  - 1) Increases transpiration
  - 2) Causes plant breakage
  - 3) Increases CO<sub>2</sub> which increases photosynthetic absorption
- b) Air pollution
  - 1) Effects
    - (a) Clogged stomata
    - (b) Covers leaf surfaces
  - 2) Sources
    - (a) Sulphur dioxide
    - (b) Fluoride
    - (c) Ozone
    - (d) PAN (peroxyacetyl nitrates)
  - 3) Symptoms
    - (a) Broad leaf plants
      - (1) Dead spots
      - (2) Dead tips and edges
      - (3) Silver leaf undersides
    - (b) Needle evergreen plants
      - (1) Dead spots
      - (2) Yellow cast
  - 4) Solutions
    - (a) Plant pollution-tolerant plants
    - (b) Rinse leaves
    - (c) Use fungicides
    - (d) Use growth retardants

#### **F. Other activity**

To demonstrate phototropism, plant a bean seed or use a house plant, if available, and place it in front of a window. Leave it facing the same direction for three to five days. Point out to students that the plant leaves grow or bend toward the area of greatest light intensity.

#### **G. Conclusion**

In order to get a plant to grow successfully in a landscape, average temperatures, light intensity, precipitation, relative humidity, and air quality must be determined for the area. Plants that will grow in those conditions may then be selected.

**H. Competency**

Describe environmental factors that affect plants.

**I. Answers to Evaluation**

1. f
2. d
3. a
4. c
5. e
6. j
7. b
8. i
9. h
10. k
11. g
12. Gray-green colored leaves, leaves with rolled edges, wilting, and buds drop (alternate - fruit and vegetable damage)
13. Yellow leaves, wilting, root diseases
14. Sulphur dioxide, fluorine, PAN, ozone
15. a
16. a
17. a
18. b
19. b
20. c
21. d
22. d
23. c

**J. Answers to work sheet**

Work Sheet 3.1 - Factors Above Ground That Affect Plant Growth

At the teacher's discretion

## UNIT - HOW PLANTS GROW

Name \_\_\_\_\_

### Lesson 3: Environment Factors Above Ground that Affect Plant Growth

Date \_\_\_\_\_

## EVALUATION

**Match the word on the right with the definition on the left.**

- |           |   |                      |
|-----------|---|----------------------|
| 1. _____  | Climate on a smaller scale influenced by lakes, buildings, and topography   | a. Rest period       |
| 2. _____  | A plant that will grow best in a temperature between 75°-90° F  | b. Phototropism      |
| 3. _____  | Phase in which the plant does not grow even though environmental conditions are favorable   | c. Microclimate      |
| 4. _____  | Climate on a very small scale that may be influenced by a house, slopes, hills, and awnings   | d. Warm-season plant |
| 5. _____  | Phase in which the plant does not grow because environmental conditions are not favorable   | e. Dormancy          |
| 6. _____  | Climate in a large area; such as Alaska; influenced by oceans, mountains, air masses, forests, and elevation  | f. Mesoclimate       |
| 7. _____  | Plant response that causes a plant to grow in the direction of greatest light intensity   | g. Photoperiodism    |
| 8. _____  | Plant that will grow best in temperatures between 60°-80°   | h. Relative humidity |
| 9. _____  | Amount of moisture in the air as compared with the percentage of moisture that the air could hold at that same temperature if the air were completely saturated | i. Cool-season plant |
| 10. _____ | Level of moisture in the air  | j. Macroclimate      |
| 11. _____ | Plant response that causes plants to bloom only on days that are a particular length  | k. Humidity          |

**Complete the following short answer questions.**

12. What are four symptoms of plants that have suffered from moisture deficiency?
- a.
  - b.
  - c.
  - d.



13. What are three symptoms of plants that have suffered from excess moisture?

- a.
- b.
- c.

14. What are four chemical air pollutants that cause damage to plants?

- a.
- b.
- c.
- d.

**Circle the letter that corresponds to the best answer.**

15. A plant will usually grow in a \_\_\_\_\_ hardiness zone than listed but not a \_\_\_\_\_ hardiness zone.

- a. Warmer, colder
- b. Colder, warmer
- c. Warmer, wetter
- d. Colder, wetter

16. Which is not a plant process that is affected by high temperature?

- a. Light quality
- b. Photosynthesis
- c. Respiration
- d. Transpiration

17. What results when a plant does not receive enough light?

- a. Pale leaves and spindly growth
- b. Pale leaves and compact growth
- c. A red color
- d. "Burned" leaves

18. What effect does wind have on temperature?

- a. Heaving
- b. Lowering
- c. Moving
- d. Raising

19. What are plants that flower when the nights are shorter than a critical length?

- a. Day-neutral plants
- b. Long-day plants
- c. Long-night plants
- d. Short-day plants

20. What are plants that flower when the nights are longer than a critical length?
- a. Day-neutral plants
  - b. Long-day plants
  - c. Short-day plants
  - d. Short-night plants
21. What causes the sunflower to follow the sun as it moves from east to west across the sky?
- a. Photogenic
  - b. Photoperiodism
  - c. Photosynthesis
  - d. Phototropism
22. How does air pollution damage plants?
- a. By clogging the stomata
  - b. By slowing photosynthesis
  - c. By slowing transpiration
  - d. a. and b.
23. What should a landscaper do in areas of high air pollution?
- a. Avoid planting trees
  - b. Wash down the trees weekly
  - c. Plant air-pollution-tolerant trees
  - d. Treat the trees with chemicals

Lesson 3: Environmental Factors Above Ground that Affect Plant Growth

Work Sheet 3.1: Factors Above Ground That Affect Plant Growth

**Define the following terms.**

1. Macroclimate
2. Mesoclimate
3. Microclimate
4. Rest period
5. Dormancy
6. Freeze damage
7. Heaving
8. Cool-season plant
9. Warm-season plant
10. Phototropism
11. Photoperiodism
12. Short-day plant
13. Long-day plant
14. Humidity
15. Relative humidity

**Explain how each of the following affects plants.**

16. Water excess
17. Water deficiency
18. High light intensity
19. Low light intensity
20. Very high temperatures
21. Very low temperatures
22. Wind damage
23. Air pollution
24. Sulphur dioxide
25. Fluorine
26. PAN
27. Ozone

## UNIT III - IDENTIFICATION

### Lesson 1: Identifying Characteristics of Trees and Shrubs

**Objective:** The student will be able to demonstrate a knowledge of the characteristics of plants which will aid plant identification.

#### Study Questions

- 1. What are the differences between woody, herbaceous, and deciduous plants; broad-leaf and narrow-leaf evergreens; and shrubs?**
- 2. What are the differences between vines and groundcovers?**
- 3. What are the differences between annual and perennial plants?**
- 4. What is form; and what are the typical natural tree and shrub forms?**
- 5. What are the external parts of the stem; and the differences between the types of buds?**
- 6. What are the leaf structures and arrangements that help in plant identification?**

#### Reference

1. Landscaping and Turf Management (Student Reference). University of Missouri-Columbia: Instructional Materials Laboratory, 1990.

## UNIT III - IDENTIFICATION

### Lesson 1: Identifying Characteristics of Trees and Shrubs

#### TEACHING PROCEDURES

##### A. Introduction

Landscapers are able to do their work more efficiently when they can readily identify many types of plants. This unit will provide information on specific plant characteristics which aid in identification.

##### B. Motivation

In the landscaping business it is often necessary to identify plants upon sight, without the aid of guides. Knowing plant characteristics can help with identification.

##### C. Assignment

##### D. Supervised study

##### E. Discussion

1. Take the class outside and have them identify as many different types of plants as possible.

**What are the differences between woody, herbaceous, and deciduous plants; broad-leaf and narrow-leaf evergreens; and shrubs?**

- a) Woody plants
  - 1) Outer bark covering
  - 2) Survive the winter (if hardy)
  - 3) Stems increase in diameter
- b) Herbaceous plants
  - 1) No outer bark covering
  - 2) Not winter hardy
- c) Deciduous plants
  - 1) Woody plants
  - 2) Go through annual dormancy in which they drop leaves
  - 3) Live more than one year
- d) Narrow-leaf evergreens
  - 1) Cone-bearing
  - 2) Needle-like leaves
  - 3) Keep their leaves all year, but periodically drop a few
- e) Broad-leaf evergreens
  - 1) Not cone-bearing
  - 2) Broader leaves than narrow-leaf evergreens
  - 3) Keep their leaves all year, but periodically drop a few
- f) Shrubs
  - 1) Multiple woody stems
  - 2) Resemble trees, but not as tall
  - 3) Can be deciduous, or broad- or narrow-leaf evergreens

2. Ask students the differences between vines and groundcovers.

**What are the differences between vines and groundcovers?**

- a) Vines
    - 1) Woody or herbaceous
    - 2) Flowering or nonflowering
    - 3) Grow upright with support; otherwise trail on ground
    - 4) Attach themselves by tendrils or twining
  - b) Groundcovers
    - 1) Herbaceous or woody
    - 2) Flowering or nonflowering
    - 3) Trailing or compact
    - 4) Cover the ground
    - 5) Help prevent erosion
3. Ask students what "annual" means. Ask students to tell differences between annual and perennial plants.

**What are the differences between annual and perennial plants?**

- a) Annual
    - 1) Herbaceous plant
    - 2) Begins and ends its life cycle in one year
  - b) Perennial
    - 1) Herbaceous plant
    - 2) Annual dormancy
    - 3) Lives more than one year
4. Discuss the basic tree forms.

**What is form; and what are the typical natural tree and shrub forms?**

- a) Form
    - 1) Branching habit
    - 2) Growth habit
  - b) Natural forms
    - 1) Oval
    - 2) Columnar
    - 3) Pyramidal or conical
    - 4) Weeping or pendulous
    - 5) Broad oval or spreading
    - 6) Irregular
    - 7) Vase-shaped
    - 8) Fastigate
    - 9) Horizontal spreading
    - 10) Upright spreading
    - 11) Mounded
    - 12) Trailing, carpet-like, or prostrate
5. Ask students to identify the parts of the stem.

**What are the external parts of the stem; and the differences between the types of buds?**

- a) Terminal bud
  - 1) Bud at the tip of the stem where new growth starts

- 2) Usually the largest bud
- 3) Can be vegetative or flowering
- b) Axillary or lateral bud
  - 1) Bud found on the side of the stem
  - 2) Vegetative - narrow, giving rise to new leaves or stems
  - 3) Flowering - round and large, giving rise to flowers
- c) Node - point from which buds grow
- d) Internode - distance between two nodes
- e) Terminal bud scar - scar left from previous year's bud
- f) Leaf scar - scar where leaf was attached to stem
- g) Lenticels - breathing pores found scattered around stem

6. Ask the students to list characteristics of a leaf that would aid in identification.

**What are the leaf structures and arrangements that help in plant identification?**

- a) Parts of a leaf
  - 1) Petiole
  - 2) Base
  - 3) Blade - surface texture
    - (a) Glabrous
    - (b) Pubescent
    - (c) Glacous
- b) Arrangement of leaves and buds
  - 1) Alternate
  - 2) Opposite
  - 3) Whorled
- c) Types of netted venation
  - 1) Pinnate
  - 2) Palmate
- d) Types of leaves
  - 1) Simple
  - 2) Compound
    - (a) Palmate
    - (b) Pinnate
    - (c) Bi-pinnate
    - (d) Trifoliate
- e) Leaf anatomy
  - 1) Leaf shapes
  - 2) Margin shapes
  - 3) Base shapes
  - 4) Tip shapes

#### F. Other activity

Take a field trip to identify as many plant characteristics and structures as possible. Encourage students to make a leaf collection. Supply students with reference handouts including all of the identifying shapes and structures.

#### G. Conclusion

There are many characteristics by which plants can be identified. Each tree or shrub has its own distinct form, stem structure, bud shape and size, leaf structure, and arrangement that makes it unique.



**H. Competency**

**Identify the basic structural features of trees and shrubs.**

**I. Answers to Evaluation**

1. c
2. c
3. b
4. a
5. d
6. c
7. c
8. b
9. a
10. d
11. d

UNIT III - IDENTIFICATION

Name \_\_\_\_\_

Lesson 1: Identifying Characteristics of Trees and Shrubs

Date \_\_\_\_\_

EVALUATION

Circle the letter that corresponds to the best answer.

1. Which of the following is not a type of leaf arrangement on the stem?

- a. Alternate
- b. Opposite
- c. Parallel
- d. Whorled

2. The tree pictured below has which of the following forms?

- a. Broad
- b. Columnar
- c. Pendulous
- d. Spreading



3. The tree pictured below has which of the following forms?

- a. Broad
- b. Columnar
- c. Pendulous
- d. Spreading



4. The distance between which of the following shows one year's growth?

- a. Bud scale scars
- b. Leaf petiole scars
- c. Lenticels
- d. Nodes

5. Where does new growth start?

- a. Bud scale scar
- b. Lateral bud
- c. Node
- d. Terminal bud

6. Which of the following is not true of netted venation?

- a. Can be pinnate
- b. Can be palmate
- c. Occurs in monocots
- d. Occurs in dicots

7. Which of the following leaf types is pictured below?

- a. Palmate
- b. Bi-pinnate
- c. Trifoliate
- d. Pinnate



8. Which of the following does not have an outer bark covering?

- a. Woody plant
- b. Herbaceous plant
- c. Broad-leaf evergreen
- d. Narrow-leaf evergreen

9. How long would annuals be expected to grow?

- a. One growing season
- b. Six months
- c. One year
- d. Several years

10. Out of what stem part do all buds grow?

- a. Terminal bud scars
- b. Leaf petiole scars
- c. Lenticels
- d. Nodes

11. The arrow is pointing to what part of the leaf?

- a. Base
- b. Blade
- c. Midrib
- d. Petiole



### UNIT III - IDENTIFICATION

#### Lesson 2: Identifying Characteristics of Narrow-Leaf Evergreens

Objective: The student will be able to describe the identifying characteristics of narrow-leaf evergreens.

#### Study Questions

1. What are the three types of leaves found on narrow-leaf evergreen plants?
2. What are distinguishing characteristics for each of the following genera: *Pinus* (Pine), *Cedrus* (Cedar), *Picea* (Spruce), *Tsuga* (Hemlock), *Abies* (Fir), *Thuja* (Arborvitae), *Juniperus* (Juniper), and *Taxus* (Yew)?

#### Reference

1. Landscaping and Turf Management (Student Reference). University of Missouri-Columbia: Instructional Materials Laboratory, 1990.

## UNIT III - IDENTIFICATION

### Lesson 2: Identifying Characteristics of Narrow-Leaf Evergreens

#### TEACHING PROCEDURES

##### A. Review

Review the previous lesson.

##### B. Motivation

Evergreens are unique in character since they remain green year-round. Identification is not always easy. Learning a few unique characteristics can make identification a simpler task.

##### C. Assignment

##### D. Supervised study

##### E. Discussion

1. Ask the students what they know about narrow-leaf evergreens. More than likely, they will say that they are green year-round and have narrow leaves. Point out that evergreens have unique leaf types.

**What are the three types of leaves found on narrow-leaf evergreens?**

- a) Awl-like
  - 1) Sharp to the touch
  - 2) Shaped like an awl (pointed)
  - 3) Found in young juniper
- b) Scale-like
  - 1) Scales overlap like shingles on a roof
  - 2) Forms a flat spray
  - 3) Soft to the touch
  - 4) Found in Arborvitae and mature juniper
- c) Needle-like
  - 1) Attached by fascicles or sheaths - pine
  - 2) Linear-shaped needles - fir, spruce, cedar and yew
- d) Other characteristics
  - 1) Length of needles - environmental conditions can make this misleading
  - 2) Stiffness of needles to the touch
  - 3) Shape of needle - square or triangular, etc.

2. One of the best ways to identify narrow-leaf evergreens is to know the general characteristics of the genus. Some unique features help in this identification process.

**What are distinguishing characteristics for each of the following genera: Pinus (Pine), Cedrus (Cedar), Picea (Spruce), Tsuga (Hemlock), Abies (Fir), Thuja (Arborvitae), Juniperus (Juniper), and Taxus (Yew)?**

- a) Pinus (Pine)

- 1) Long, needle-like leaves
- 2) In clusters of two to five
- 3) Spirally arranged on stem
- b) Cedrus (Cedar)
  - 1) Short, stiff, needle-like leaves
  - 2) Triangular-shaped
  - 3) Scattered along the branch
  - 4) Clustered on spurs; ten or more leaves per cluster
- c) Picea (Spruce)
  - 1) Short, stiff, needle-like leaves of uniform width
  - 2) Sharp-pointed
  - 3) Scattered all around twig
  - 4) Twigs very rough after needles fall
- d) Tsuga (Hemlock)
  - 1) Flat, linear, needle-like leaves, less than three-fourths inch long
  - 2) On short stalk in ranks of two
  - 3) Notched at end of leaf
  - 4) White beneath
- e) Abies (Fir)
  - 1) Flat, linear, needle-like leaves
  - 2) Spirally arranged on stem
  - 3) Stem smooth after leaves fall
- f) Thuja (Arborvitae)
  - 1) Small, scale-like leaves in pairs
  - 2) Arise on short, central stalk
  - 3) Leaves overlap tightly on branchlet
  - 4) Soft to the touch
- g) Juniperus (Juniper)
  - 1) Mixture of awl-like and scale-like leaves
  - 2) Scale-like leaves surround stem tightly
  - 3) Awl-like leaves point out
  - 4) Harsh to the touch
- h) Taxus (Yew)
  - 1) Flat, linear, needle-like leaves
  - 2) Mostly green on both sides
  - 3) In two ranks on the stem
  - 4) Curved and scythe-shaped

**F. Other activity**

Have students bring in samples of evergreen stems to identify in class.

**G. Conclusion**

Although there are other detailed characteristics that can be used, these are a few to be used for general identification of narrow-leaf evergreens..

**H. Competency**

Identify the distinguishing characteristics for common narrow-leaf evergreens.

**I.     Answers to Evaluation**

1.     a
2.     c
3.     d
4.     c
5.     b
6.     c
7.     d
8.     h
9.     g
10.    e
11.    a
12.    b
13.    f

EVALUATION

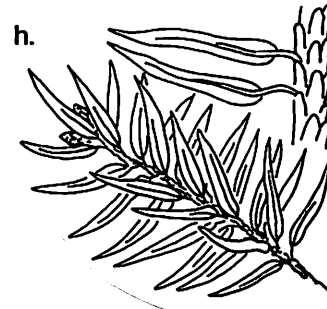
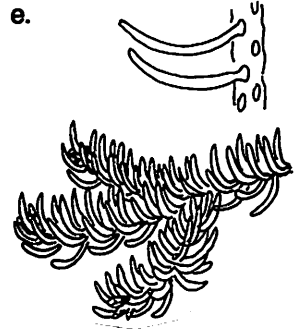
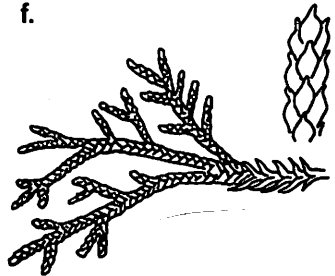
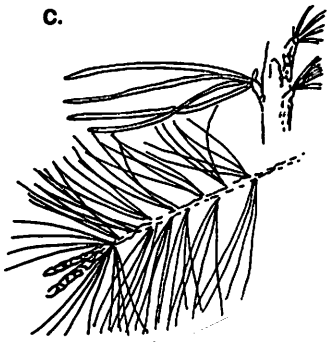
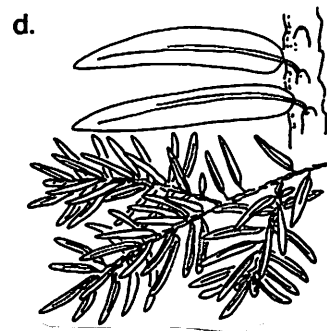
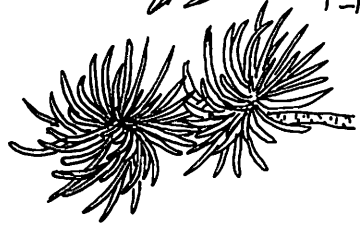
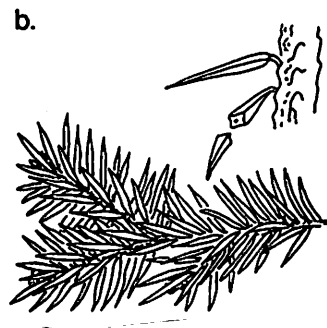
**Circle the letter that corresponds to the best answer.**

1. Of the three types of narrow-leaf evergreen leaves, which is found on a juniper in the juvenile stage of growth?
  - a. Awl-like
  - b. Needle-like
  - c. Owl-like
  - d. Scale-like
2. Which type leaves are most characteristic of pines?
  - a. Awl-like
  - b. Linear
  - c. Needle-like
  - d. Scale-like
3. Which type leaves are most characteristic of arborvitae?
  - a. Awl-like
  - b. Linear
  - c. Needle-like
  - d. Scale-like
4. Which characteristic can be used to identify narrow leaf evergreens but is unreliable because environmental conditions may cause variation?
  - a. Leaf shapes (square, triangular)
  - b. Leaf types
  - c. Length of needles
  - d. Stiffness or softness
5. Which type leaves are characteristic of yews?
  - a. Awl-like
  - b. Linear
  - c. Needle-like
  - d. Scale-like



Match the genus name to the picture.

6. \_\_\_\_ Pinus
7. \_\_\_\_ Tsuga
8. \_\_\_\_ Taxus
9. \_\_\_\_ Juniperus
10. \_\_\_\_ Abies
11. \_\_\_\_ Cedrus
12. \_\_\_\_ Picea
13. \_\_\_\_ Thuja



## UNIT III - IDENTIFICATION

### Lesson 3: Identifying Trees

**Objective:** The student will be able to identify selected shade, flowering, and evergreen trees.

#### Study Questions

- 1. What are the key identifying characteristics of selected shade trees?**
- 2. What are the key identifying characteristics of selected flowering trees?**
- 3. What are key identifying characteristics of selected evergreen trees?**

#### References

1. Landscaping and Turf Management (Student Reference). University of Missouri-Columbia: Instructional Materials Laboratory, 1990.
2. Work Sheet
  - a) WS 3.1: Leaf Identification

## UNIT III - IDENTIFICATION

### Lesson 3: Identifying Trees

#### TEACHING PROCEDURES

##### A. Review

Review the previous lesson.

##### B. Motivation

Ask for two student volunteers. Direct the discussion by asking questions about unique characteristics of each student including height, hair color, and other distinguishing differences. Point out that trees and plants also have unique characteristics that distinguish them from one another. They will study these characteristics so they can identify each tree.

##### C. Assignment

##### D. Supervised study

##### E. Discussion

1. Take the students on a field trip to a park, school grounds, or nursery where they can actually see the trees. Point out to the students the form, branching habit, and growth habit. Point out how the tree fits into the landscape. Require the students to make a leaf collection. Have them attach each leaf to WS 3.1 and fill in the blanks. The same form will be used for Lessons 4, 5, and 7. WS 3.1 will be begun in this unit and finished in Unit X - Selecting and Using Plants in the Landscape. The students will have a complete record of the plants when finished. They will also see how this unit fits together. The students will need one sheet for each plant.

If a field trip is not feasible, collect samples before class for students to observe. Place the samples in bottles of water to keep them fresh. This may be combined with viewing slides that demonstrate the form and growth habit of the trees.

NOTE: All tree identification tables are in the student reference.

#### What are key identifying characteristics of selected shade trees?

- a) Acer rubrum - red maple
- b) Acer saccharum - sugar maple
- c) Betula nigra - river birch
- d) Betula pendula - European white birch
- e) Fraxinus Pennsylvanica - green ash
- f) Gleditsia triacanthos inermis - honey locust
- g) Liquidambar styraciflua - sweet gum
- h) Liriodendron tulipifera - tulip tree
- i) Platanus occidentalis - sycamore
- j) Quercus palustris - pin oak
- k) Tilia cordata - littleleaf linden

2. Have students continue collecting leaves and filling out WS 3.1.

**What are key identifying characteristics of selected flowering trees?**

- a) Albizia julibrissin - mimosa
- b) Cercis canadensis - eastern redbud
- c) Cornus florida - flowering dogwood
- d) Crataegus phaenopyrum - Washington hawthorne
- e) Koelreuteria paniculata - golden raintree
- f) Magnolia soulangiana - saucer magnolia
- g) Malus species - flowering crabapple
- h) Pyrus calleryana "Bradford" - Bradford pear

3. The students should continue collecting leaves and filling out WS 3.1.

**What are key identifying characteristics of selected evergreen trees?**

- a) Ilex opaca - American holly
- b) Juniperus virginiana - Eastern red cedar
- c) Magnolia grandiflora - southern magnolia
- d) Picea abies - Norway spruce
- e) Picea pungens "Glauca" - blue spruce
- f) Pinus nigra - Austrian pine
- g) Pinus strobus - white pine
- h) Pinus sylvestris - Scotch pine
- i) Tsuga canadensis - hemlock

**F. Other activity**

Have the student sketch a leaf for each of the trees listed, and label the key parts.

**G. Conclusion**

Tree form, branching and growth habit, stem and bark characteristics, buds, and leaf characteristics, are all essential information in identifying trees.

**H. Competency**

Identify selected trees.

**I. Evaluation**

There are a number of ways to test over this unit. The method used will depend on individual circumstances. Three suggestions follow. Answers will be left to the discretion of the teacher. In all evaluations, the common and botanical names should be written by the student.

- 1) Collect live samples from trees in the local area. Tag them with numbers or letters. Set them in bottles of water to keep them fresh and alive. Set them around the room in stations. Have students go from station to station identifying each sample. Allow only one to three students at a station at a time (preferably one). Allow only two to three minutes, or any workable time limit, at each station. Call time and have the students change stations. Repeat until each student has visited each station.
- 2) If feasible, tag live trees outdoors and have the students identify them.

- 3) If live samples or trees are not available in the area, a slide set can be used. Flash the picture of each species on a screen for a given amount of time. Have the students write the name of each tree.

H. Answers to WS 3.1

The instructor will need to determine if answers are appropriate.

## Lesson 3: Identifying Trees

## Work Sheet 3.1: Leaf Identification

**Directions:** For each tree specified, collect a leaf and attach it to this sheet. Fill in the information needed in the following blanks. (A separate sheet is needed for each tree.)

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

Common Name: \_\_\_\_\_ Size: \_\_\_\_\_

Branching Habit: \_\_\_\_\_ Zone: \_\_\_\_\_

Leaf Arrangement: \_\_\_\_\_ Venation: \_\_\_\_\_ Type: \_\_\_\_\_

Leaf Shape: \_\_\_\_\_ Surface: \_\_\_\_\_ Texture: \_\_\_\_\_

Leaf Color: \_\_\_\_\_ Fall Color: \_\_\_\_\_

Growth Habit: \_\_\_\_\_

Fruit Color: \_\_\_\_\_ Duration: \_\_\_\_\_ Use: \_\_\_\_\_

Flower Color: \_\_\_\_\_ Duration: \_\_\_\_\_ Fragrance: \_\_\_\_\_

Stem Characteristics: \_\_\_\_\_

Buds: Terminal \_\_\_\_\_ Lateral \_\_\_\_\_ Form: \_\_\_\_\_

Light Requirement: \_\_\_\_\_

Soil Requirement: \_\_\_\_\_

Insects and Diseases: \_\_\_\_\_

Landscape Uses: \_\_\_\_\_

Notes: \_\_\_\_\_

\_\_\_\_\_

## UNIT III - IDENTIFICATION

### Lesson 4: Identifying Shrubs

**Objective:** The student will be able to identify selected flowering and evergreen shrubs.

#### Study Questions

- 1. What are the key identifying characteristics of selected flowering shrubs?**
- 2. What are the key identifying characteristics of selected evergreen shrubs?**

#### References

1. Landscaping and Turf Management. (Student Reference). University of Missouri-Columbia: Instructional Materials Laboratory, 1990.
2. Work Sheet
  - a) WS 4.1: Shrub Identification

## UNIT III - IDENTIFICATION

### Lesson 4: Identifying Shrubs

#### TEACHING PROCEDURES

##### A. Review

Review the previous lesson.

##### B. Motivation

Shrubs are just as important to a successful landscape as trees. Landscapers need to develop skill in identification of flowering and evergreen shrubs in order to select appropriate plants for a landscape.

##### C. Assignment

##### D. Supervised study

##### E. Discussion

1. Take students on a field trip to a park, school grounds, or nursery where they can actually see the shrubs. Point out to the students the form, branching habit, and growth habit. Point out how the shrub fits into the landscape. Have students continue the leaf collection from Lesson 3 using leaves from shrubs. Have them attach each leaf to WS 4.1 and fill in the blanks. They will need one sheet for each plant.

If a field trip is not feasible, collect samples before class for students to observe. Place the samples in bottles of water to keep them fresh. This may be combined with viewing slides that demonstrate the form and growth habit of the shrubs.

NOTE: All shrub identification tables are in the student reference.

#### What are key identifying characteristics of selected flowering shrubs?

- a) Berberis thunbergii - japanese barberry
  - b) Cornus sericea - redosier dogwood
  - c) Chaenomeles speciosa - flowering quince
  - d) Euonymus alatus - winged euonymus
  - e) Forsythia x intermedia - border forsythia
  - f) Ligustrum japonicum - wax leaf pivot
  - g) Nandina domesticum - nandina
  - h) Pyracantha coccinea - scarlet firethorn
  - i) Salix gracilistyla - rosegold pussywillow
  - j) Spirea vanhouttei - Vanhoutte spirea
  - k) Syringa vulgaris - common lilac
2. Have students continue collecting leaves and filling out WS 4.1.

#### What are key identifying characteristics of selected evergreen shrubs?

- a) Buxus microphylla - Korean boxwood



- b) Euonymus kirutschovicus - spreading euonymus
- c) Ilex creata "helleri" - Japanese holly
- d) Juniperus chinensis "hetzii" - hetzii juniper
- e) Juniperus chinensis "phitzeriana" - phitzer juniper
- f) Mahonia aquifolium - Oregon grape holly
- g) Pinus mugo - mugo pine
- h) Rhododendron catawbiense - catawba rhododendron
- i) Taxus cuspidata - Japanese yew
- j) Thuja occidentalis - Eastern or American arborvitae or white cedar
- k) Viburnum x rhytidophyllodies - leather leaf viburnum

F. Other Activity

Have the student sketch a leaf for each of the shrubs listed, and label the key parts.

G. Conclusion

Shrub form, branching and growth habit, stem and bark characteristics, buds, and leaf characteristics, are all essential information in identifying shrubs.

H. Competency

Identify selected shrubs.

I. Evaluation

There are a number of ways to test over this lesson. The method used will depend on individual circumstances. Three suggestions follow. Answers will be left to the discretion of the teacher. In all evaluations, the common and botanical names should be written by the student.

- 1) Collect live samples from shrubs in the local area. Tag them with numbers or letters. Set them in bottles of coater to keep them fresh and alive. Set them around the room in stations. Have students go from station to station identifying each sample. Allow only one to three students at a station at a time (preferably one). Allow only two to three minutes, or any workable time limit, at each station. Call time and have the students change stations. Repeat until each student has visited each station.
- 2) If feasible, tag shrubs outdoors and have the students identify them.
- 3) If live samples or trees are not available in the area, a slide set can be used. Flash the picture of each species on a screen for a given amount of time. Have the students write the name of each shrub.

H. Answers to Work Sheet

The instructor will need to determine if answers are appropriate.

## Lesson 4: Identifying Shrubs

## Work Sheet 4.1: Leaf Identification

**Directions:** For each shrub specified, collect a leaf and attach it to this sheet. Fill in the information needed in the following blanks. (A separate sheet is needed for each shrub.)

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

Common Name: \_\_\_\_\_ Size: \_\_\_\_\_

Branching Habit: \_\_\_\_\_ Zone: \_\_\_\_\_

Leaf Arrangement: \_\_\_\_\_ Venation: \_\_\_\_\_ Type: \_\_\_\_\_

Leaf Shape: \_\_\_\_\_ Surface: \_\_\_\_\_ Texture: \_\_\_\_\_

Leaf Color: \_\_\_\_\_ Fall Color: \_\_\_\_\_

Growth Habit: \_\_\_\_\_

Fruit Color: \_\_\_\_\_ Duration: \_\_\_\_\_ Use: \_\_\_\_\_

Flower Color: \_\_\_\_\_ Duration: \_\_\_\_\_ Fragrance: \_\_\_\_\_

Stem Characteristics: \_\_\_\_\_

Buds: Terminal \_\_\_\_\_ Lateral \_\_\_\_\_ Form: \_\_\_\_\_

Light Requirement: \_\_\_\_\_

Soil Requirement: \_\_\_\_\_

Insects and Diseases: \_\_\_\_\_

Landscape Uses: \_\_\_\_\_

Notes: \_\_\_\_\_

\_\_\_\_\_

## UNIT III - IDENTIFICATION

### Lesson 5: Identifying Vines, Ground Covers, and Perennials

**Objective:** The student will be able to identify selected vines, ground covers, and perennials commonly used in the landscape.

#### Student Questions

- 1. What are key identifying characteristics of selected vines and ground covers?**
- 2. What are key identifying characteristics of selected perennials?**

#### References

1. Landscaping and Turfgrass Management (Student Reference). University of Missouri-Columbia: Instructional Materials Laboratory, 1990.
2. Work Sheet
  - a) WS 5.1: Vine, Ground Cover, and Perennial Identification

## UNIT III - IDENTIFICATION

### Lesson 5: Identifying Vines, Ground Covers, and Perennials

#### TEACHING PROCEDURES

##### A. Review

Review the previous lesson.

##### B. Motivation

Bring in examples of several different vines, ground covers, and perennials in potted containers for the class to look at. Explain that each has a different function in the landscape.

##### C. Assignment

##### D. Supervised study

##### E. Discussion

1. Take students on a field trip to a park, school grounds, or nursery where they can actually see the plants. Point out to the students the form, branching habit, and growth habit. Point out how the plants fit into the landscape. Require the students to make a leaf collection. The instructor should determine the number of plants to be collected. Work Sheet 5.1 will need to be duplicated for the number of plants determined. Have them attach the leaf to WS 5.1 and fill in the blanks. The same form is used for Lessons 3, 4, and 7, and will be combined with Unit X - Selecting and Using Plants in the Landscape.

If a field trip is not feasible, collect samples before class for students to observe. Place the samples in bottles of water to keep them fresh. This may be combined with viewing slides that demonstrate the form and growth habit of the plants. If live plant species are not available, obtain pictures of the plants.

NOTE: All identification tables are in the student reference.

#### **What are key identifying characteristics of selected vines and ground covers?**

- a) Ajuga reptans - ajuga or bugleweed
  - b) Celastrus scandens - American bittersweet
  - c) Coronilla varis - crown vetch
  - d) Euonymus fortunei "Radicans" - bigleaf wintercreeper
  - e) Hedra helix - English ivy
  - f) Juniperus horizontalis - creeping juniper
  - g) Lonicera japonica "Halliana" - Hall's honeysuckle
  - h) Vinca minor - creeping myrtle or periwinkle
2. The students should continue taking leaf or branch collections and completing WS 5.1.

#### **What are key identifying characteristics of selected perennials?**

- a) Artemisia schmidtiana - silver mound
- b) Astilbe x ardendsii - false spirea astilbe

- c) Aquilegia hybrids - columbine
- d) Chrysanthemum x morifolium - garden mum
- e) Coreopsis lanceolata - coreopsis
- f) Hemerocallis hybrids - day lily
- g) Heuchera sanguinea - coral bells
- h) Hosta species - plantain lily or hosta
- i) Liriope spicata - lily turf
- j) Phlox subulata - creeping phlox

F. Other activity

Have the students sketch the most unique identifying characteristic of the plants in this lesson.

G. Conclusion

The growth habit is one of the most distinguishing characteristics between ground covers and vines. Many ground covers can be used as vines, given the proper support to grow on. Perennials are often identified by the flower, or the form of the plant as a whole.

H. Competency

Identify ground covers, vines, and perennials.

I. Evaluation

There are a number of ways to test over this lesson. The method used will depend on individual circumstances. Three suggestions follow. Answers will be left to the discretion of the teacher. In all evaluations, common and botanical names should be written by the student.

- 1) Collect live samples from plants in the local area. Tag them with numbers or letters. Set them in bottles of water to keep them fresh and alive. Set them around the room in stations. Have students go from station to station identifying each sample. Allow only one to three students at a station at a time (preferably one). Allow only two to three minutes, or any workable time limit, at each station. Call time and have the students change stations. Repeat until each student has visited each station.
- 2) If feasible, tag live plants outdoors and have the students identify them.
- 3) If live samples are not available in the area, a slide set can be used. Flash the picture of each species on a screen for a given amount of time. Have the students write the name of each plant.

H. Answers to WS 5.1.

The instructor will need to determine if answers are appropriate.

## Lesson 5: Identifying Vines, Ground Covers, and Perennials

## Work Sheet 5.1: Vine, Ground Cover, and Perennial Identification

**Directions:** Collect a leaf from each specified plant. Attach it to this sheet. Fill in information needed in the following blanks. (One plant per sheet.)

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

Common Name: \_\_\_\_\_ Size: \_\_\_\_\_

Branching Habit: \_\_\_\_\_ Zone: \_\_\_\_\_

Leaf Arrangement: \_\_\_\_\_ Venation: \_\_\_\_\_ Type: \_\_\_\_\_

Leaf Shape: \_\_\_\_\_ Surface: \_\_\_\_\_ Texture: \_\_\_\_\_

Leaf Color: \_\_\_\_\_ Fall Color: \_\_\_\_\_

Growth Habit: \_\_\_\_\_

Fruit Color: \_\_\_\_\_ Duration: \_\_\_\_\_ Use: \_\_\_\_\_

Flower Color: \_\_\_\_\_ Duration: \_\_\_\_\_ Fragrance: \_\_\_\_\_

Stem Characteristics: \_\_\_\_\_

Buds: Terminal \_\_\_\_\_ Lateral \_\_\_\_\_ Form: \_\_\_\_\_

Light Requirement: \_\_\_\_\_

Soil Requirement: \_\_\_\_\_

Insects and Diseases: \_\_\_\_\_

Landscape Uses: \_\_\_\_\_

Notes: \_\_\_\_\_

\_\_\_\_\_

## UNIT III - IDENTIFICATION

### Lesson 6: Identifying Characteristics of Grasses

**Objective:** The student will be able to identify the characteristics of grasses used in identification.

#### Study Questions

- 1. What are the structural parts of grasses?**
- 2. How can the roots, blade and tip shapes, collar, venation, sheath, auricle and ligule help identify grasses?**
- 3. How can the type of inflorescence help identify grasses?**

#### References

1. Landscaping and Turf Management (Student Reference). University of Missouri-Columbia; Instructional Materials Laboratory, 1990.
2. Transparency Master
  - a) TM 6.1: Structural Parts of Grasses

## UNIT III - IDENTIFICATION

### Lesson 6: Identifying Characteristics of Grasses

#### TEACHING PROCEDURES

##### A. Review

Review previous lesson.

##### B. Motivation

Have grass plants in pots to show the students. These should be grown ahead of time in the greenhouse or classroom. Let the students observe the plants. Have magnifying glasses available for the students to see the structural parts.

##### C. Assignment

##### D. Supervised study

##### E. Discussion

1. Ask the students to name the structural parts of the grasses. Have an example of a plant in class so they can see the actual parts along with the schematic drawings. Try to get a plant with roots and flower. Show TM 6.1 Structural Parts of Grasses.

#### **What are the structural parts of grasses?**

- |              |                 |
|--------------|-----------------|
| a) Roots     | f) Auricle      |
| b) Node      | g) Ligule       |
| c) Internode | h) Leaf sheath  |
| d) Leaf bud  | i) Cull or stem |
| e) Collar    | j) Flower       |

2. Ask the students how the structural parts can help in identification of grasses.

#### **How can the roots, blade and tip shapes, collar, venation sheath, auricle and ligule help identify grasses?**

- a) Roots
  - 1) Annual
    - (a) Fibrous
    - (b) Weak
    - (c) Pulls easily from ground
  - 2) Perennial
    - (a) Fibrous
    - (b) Strong
    - (c) Plant breaks from roots and rhizome
- b) Leaf blade shapes
  - 1) Tapering to tip
  - 2) Boat-shaped tip
  - 3) Parallel-sided
  - 4) Narrowed to base



- d) Collar
  - 1) Broad
  - 2) Narrow
  - 3) Divided
  - 4) Oblique
  - 5) Hairy
  - 6) Margins hairy
- e) Venation
  - 1) Rolled
  - 2) Folded
- f) Sheath
  - 1) Split
  - 2) Split, margins overlapping
  - 3) Closed
- g) Auricle
  - 1) Large
  - 2) Small
  - 3) Absent
- h) Ligule Shapes
  - (a) Acuminate
  - (b) Acute
  - (c) Rounded
  - (d) Truncate
  - (e) Absent

3. Ask the students to describe different shapes of flowers they have seen on grasses. Have students bring examples of grass flowers.

**How does the type of inflorescence help identify grasses?**

- a) Spike
- b) Raceme
- c) Panicle

**F. Other activity**

Either go on a field trip or have examples of different grasses (the six listed in Unit III, Lesson 7) so the students can relate the schematics to the actual plant.

**G. Conclusion**

Grasses need to be identified in their vegetative state since they do not flower until late in the season. The plant species determines the cultural care a lawn needs. The structural parts of grasses are used to identify the vegetative plant.

**H. Competency**

Identify the basic structural features of grasses.

**I. Answers to Evaluation**

- |      |      |
|------|------|
| 1. d | 4. a |
| 2. b | 5. c |
| 3. b |      |

**UNIT III - IDENTIFICATION**

Name \_\_\_\_\_

**Lesson 6: Identifying Characteristics of Grasses**

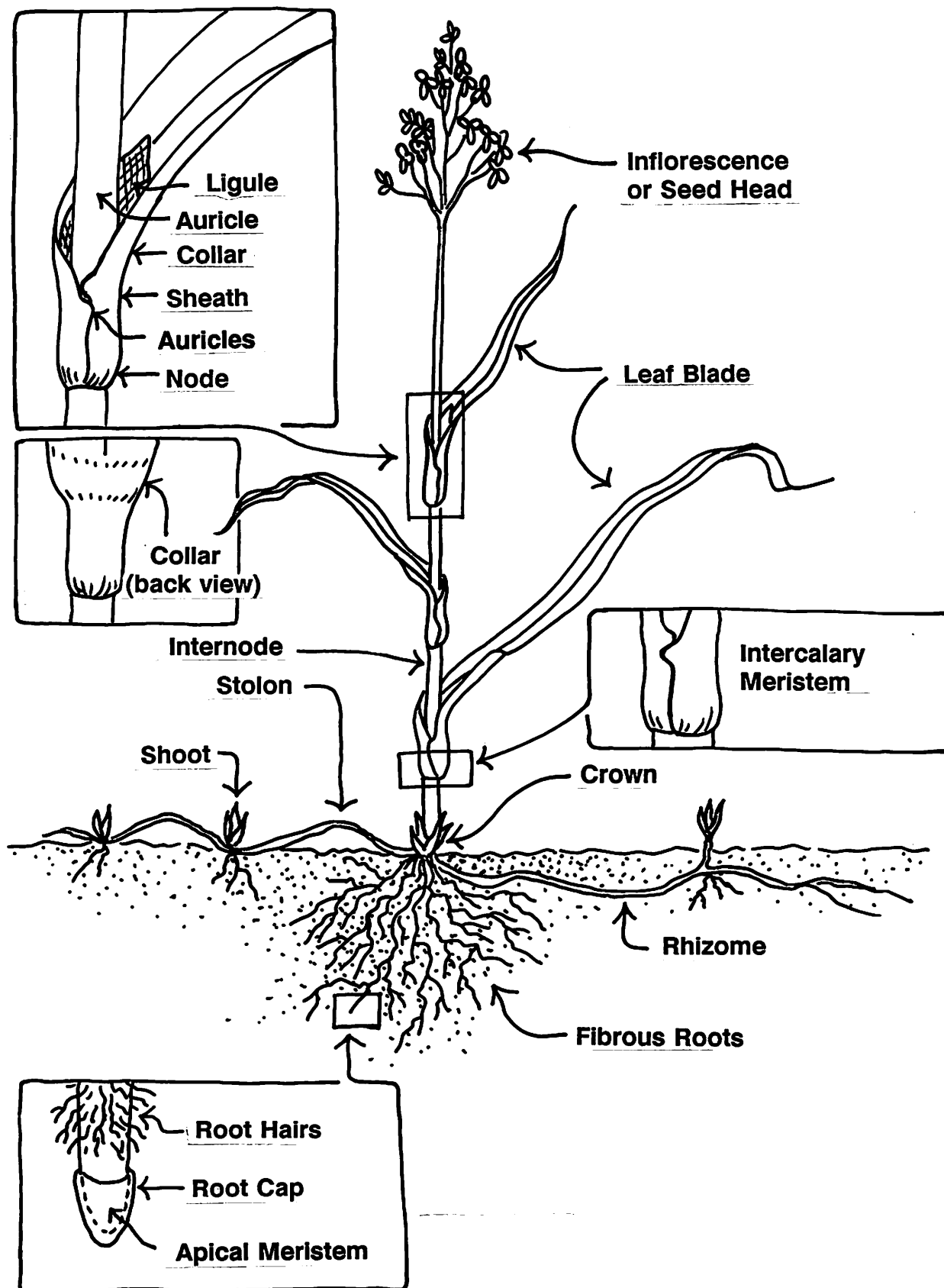
Date \_\_\_\_\_

**EVALUATION**

**Circle the letter that corresponds to the best answer.**

1. What is the arrangement of the leaves in the bud shoot?
  - a. Leaf pinnation
  - b. Sheath
  - c. Spike
  - d. Venation
2. What is the part of the grass plant that projects upwardly where the blade and the sheath connect?
  - a. Apex
  - b. Ligule
  - c. Node
  - d. Sheath
3. Which type of inflorescence is most common?
  - a. Internode
  - b. Panicle
  - c. Raceme
  - d. Spike
4. Which of the following is part of a grass plant?
  - a. Collar
  - b. Lapel
  - c. Seam
  - d. All of the above
5. Which type of grass has a stronger root system?
  - a. Annual
  - b. Semi-annual
  - c. Perennial
  - d. None of the above

# Structural Parts of Grasses



### UNIT III - IDENTIFICATION

#### Lesson 7: Identifying Grasses

**Objective:** The student will be able to identify the six major turfgrasses used in Missouri.

#### Study Question

- 1. What are the key identifying characteristics of the six major turfgrasses used in Missouri?**

#### Reference

- 1. Landscaping and Turf Management (Student Reference). University of Missouri-Columbia; Instructional Materials Laboratory, 1990.**

## UNIT III - IDENTIFICATION

### Lesson 7: Identifying Grasses

#### TEACHING PROCEDURES

##### A. Review

Review previous lesson.

##### B. Motivation

There are six major turfgrasses that are commonly used in Missouri. It is helpful for the landscaper to know the identifying characteristics of each.

##### C. Assignment

##### D. Supervised study

##### E. Discussion

1. Ask the students to identify the six turfgrasses.

**What are the key identifying characteristics of the six major turfgrasses used in Missouri?**

The characteristics of the following grasses are located in Table 7.1 in the Student Reference.

- a) Cynodon dactylon - Bermudagrass
- b) Zoysia japonica - Zoysia grass
- c) Lolium perenne - Perennial ryegrass
- d) Festuca rubra - Red fescue
- e) Festuca arundinacea - Tall fescue
- f) Poa pratensis - Kentucky bluegrass

##### F. Other activity

Try to have live samples that the students can look at and study. Have hand lenses for them to look through.

##### G. Conclusion

Grasses must be identified in their vegetative state since their flowers only appear late in the season.

##### H. Competency

Identify the six major turfgrasses used in Missouri.

##### I. Answers to Evaluation

There are a number of ways to test over this lesson. The method used will depend on individual circumstances. Three suggestions follow. Answers will be left to the discretion of the teacher. In all evaluations, the common and botanical names should be written by the student.

- 1) Collect live samples and tag them with numbers or letters. Set them around the room in stations. Have students go from station to station identifying each sample. Allow only one to three students at a station at a time (preferably one). Allow only two to three minutes, or any workable time limit, at each station. Call time and have the students change stations. Repeat until each student has visited each station.
- 2) If feasible, tag turfgrasses outdoors and have the students identify them.
- 3) If live samples are not available in the area, a slide set can be used. Flash the picture of each species on a screen for a given amount of time. Have the students write the name of each turfgrass.

## UNIT IV - TOOL IDENTIFICATION AND MAINTENANCE

### Lesson 1: Hand Tools and Equipment

**Objective:** The student will be able to identify and maintain the common hand tools used in the landscape and turfgrass industries.

#### Study Questions

- 1. What hand tools and equipment are used in the landscape and turfgrass industries?**
- 2. What types of maintenance should be performed routinely on hand tools and equipment?**
- 3. What safety precautions should be taken when using and sharpening hand tools?**

#### References

1. Landscaping and Turf Management (Student Reference). University of Missouri-Columbia: Instructional Materials Laboratory, 1990.
2. Job Sheets
  - a) JS 1.1: Restoration of Wooden Handles
  - b) JS 1.2: Restoration of Metal Surfaces

## UNIT IV - TOOL IDENTIFICATION AND MAINTENANCE

### Lesson 1: Hand Tools and Equipment

#### TEACHING PROCEDURES

##### A. Introduction

Tools are important to the landscape and turfgrass industries. Being familiar with the variety of available tools and how to use and maintain them, aids a landscaper in handling each task efficiently.

##### B. Motivation

Landscapers are able to complete work more easily when they are able to properly identify, use, and maintain tools. Routine maintenance prolongs the usefulness of the tools.

##### C. Assignment

##### D. Supervised study

##### E. Discussion

1. Show a number of hand tools and equipment to the class. Ask students to name them and explain what job the tool performs.

**What hand tools and equipment are used in the landscape and turfgrass industries?**

- |                          |                      |
|--------------------------|----------------------|
| a) Pruning saw           | p) Garden rake       |
| b) Bow saw               | q) Lawn or leaf rake |
| c) Axe                   | r) Garden hoe        |
| d) Pruning shears        | s) Action hoe        |
| e) Lopping shears        | t) Bulb planter      |
| f) Hedge shears          | u) Wheelbarrow       |
| g) Hand trowel           | v) Spreader          |
| h) Cultivators           | w) Sod roller        |
| i) Garden spade          | x) Turf edger        |
| j) Sharp shooter         | y) Post-hole digger  |
| k) Round-pointed shovel  | z) Weed cutter       |
| l) Square-pointed shovel | aa) Mattock          |
| m) Scoop shovel          | bb) Pick             |
| n) Spading fork          |                      |
| o) Pitch fork            |                      |

2. Ask students to describe different maintenance tasks that should be performed routinely on cars and trucks.

**What types of maintenance should be performed routinely on hand tools and equipment?**

- a) Restore wood surfaces.
- b) Restore metal surfaces.
- c) Sharpen tools.



3. Ask students if they or anyone they know has been hurt while using hand tools. Ask students how this could have been prevented.

**What safety precautions should be taken when using and sharpening hand tools?**

- a) Do not wear loose fitting clothes.
- b) Wear eye protection.
- c) Wear gloves.
- d) Be conscious of where others are working.
- e) Be alert to surrounding conditions.

**F. Other Activities**

1. Assign each student a hand tool and have them explain to the class how it should be maintained.
2. Demonstrate how to sharpen tools.
3. Have students sharpen tools.
4. Take a field trip to local store to see tools.

**G. Conclusion**

Routine maintenance of hand tools will prolong the life of the tools. Restoration of wood and metal surfaces and sharpening tools are some routine maintenance tasks. Safety should always be practiced when working with tools.

**H. Competency**

Identify and maintain hand tools and equipment.

**I. Answers to Evaluation**

1. c
2. b
3. c
4. a

UNIT IV - TOOL IDENTIFICATION AND MAINTENANCE

Name \_\_\_\_\_

Lesson 1: Hand Tools and Equipment

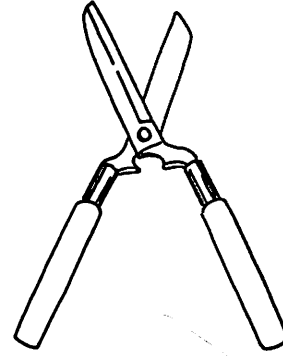
Date \_\_\_\_\_

EVALUATION

Circle the letter that corresponds to the best answer.

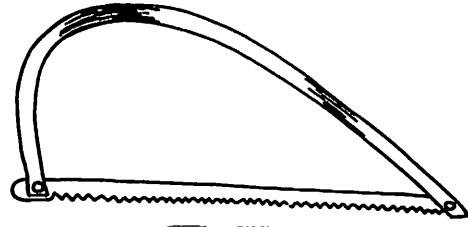
1. What is the tool pictured below?

- a. Bow saw
- b. Hand pruners
- c. Hedge shears
- d. Pruning saw



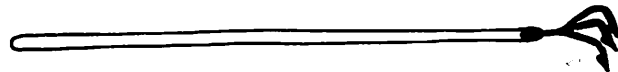
2. What is the tool pictured below?

- a. Anvil-type pruning shears
- b. Bow saw
- c. Garden hoe
- d. Hand pruners



3. What is the tool pictured below?

- a. Anvil-type pruning shears
- b. Bypass
- c. Cultivator
- d. Spading fork



4. Which is not an easy task of routine maintenance used to keep tools in good working condition?

- a. Waiting until tools show signs of wear and tear to repair them
- b. Sharpening tools
- c. Preventing rust
- d. Restoring wooden handles

## UNIT IV - TOOL IDENTIFICATION AND MAINTENANCE

JS 1.1

### Lesson 1: Hand Tools and Equipment

#### Job Sheet 1.1: Restoration of Wooden Handles

**Objective:** Upon completion of this job sheet, the student will be able to restore the wooden handle of a hand tool.

#### Materials and Supplies Needed:

1. Any hand tool with a wooden handle
2. Sandpaper (80 or 100 grit)
3. Soft cloths
4. Linseed oil
5. Any source of heat

#### Procedure:

1. Sand the wooden handle until smooth.
2. Heat the linseed oil.

**CAUTION:** Be careful when applying heated linseed oil.

3. Using a soft cloth, rub the wooden handle with linseed oil.
4. Allow sufficient time for the linseed oil to dry.
5. With a second soft cloth, rub the wooden handle.

## UNIT IV - TOOL IDENTIFICATION AND MAINTENANCE

JS 1.2

### Lesson 1: Hand Tools and Equipment

#### Job Sheet 1.2: Restoration of Metal Surfaces

**Objective:** Upon completion of this job sheet, the student will be able to restore hand tools with a metal surface.

#### Materials and Supplies Needed:

1. Soft cloths
2. Any tool with a metal surface
3. Nonflammable cleaner (hot soapy, water)
4. Wire brush or steel wool with naval jelly
5. Silicon carbide paper and oil (S.A.E. 10 oil is suggested.)

#### Procedure:

1. Remove any soil from the metal surface.
2. Use a soft cloth to remove any grease or oil on the metal with hot, soapy water.
3. Use a wire brush or steel wool with naval jelly to remove any pitted rust in the metal.
4. Use silicon carbide paper and oil to remove scratches and add shine to the metal.

## UNIT IV - TOOL IDENTIFICATION AND MAINTENANCE

### Lesson 2: Power Tools

**Objective:** The student will be able to identify and maintain common power tools used in the landscape and turfgrass industries.

#### Study Questions

- 1. What gas and electric powered tools are used in the landscape and turfgrass industries?**
- 2. How should gas powered tools be maintained?**
- 3. How should power tools be stored?**
- 4. What safety precautions should be taken when handling gas and electric powered tools?**

#### References

1. Landscaping and Turf Management (Student Reference). University of Missouri-Columbia: Instructional Materials Laboratory, 1990.
2. Demonstration Sheet
  - a) DS 2.1: Winterization of a Lawn Mower

## UNIT IV - TOOL IDENTIFICATION AND MAINTENANCE

### Lesson 2: Power Tools

#### TEACHING PROCEDURES

##### A. Review

Review the previous lesson.

##### B. Motivation

Power tools allow landscapers to handle larger maintenance and turfgrass jobs in less time than with hand tools, thus bringing larger financial gain.

##### C. Assignment

##### D. Supervised study

##### E. Discussion

1. Ask students to list power tools that might be used in landscape and turfgrass industries.

**What gas and electric powered tools are used in the landscape and turfgrass industries?**

- a) Gas-hand operated
  - 1) Chain saw
  - 2) Lawn mower
  - 3) Leaf blower/vacuum
  - 4) Rototiller
  - 5) Lawn aerator (core or slicer)
  - 6) String trimmer
  - 7) Edger
  - 8) Hedge trimmer
  - 9) Walk-behind mower
  - 10) Dethatcher
  - 11) Sod cutter
  - 12) Chipper/shredder
  - 13) Trencher
  - 14) Snow blower
- b) Gas-large equipment
  - 1) Tree spade
  - 2) Stump remover
  - 3) Power sweeper
  - 4) Skid loader
  - 5) Front end loader
  - 6) Chipper
  - 7) Snow blade
  - 8) Lawn tractor
  - 9) Fork lift
- c) Electric
  - 1) Lawn mower
  - 2) Chain saw

- 3) Hedge trimmer
- 4) String trimmer
- 5) Edger

2. Ask students what types of routine maintenance should be practiced in caring for power tools.

**How should gas powered tools be maintained?**

- 1) Check and clean air cleaners and filters.
- 2) Replace crankcase oil.
- 3) Check and service spark plugs.

3. Ask students what should be done with a lawn mower during the winter months.

**How should power tools be stored?**

- a) To store for a month or less
  - 1) Close fuel valve, drain carburetor.
  - 2) Fill tank with gas.
  - 3) Charge battery, if needed.
- b) To store for more than a month
  - 1) Drain fuel tank, run engine until dry.
  - 2) Change engine oil.
  - 3) Clean and replace filters, as needed.
  - 4) Clean exterior of tool.
  - 5) Loosen belts.
  - 6) Clean and lubricate wearing surfaces and coat drive chains with oil to prevent rusting.
  - 7) Place tool off the ground, if indoors; cover engine, if outdoors.

4. Ask students if they, or someone they know, were hurt while using power tools. Ask students how this could have been prevented.

**What safety precautions should be taken when handling gas and electric powered tools?**

- a) Gas powered tools
  - 1) Keep hands and feet away from moving parts.
  - 2) Do not smoke while working with gas engines.
  - 3) Stop engine before refueling.
  - 4) Work with gasoline engines outdoors or in well-ventilated areas.
  - 5) Retain all safety shields in proper places.
  - 6) Operate ventilation system when working indoors.
- b) Electric powered tools
  - 1) Use only insulated tools.
  - 2) Do not use electric tools near water.
  - 3) Always use ground fault circuit interrupters.
  - 4) Do not use cracked extension cords or those that feel warm to the touch while in use.

**F. Other Activities**

1. Assign each student a power tool and have them explain to the class how it should be maintained.

2. Demonstrate how to clean and change air filters.
3. Demonstrate how to change the crankcase oil.
4. Demonstrate how to service the spark plugs.
5. Have students clean and change air filters.
6. Have students change the crankcase oil.
7. Have students service the spark plugs.
8. Have students winterize tools.
9. Demonstrate how to prepare a machine or engine for use in the spring.

**G. Conclusion**

Power tools can allow landscapers to do more work in less time than with hand tools and provide more financial gain. If power tools are well-maintained and properly stored, the usefulness of the tool will be prolonged. Be sure to follow safety precautions when working with power tools.

**H. Competency**

Identify, maintain, and safely use power tools.

**I. Answers to Evaluation**

1. b
2. c
3. a
4. Answers should include four of the following:  
Do not wear loose fitting clothes.  
Use sharp tools.  
Wear eye protection.  
Let others know when operating power tools.  
Never smoke around gas.  
Keep hands and feet away from moving parts.  
Use gasoline engines outdoors.  
Stop engine before refueling.  
Keep safety shields in place.



UNIT IV - TOOL IDENTIFICATION AND MAINTENANCE

Name \_\_\_\_\_

Lesson 2: Power Tools

Date \_\_\_\_\_

EVALUATION

**Circle the letter that corresponds to the best answer.**

1. Which is not a maintenance procedure for power tools?
  - a. Change air cleaners and air filters.
  - b. Change crankcase oil in a two-cycle engine.
  - c. Change crankcase oil in a four-cycle engine.
  - d. Maintain spark plugs.
  
2. Which is not a step in the winterization of power tools?
  - a. Change oil.
  - b. Drain remaining fuel in the engine.
  - c. Tighten belts.
  - d. Lubricate chains.
  
3. Which is not a proper safety precaution when handling electric powered tools?
  - a. Work near wet areas, if careful.
  - b. Use ground fault circuit interrupters.
  - c. Do not use cracked extension cords.
  - d. Use insulated tools.

**Complete the following short answer question.**

4. List four safety precautions that should be taken when working with gas powered tools.
  - a.
  - b.
  - c.
  - d.

Demonstration Sheet 2.1: Winterization of a Lawn Mower

Objective: Students will be shown the steps necessary to winterize a lawn mower.

Materials and Supplies Needed:

1. Lawn mower
2. Oil (see owner's manual of lawn mower)
3. Fuel filter (see owner's manual of lawn mower)
4. Oil for lubrication
5. Tarpaulin or blanket
6. Blocks or bricks

Procedure:

1. Drain fuel tank.
2. Run engine until dry.
3. Change the crankcase oil.
4. Clean and replace filters (e.g., air, fuel).
5. Clean the exterior of the lawn mower.
6. Loosen any belts.
7. Clean and lubricate chains.
8. Place lawn mower off the ground onto blocks or bricks.
9. Cover lawn mower with tarpaulin or blanket.

## UNIT V - PESTICIDES

### Lesson 1: General Pesticide Information

Objective: The student will be able to describe how various types of pesticides work.

#### Study Questions

1. **What is the disease triangle?**
2. **What are the four types of metamorphosis in the life cycle of insects?**
3. **What is the Integrated Pest Management approach to pest control?**
4. **What is the origin of pesticides?**
5. **What are the various types of pesticides?**
6. **How do pesticides work?**
7. **What are the various formulations of pesticides?**

#### Reference

1. Landscaping and Turf Management (Student Reference). University of Missouri-Columbia: Instructional Materials Laboratory, 1990.

## UNIT V - PESTICIDES

### Lesson 1: General Pesticide Information

#### TEACHING PROCEDURES

##### A. Introduction

There are many types of pesticides. Knowing the types of pesticides and how they are used can be very beneficial to growing plants and keeping them healthy. Pesticides are any kinds of material used in the control of pests.

##### B. Motivation

Pesticides can be beneficial. They eradicate pests and keep them from destroying plants. If pests are left alone and are allowed to overtake a plant, there will be expense and work involved in replacing the plant.

##### C. Assignment

##### D. Supervised study

##### E. Discussion

1. Ask students if they control diseases in their garden, on their houseplants, or in their yard.

##### **What is the disease triangle?**

The disease triangle is a combination of pathogen, host, and the environment which contributes to the growth of disease.

2. Ask students to explain the life cycle of a butterfly to illustrate the process of metamorphosis.

##### **What are the four types of metamorphosis in the life cycle of insects?**

- a) No metamorphosis - no change in insect
- b) Gradual metamorphosis - egg, nymph, and adult
- c) Incomplete metamorphosis - egg, naiad, and adult
- d) Complete metamorphosis - egg, larva, pupa, and adult

3. Ask students how they control pests in their garden, on houseplants, and in the yard.

##### **What is the Integrated Pest Management approach to pest control?**

Integrated Pest Management uses a combination of cultural, biological, mechanical, and chemical control methods to aid in eliminating pests.

4. Ask students if they can explain what ingredients make up pesticides.

##### **What is the origin of pesticides?**

- a) Inorganic
- b) Organic

c) Synthetic

5. Ask students to make a list of different types of pests.

**What are the various types of pesticides?**

- a) Insecticides
- b) Herbicides
- c) Fungicides
- d) Rodenticides
- e) Miticides
- f) Aracicides
- g) Molluscicides
- h) Bactericides
- i) Nematocides

6. Ask students how they might control an insect that lives inside a plant or one that has chewing mouth parts.

**How do pesticides work?**

- a) As stomach poisons
- b) As systemic poisons
- c) As contact poisons
- d) As fumigants

7. Ask students if all pesticides are applied to plants in the same way. Ask them some of the different ways they are applied.

**What are the various formulations of pesticides?**

- a) Liquid form
  - 1) Emulsifiable concentrates (EC or C)
  - 2) Solutions (S)
  - 3) Flowables (FL or L)
  - 4) Aerosols (A)
  - 5) Liquified gases
- b) Dry form
  - 1) Dusts (D)
  - 2) Granules (G)
  - 3) Wettable powders (WP)
  - 4) Soluble powders (SP)
  - 5) Baits (B)

**F. Other Activities**

- 1. Walk through a greenhouse to check for pests.
- 2. Walk through school grounds looking for different types of pests.
- 3. Have students make a poster of different types of pests.

**G. Conclusion**

There are many types of pesticides used to control pests in the home, yard, and garden.

**H. Competency**

Describe how various types of pesticides work.

**I. Answers to Evaluation**

1. d
2. d
3. a
4. b
5. d
6. c
7. b
8. c
9. a
10. e
11. b
12. d
13. c
14. a
15. f
16. b

UNIT V - PESTICIDES

Name \_\_\_\_\_

Lesson 1: General Pesticide Information

Date \_\_\_\_\_

EVALUATION

Circle the letter that corresponds to the best answer.

1. What type(s) of control is (are) included in Integrated Pest Management?
  - a. Chemical control only
  - b. Chemical and biological control
  - c. Cultural and mechanical control
  - d. Cultural, mechanical, biological, and chemical control
2. What are the three parts of a disease triangle?
  - a. Environment, host, insect
  - b. Host, insect, pathogen
  - c. Insect, pathogen, environment
  - d. Environment, host, pathogen
3. What are the three stages of incomplete metamorphosis?
  - a. Egg, naiad, adult
  - b. Egg, pupa, adult
  - c. Egg, nymph, adult
  - d. Egg, larva, adult
4. Which is an example of an insect that experiences complete metamorphosis?
  - a. Aphid
  - b. Butterfly
  - c. Scale
  - d. Silver fish
5. What are the three types of mouth parts an insect may have?
  - a. Chewing, sucking, rasping
  - b. Rasping-sucking, chewing-sucking, piercing-sucking
  - c. Chewing, piercing-sucking, grasping-sucking
  - d. Chewing, piercing-sucking, rasping-sucking
6. Which is a pesticide that must be eaten by the insect to be effective?
  - a. Contact poison
  - b. Fumigant
  - c. Stomach poison
  - d. Systemic poison

7. What classification are pesticides that are made from plant parts?

- a. Inorganic pesticides
- b. Organic pesticides
- c. Synthetic pesticides
- d. Systemic pesticides

Match the following pesticides with the pests they control.

Type of pesticide		Pests
8.	_____ herbicide	a. fungi diseases
9.	_____ fungicide	b. spiders
10.	_____ bactericide	c. weeds
11.	_____ aracicide	d. rats
		e. bacterial diseases

Match the following formulations to the proper letters.

12.	_____ dust	a. no letter
13.	_____ flowables	b. A
14.	_____ liquified gas	c. FL or L
15.	_____ soluble powders	d. D
16.	_____ aerosols	e. LG
		f. SP



## UNIT V - PESTICIDES

### Lesson 2: Interpreting Pesticide Labels

**Objective:** Students will be able to accurately read and interpret pesticide labels.

#### Study Questions

1. **What are the three names found on a pesticide label?**
2. **What are the restrictions for the purchase and use of pesticides?**
3. **What are the two degrees of toxicity?**
4. **What are the signal words for the severity of toxicity?**
5. **What additional information can be found on pesticide labels?**

#### References

1. Landscaping and Turf Management (Student Reference). University of Missouri-Columbia: Instructional Materials Laboratory, 1990.
2. Work Sheet
  - a) WS 2.1: Reading a Pesticide Label

## UNIT V - PESTICIDES

### Lesson 2: Interpreting Pesticide Labels

#### TEACHING PROCEDURES

##### A. Review

Review the previous lesson.

##### B. Motivation

Interpreting a pesticide label correctly is a necessity. It will help reduce accidents and poisonings of humans, animals, and the environment.

##### C. Assignment

##### D. Supervised study

##### E. Discussion

1. Ask students what the two names are for all plants (common name and botanical name).

**What are the three names found on a pesticide label?**

- a) Brand or trade name
- b) Common name
- c) Chemical name

2. Ask students if any of them has a driver's or chauffeur's license or a learner's permit. Have them explain the restrictions and use of each.

**What are the restrictions for the purchase and use of pesticides?**

- a) General-use pesticides - Anyone can purchase or use these pesticides.
- b) Restricted-use pesticides - These pesticides may only be purchased and used by certified applicators.

3. Ask students to list some household chemicals one might find in a home. Discuss the toxicity of those chemicals.

**What are the two degrees of toxicity?**

- a) Acute
- b) Chronic

4. Ask students to list some symbols and signal words they might encounter in their everyday activities (e.g., stop lights, stop signs, "no smoking" signs).

**What are the signal words for the severity of toxicity?**

- a) **DANGER** - high toxicity with symbol of skull and crossbones

- b) **WARNING** - moderate toxicity
- c) **CAUTION** - low toxicity

5. Ask students what kind of information they might find on a cereal box or a package of hot dogs. Have students complete WS 2.1. The instructor will need to provide pesticide containers or photocopies of pesticide labels.

**What additional information can be found on pesticide labels?**

- a) Name and address of manufacturer
- b) Active ingredients and net content
- c) Type and formulation of pesticide
- d) EPA registration and identification number
- e) Directions for use
- f) Hazard statement
- g) Precaution statement
- h) Misuse statement (federal law information)
- i) Statement of practical treatment
- j) Storage and disposal instructions
- k) Reentry and safe handling of plant

**F. Other Activity**

Have students compare various pesticide labels.

**G. Conclusion**

A pesticide label gives vital information about a particular pesticide. The label information will include, toxicity level, accurate use of the pesticide, and treatment needed if exposure to the pesticide causes harm.

**H. Competency**

Accurately interpret a pesticide label for information about use, effectiveness, and safe handling.

**I. Answers to Evaluation**

- 1. a
- 2. b
- 3. c
- 4. c
- 5. b

6. Students should include five of the following responses:

Name and address of manufacturer  
EPA identification and registration number  
Active ingredients  
Type of pesticide  
Directions for use  
Hazard statement  
Precaution statement  
Misuse statement  
Statement of practical treatment  
Storage and disposal instructions

**Reentry and safe handling of plant**

**J.    Answers to WS 2.1**

**Answers will be evaluated by instructor dependent upon pesticide labels used.**

UNIT V - PESTICIDES

Name \_\_\_\_\_

Lesson 2: Interpreting Pesticide Labels

Date \_\_\_\_\_

EVALUATION

Circle the letter that corresponds to the best answer.

1. Which is not a name of a pesticide found on its label?
  - a. Botanical
  - b. Brand
  - c. Chemical
  - d. Common
  
2. Which pesticide name has a trademark?
  - a. Botanical
  - b. Brand
  - c. Chemical
  - d. Common
  
3. What does the signal word **WARNING** mean?
  - a. High toxicity
  - b. Low toxicity
  - c. Moderate toxicity
  - d. Slight toxicity
  
4. What does the signal word **CAUTION** mean?
  - a. One teaspoon to kill an average adult
  - b. One tablespoon to kill an average adult
  - c. One ounce to one pint to kill an average adult
  - d. One pint to one gallon to kill an average adult
  
5. Which signal word also has the skull and crossbones on the pesticide label?
  - a. **CAUTION**
  - b. **DANGER**
  - c. **PREVENTIVE**
  - d. **WARNING**

Complete the following short answer question.

6. What are five additional items of information that may be found on a pesticide label?
  - a.
  - b.
  - c.
  - d.
  - e.

Lesson 2: Interpreting Pesticide Labels

Work Sheet 2.1: Reading a Pesticide Label

**Read a pesticide label to find the correct information.**

1. Brand name \_\_\_\_\_
2. Type of formulation \_\_\_\_\_
3. Common name of product \_\_\_\_\_
4. Active ingredients \_\_\_\_\_
5. Signal words \_\_\_\_\_
6. Precautionary statement \_\_\_\_\_
7. Use classification \_\_\_\_\_
8. Misuse statement \_\_\_\_\_
9. Reentry statement \_\_\_\_\_
10. Storage and disposal directions \_\_\_\_\_
11. Net weight \_\_\_\_\_
12. Name and address of manufacturer \_\_\_\_\_
13. Directions for use \_\_\_\_\_
14. Statement of practical treatment \_\_\_\_\_
15. EPA Registration Number \_\_\_\_\_

## UNIT V - PESTICIDES

### Lesson 3: Using Pesticides Safely

**Objective:** Students will be able to identify safety precautions that should be followed when mixing, applying, storing, and disposing of pesticides.

#### Study Questions

- 1. What safety precautions should be followed when mixing and applying pesticides?**
- 2. What special clothing and equipment are needed when applying pesticides?**
- 3. If poisoning occurs, what first aid should be administered?**
- 4. What safety precautions should be followed when storing and disposing of pesticides?**

#### Reference

1. Landscaping and Turf Management (Student Reference). University of Missouri-Columbia: Instructional Materials Laboratory, 1990.

## UNIT V - PESTICIDES

### Lesson 3: Using Pesticides Safely

#### TEACHING PROCEDURES

A. Review

Review previous lesson.

B. Motivation

Following safety procedures when working with pesticides is a must. Accurate use of pesticides will help prevent the occurrence of poisoning.

C. Assignment

D. Supervised study

E. Discussion

1. Ask students how they might go about baking a cake or barbecuing steaks. What kinds of safety precautions are needed when cooking?

**What safety precautions should be followed when mixing and applying pesticides?**

a) Mixing pesticides

- 1) Read label first.
- 2) Always wear protective clothing.
- 3) Keep pesticides and containers below eye level.
- 4) Do not use the same measuring utensils used in food preparation.
- 5) Do not mix with other pesticides unless indicated on label.
- 6) Mix in well-ventilated area with good lighting.
- 7) Never mix stronger than recommended rates.
- 8) Mix only amount of pesticide needed.
- 9) Measure carefully.

b) Applying pesticides

- 1) Read label first.
- 2) Apply only on recommended pests and plants.
- 3) Wear protective clothing.
- 4) Never smoke or eat when using pesticides.
- 5) Direct pesticide only at area to be sprayed.
- 6) Do not spray on windy or rainy days.
- 7) Do not work alone when using highly toxic pesticides.
- 8) Always shower and wash hair and nails. Clean clothing and equipment thoroughly after pesticide application is completed.

2. Ask students what special clothing and equipment a football player or a sky diver might wear.

**What special clothing and equipment are needed when applying pesticides?**

Always read label for required clothing and equipment instructions.



- a) Long sleeved shirt
  - b) Long pants
  - c) Rubber gloves and boots
  - d) Wide-brimmed hat
  - e) Waterproof clothing - raincoat
  - f) Eye protection - goggles, face shield
  - g) Respirator
3. Ask student what first aid techniques are used for cuts, broken arms or legs. Ask students if anyone knows what CPR is and how to administer it.

**If poisoning occurs, what first aid should be administered?**

- a) Act as quickly as possible.
- b) Without endangering oneself, remove the victim from the contaminated area.
- c) Remove contaminated clothing from the victim.
- d) Generaously flood the affected skin area or eye with water.
- e) Contact the Poison Control Center or a doctor.
- f) Administer first aid as indicated by Poison Control Center Personnel or doctor.

NOTE: If a pesticide accident occurs at school, the instructor should notify the school nurse as soon as possible.

4. Ask students how cleansers and detergents are stored in their homes.

**What safety precautions should be followed when storing and disposing of pesticides?**

- a) Storing pesticides
  - 1) Store in original containers.
  - 2) Store in locked cabinet or room.
  - 3) Store in a well-lighted area to allow reading of labels.
  - 4) Store in an area away from children and animals.
  - 5) Store in a dry, cool area.
- b) Disposing of pesticides and containers
  - 1) Read and follow pesticide container label for disposal instructions and/or precautions.
  - 2) Apply any surplus pesticide to other areas with the same pest problem.
  - 3) Never flush pesticides down the drain, into sewers, or into waterways.
  - 4) Take unwanted pesticides and/or containers to a toxic waste disposal landfill.
  - 5) Follow these general guidelines for pesticide disposal as mandated by the U.S. Department of Agriculture and the U.S. Environmental Protection Agency.
    - (a) Never leave surplus pesticides and/or pesticide containers at the application site.
    - (b) Never reuse pesticide containers.
    - (c) Keep all pesticide containers out of the reach of children.
    - (d) Store leftover pesticides in tightly covered containers in a safe storage facility until they can be disposed of safely.
  - 6) For help with safe disposal of pesticides and/or pesticide containers, contact:  
 Missouri Department of Natural Resources  
 Division of Environmental Quality  
 P.O. Box 176  
 Jefferson City, Missouri 65102  
 Business phone: 314-751-7929  
 Emergency response phone: 314-634-2436

**F. Other Activities**

1. Have students try on protective clothing and equipment.
2. Have students make a first aid chart.
3. Have students practice first aid procedures.
4. Have an agricultural extension agent come in at end of unit to give certification for pesticide application.

**G. Conclusion**

Safety is a necessary factor in mixing, applying and storing pesticides. Following safety precautions will help prevent poisoning.

**H. Competency**

Identify safety precautions that should be followed when using pesticides.

**I. Answers to Evaluation**

1. b
2. b
3. c
4. a
5. a
6. b
7. List should include five of the following items:
  - Long sleeved shirt
  - Long pants
  - Rubber gloves and boots
  - Raincoat
  - Wide-brimmed hat
  - Goggles or face shield
  - Respirator

UNIT V - PESTICIDES

Name \_\_\_\_\_

Lesson 3: Using Pesticides Safely

Date \_\_\_\_\_

EVALUATION

Circle the letter that corresponds to the best answer.

1. Which is not a safety precaution in mixing pesticides?
  - a. Read the label before mixing.
  - b. Mix more than is needed.
  - c. Do not use measuring utensils used in food preparation.
  - d. Measure carefully.
2. Which is not a safety precaution for application of pesticides?
  - a. Wear protective clothing.
  - b. Work alone to prevent poisoning others.
  - c. Do not apply on windy days.
  - d. Take a shower after application.
3. Which of the following is the most important rule to follow when applying first aid to a pesticide poisoning victim?
  - a. Induce vomiting.
  - b. Remove contaminated clothing.
  - c. Act immediately to begin first aid.
  - d. Check for shock symptoms.
4. If poison gets into the eyes, what type of first aid should be administered?
  - a. Flush with clean water.
  - b. Open all doors and windows so victim can have light.
  - c. Wrap victim in a blanket.
  - d. Wash victim's skin.
5. Where should pesticides not be stored?
  - a. In other containers
  - b. In a cool, dry place
  - c. In a locked cabinet
  - d. Away from children
6. What safety information is not found on a pesticide label?
  - a. Protective clothing to be worn during application
  - b. Doctor's phone number should poisoning occur
  - c. First aid suggestions
  - d. Proper disposal of the pesticide container

**Complete the following short answer question.**

7. What are five articles of special clothing or equipment to use for safety when applying pesticides?
- a.
  - b.
  - c.
  - d.
  - e.

## UNIT VI - INSTALLATION AND MAINTENANCE OF TREES AND SHRUBS

### Lesson 1: Installing Trees and Shrubs

**Objective:** The student will be able to describe procedures for planting and transplanting balled and burlapped, container-grown, and bare-root trees and shrubs.

#### Study Questions

1. **How are trees and shrubs sold?**
2. **How should the soil be prepared before planting trees and shrubs?**
3. **How are trees and shrubs transplanted?**
4. **What procedures should be followed when planting bare-root, balled and burlapped, and container-grown plants?**
5. **What types of mulches can be used around trees and shrubs?**

#### References

1. Landscaping and Turf Management (Student Reference). University of Missouri-Columbia: Instructional Material Laboratory, 1990.
2. Job Sheets
  - a) JS 1.1: Transplanting a Tree or Shrub
  - b) JS 1.2: Planting Bare-Root Trees or Shrubs
  - c) JS 1.3: Planting Container-Grown Trees or Shrubs
  - d) JS 1.4: Planting Balled and Burlapped Trees or Shrubs

## UNIT VI - INSTALLATION AND MAINTENANCE OF TREES AND SHRUBS

### Lesson 1: Installing Trees and Shrubs

#### TEACHING PROCEDURES

##### A. Introduction

Ask the students if they or their parents have purchased any plants from the nursery lately. If so, ask them how the roots were confined. Were they bare, in a container with soil, or covered with burlap? Point out that each of these have advantages and that they have to weigh these before they choose a form to plant.

##### B. Motivation

The life or death of a tree or shrub depends partly on using high quality plant material. However, even with high quality plant material, unless it is transplanted by the proper procedures, an expensive tree or shrub will be more likely to die.

##### C. Assignment

##### D. Supervised study

##### E. Discussion

1. During the discussion, it would be helpful to show examples of how trees and shrubs are sold.

#### **How are trees and shrubs sold?**

- a) Bare-root
  - 1) Advantages
    - (a) Least expensive
    - (b) Light weight and easy to transplant
    - (c) Should be dormant when transplanted in winter and early spring
    - (d) Can use unamended back-fill
  - 2) Disadvantages
    - (a) Reduced root system
    - (b) Small plants needing long time to mature
    - (c) Transplant season limited to winter and early spring
- b) Balled and burlapped (B and B)
  - 1) Advantages
    - (a) Larger plants can be planted
    - (b) Less damage to root system
    - (c) Planted throughout early spring to late fall
    - (d) Planted in winter as long as ground is not frozen
  - 2) Disadvantages
    - (a) Usually more expensive
    - (b) Soil ball adds extra weight and bulk
    - (c) Larger plants expensive to install, require heavy equipment
- c) Container-grown plants
  - 1) Advantages
    - (a) Less expensive than B and B, yet have a rootball
    - (b) Can be planted through spring, summer, and fall

- 2) Disadvantage of becoming root bound if left in container too long
2. Ask if the students have planted or helped plant any trees or shrubs. Ask if they added anything to the soil before they planted the tree. Point out that this is a very important step, and if the proper items are not added to the soil when planting, the tree or shrub could die. Have the students prepare the planting hole for a tree.

**How should the soil be prepared before planting trees and shrubs?**

- a) Assess the soil.
    - 1) Texture
    - 2) Structure
    - 3) Depth
    - 4) Compaction
    - 5) Soil test
  - b) Add recommended materials to the back-fill soil.
    - 1) Slow release form of fertilizer (in tablets)
    - 2) Not a high analysis form of fertilizer
  - c) Test for drainage and aeration.
    - 1) Fill planting hole with water.
    - 2) If water drains out in 18-24 hours; it is satisfactory.
    - 3) If not, choose water-tolerant plants or install drainage tiles.
  - d) If a plow-pan soil:
    - 1) Planting hole must be below plow pan.
    - 2) Fill with soil from below the plow-pan zone plus organic matter.
  - e) If shallow:
    - 1) Make raised beds.
    - 2) Drill below the plow-pan zone; fill with surface soil plus organic matter.
    - 3) Add nitrogen to organic material.
3. Spring and fall are busy times in the nursery business, since these are the best times to plant trees and shrubs. At these times, the plants are dormant or semi-dormant. For the most success, a tree should be planted when the leaves are not actively growing. This reduces the stress on the tree and allows the roots to get well established. Have the students complete JS 1.1 Transplanting a Tree. Obtain permission for the class to dig a tree from the field of a local nursery. If this is not feasible, dig a tree from the school grounds. Avoid large trees. A one to two inch caliper is satisfactory.

**How are trees and shrubs transplanted?**

- a) Time
  - 1) Best time is when plant is dormant or semi-dormant.
  - 2) If plant is in leaf, keep leaves cool and shaded.
  - 3) Choose a time when root growth exceeds top growth.
    - (a) Early autumn
    - (b) Early spring
- b) Preparation
  - 1) Soil should not be too wet or dry to keep rootball together.
  - 2) Larger trees can be root pruned ahead of time, several months to a year, if possible, to encourage a more vigorous root system.
- c) Digging
  - 1) Use a sharp spade.
  - 2) Dig a circle 12" in diameter per inch of trunk diameter.
  - 3) Dig as deep as wide.

- 4) Shape ball in a spherical shape; leave on a pedestal of soil.
  - 5) Tip soil ball off pedestal; cut roots still attached.
  - 6) Bring burlap under ball; pull tightly and secure with nails, used as pins.
  - 7) Wrap the ball completely, securing the burlap with the pinning nails.
  - 8) Bind top with cord, going around the ball for support.
  - d) Removing from hole
    - 1) Lift the tree out of the hole by using the soil ball and the cords.
    - 2) Do not use trunk as a handle.
4. Following the proper procedure when planting a tree or shrub will help ensure the success of the tree or shrub. There are different procedures to follow for each bare-root, container-grown, and B and B plant. Demonstrate the procedures listed in Job Sheets 1.2 - 1.4. Then have the students complete Job Sheets 1.2 - 1.4. If all of the plant material is not available, omit as necessary.

**What procedures should be followed when planting bare-root, balled and burlapped, and container-grown plants?**

- a) Prepare the planting hole.
  - 1) Bare-root plants - large enough not to cramp or bend roots
  - 2) Balled and burlapped and container-grown plants
    - (a) Six inches wider than the container or ball width on all sides.
    - (b) Glazed sides roughened
  - 3) Four to six inch mound of soil left in bottom of hole for bare-root plants.
- b) Decide on the orientation of the plant.
  - 1) Windy conditions
    - (a) Side with most branches into wind
    - (b) Bare-root - largest root into the wind
  - 2) Non-windy conditions
    - (a) Most pleasing side to the most viewed area
    - (b) Side with lowest branches away from activity area
    - (c) Side with highest branches on side of activity
- c) Plant bare-root plant.
  - 1) Prepare the roots.
    - (a) Soak in water overnight.
    - (b) Prune back twisted, broken, or diseased roots.
  - 2) Spread roots over mound of soil.
  - 3) Set stakes, if needed.
  - 4) Fill hole three-fourths full (can use original soil).
  - 5) Firm in the soil.
  - 6) Water thoroughly.
  - 7) If it settles, below crown or original soil line, rock trunk back and forth while pulling up.
  - 8) Finish filling hole with soil.
  - 9) Adjust depth while filling.
  - 10) Make a berm (dish):
    - (a) Twice the diameter of rootball.
    - (b) Four to six inches high around outside.
    - (c) Six inches away from trunk.
  - 11) Water again.
  - 12) Add mulch.
- d) Plant balled and burlapped plant.
  - 1) Set soil ball at original soil level.
  - 2) Untie and remove string securing burlap around trunk.



- 3) Spread burlap open.
  - 4) Fill hole with prepared back-fill one half full.
  - 5) Firm soil around rootball.
  - 6) Stake if necessary.
  - 7) Fill in remainder of soil.
  - 8) Cut away excess burlap.
  - 9) Build a berm (dish).
  - 10) Water thoroughly.
  - 11) Add mulch.
  - e) Plant container-grown plant.
    - 1) Remove from container.
      - (a) Turn plastic pots over.
      - (b) Cut sides of metal cans.
      - (c) Tear top of fiber pots below soil level.
    - 2) Loosen or cut circling roots.
    - 3) Make several, shallow, vertical cuts in the sides of the rootball.
    - 4) Place rootball on mound of soil.
    - 5) Fill hole one half full with back-fill.
    - 6) Firm soil in around roots.
    - 7) Stake if necessary.
    - 8) Finish filling hole, firming in the process.
    - 9) Make a berm (dish).
    - 10) Water thoroughly.
    - 11) Add mulch.
5. Newly-planted trees and shrubs benefit greatly when a mulch is applied to the surface of the planting area. The roots are not developed fully yet so they are unable to handle stress due to lack of water.

**What types of mulches can be used around trees and shrubs?**

- a) Purposes of mulch
  - 1) Retains water
  - 2) Keeps weeds down
  - 3) Has attractive appearance
  - 4) Stabilizes temperatures
- b) Characteristics
  - 1) Must be two to four inches thick to keep weeds down
  - 2) Black plastic used under a thin mulch
    - (a) Keeps weeds down
    - (b) Causes water logging
    - (c) Does not allow oxygen to reach roots
    - (d) Should be cut to allow oxygen and air to reach plants
  - 3) Landscape fabric, a weed barrier mat
    - (a) Keeps weeds down
    - (b) Allows water and air to pass through
    - (c) Does not waterlog plants
- c) Choices of mulch
  - 1) Organic
    - (a) Wood chips
    - (b) Shredded bark
    - (c) Lawn clippings
    - (d) Pine needles

- 2) Inorganic
  - (a) Crushed stone
  - (b) Marble chips
  - (c) Brick chips
  - (d) River rock

**F. Other activities**

1. Acquire one or more bare-root, B and B, or container-grown plants (could be a donation or purchase from a local nursery). A field trip to select these plants at the nursery would be good, if possible. If this is not feasible, there might be plants on the school property that could be used.
2. Have students dig a tree or shrub, prepare the planting hole, and plant the tree or shrub following the procedures explained in the unit.
3. If possible, have students take a soil test. Have them prepare the planting hole at least two or three days ahead so it can be filled with water and drained to check for drainage.
4. Demonstrate how to dig a tree and cover the ball with burlap. Demonstrate how to plant a bare-root, container-grown, and B and B tree or shrub.

**G. Conclusion**

Trees and shrubs must be planted according to the proper procedure for different types of root systems. Learning the proper planting procedure is essential for a successful future in the landscape installation business.

**H. Competency**

Transplant a tree or shrub and properly plant a bare-root, container-grown, or B and B tree or shrub.

**I. Answers to Evaluation**

- |      |       |
|------|-------|
| 1. c | 9. a  |
| 2. c | 10. b |
| 3. a | 11. b |
| 4. a | 12. c |
| 5. a | 13. b |
| 6. d | 14. a |
| 7. a | 15. d |
| 8. b |       |

## EVALUATION

Circle the letter that corresponds to the best answer.

1. What type of hole should be used when planting bare-root plants?
  - a. A post hole
  - b. A shallow trench
  - c. A hole large enough not to cramp roots
  - d. A hole deeper than it is wide
2. Where is the best place to grasp a B and B tree?
  - a. By the rope
  - b. By the small branches
  - c. By the soil ball
  - d. By the trunk
3. What depth should the hole be when planting a B and B tree?
  - a. The same depth as the rootball
  - b. Four to five inches deeper than the rootball
  - c. Three times the size of the rootball
  - d. Twice the size of the rootball
4. What should be mixed with soil when planting trees and shrubs in compacted soil?
  - a. Nothing
  - b. Sand
  - c. Sawdust
  - d. Strong fertilizer
5. When is best time of year to plant trees and shrubs?
  - a. Early fall
  - b. Late spring
  - c. Mid-summer
  - d. Mid-winter
6. What should be done to plastic when used under a mulch?
  - a. Cut it so that the weed barrier touches the plant.
  - b. Layer it under the roots.
  - c. Cover the plant with it.
  - d. Cut it to allow air and water to get to roots.

7. Which is an inorganic mulch?
- a. Crushed stone
  - b. Lawn clippings
  - c. Pine needles
  - d. Shredded bark
8. How large a rootball should be dug for a B and B tree with a trunk of one inch in diameter?
- a. 6 inches in diameter
  - b. 12 inches in diameter
  - c. 24 inches in diameter
  - d. 36 inches in diameter
9. What type of fertilizer should not be used when planting trees or shrubs?
- a. High analysis granular
  - b. Liquid
  - c. Slow-release
  - d. Water-soluble
10. What is advantage of planting a B and B tree as opposed to a bare-root tree?
- a. It is the least expensive type of tree.
  - b. Larger plants can be planted.
  - c. They can be planted when dormant in the early spring.
  - d. They have a reduced root system that is easier to plant.
11. What should the ball be set on in the bottom of the hole when planting a B and B tree?
- a. A mound of loose soil
  - b. A flat surface at the bottom of the hole
  - c. A flat surface of gravel
  - d. A flat surface covered with some loose soil
12. When planting a bare-root tree, when should it be watered?
- a. Four hours after the tree is planted
  - b. When the hole is half full
  - c. When the hole is half full, and again when it is full
  - d. After the tree is placed on the mound of soil
13. Which is the best procedure for making a berm?
- a. Make it four to six inches high by the trunk of the tree.
  - b. Make it four to six inches high at the outer edge of the planting hole.
  - c. Make it two inches high at the outer edge of the planting hole.
  - d. Make it twelve inches high by the trunk of the tree.

14. What should be done with exposed burlap?
- a. It should be removed.
  - b. It should be left on to protect the roots.
  - c. It should be left on to maintain wick action.
  - d. It should be left on to keep soil ball warm.
15. What should be done with the cord around a B and B tree when the tree is planted?
- a. It should be kept on to hold the ball securely.
  - b. It should be removed along with the burlap.
  - c. It should be kept on for three weeks.
  - d. It should be removed so it does not girdle the roots.

Lesson 1: Installing Trees and Shrubs

Job Sheet 1.1: Transplanting a Tree or Shrub

Objective: Upon completion of this job sheet, the student will be able to transplant trees and shrubs.

Materials and Supplies Needed:

1. Sharp spade
2. Burlap
3. Twine or cord
4. Nails (Use as pins)

Procedure:

1. Using a sharp spade dig a circle around the tree. The diameter of the soil ball should be 12 inches per inch of caliper (diameter of the trunk).
2. Dig the hole as deep as wide.
3. Shape the ball in a spherical shape while digging. Leave on a pedestal of soil.
4. Prune any large, protruding roots.
5. Tip the ball off the pedestal, and cut any roots still attached.
6. Bring the burlap under the ball.
7. Pull burlap tightly, and secure using nails as pins, wrapping the entire ball.
8. Bind the top with twine or cord, wrapping it around the ball.
9. Remove the tree from the hole by lifting the soil ball.

Note: Do not use the trunk as a handle.

Lesson 1: Installing Trees and Shrubs

Job Sheet 1.2: Planting Bare-Root Trees or Shrubs

Objective: Upon completion of this job sheet, the student will be able to plant bare-root trees or shrubs.

Materials and Supplies Needed:

1. Spade
2. Bare-root plant material
3. Soil amendments, fertilizer (based on previous soil test)
4. Staking or guying materials (See Job Sheets 2.1 and 2.2 for instructions on staking and guying).

Procedures:

1. Prepare the roots by soaking them in water overnight if dry, and pruning any dead or twisted roots.
2. Dig a hole just large enough so the roots can be spread out and not cramped.
3. The hole should be four to six inches deeper than needed; then a mound of soil should be placed back in the hole in a cone shape.
4. Decide the orientation of the tree.
5. Place the roots spread out over the mound of soil.
6. Stake if necessary.
7. Fill the hole three-fourths full with soil.
8. Tamp the soil in around the roots to avoid air pockets. Note: Can use original soil.
9. Water thoroughly.
10. If the tree settles too low, below the crown or the original soil line, gently rock the tree back and forth while pulling up. Note: Do not try this on container-grown or B and B trees.
11. Finish filling in the soil and adjust the depth in the process.
12. Make a berm around the tree to hold water. It should be two times the diameter of the rootball, four to six inches high around the outside and six inches away from the trunk.
13. Water again.
14. Add mulch.

**Lesson 1: Installing Trees and Shrubs**

**Job Sheet 1.3: Planting Container-Grown Trees or Shrubs**

**Objective:** Upon completion of this job sheet the student will be able to plant container-grown trees or shrubs.

**Materials and Supplies Needed:**

1. Spade
2. Container-grown tree or shrub
3. Soil amendments, fertilizer (based on previous soil test)
4. Staking and guying materials (See Lesson 2, Job Sheets 2.1 and 2.2 for instructions on staking and guying).

**Procedures:**

1. Be sure the plant material is well-watered.
2. Prepare the planting hole by digging two times the container width and the same depth as the container depth.
3. Be sure the sides of the hole are straight down or flared out.
4. Roughen glazed sides.
5. Determine the orientation of the tree or shrub.
6. Remove the plant from the container (follow description in student reference).
7. Loosen or cut circling roots. Make several shallow vertical cuts on the sides of the rootball.
8. Place the tree or shrub in the hole. The rootball should be at the soil level.
9. Fill the hole one-half full with back-fill.
10. Firm the soil in around the roots.
11. Stake if necessary.
12. Finish filling in the hole firming the soil in the process.
13. Make a berm (dish) four to six inches high around the outside edge of the planting hole.
14. Water thoroughly.
15. Add mulch.



**Lesson 1: Installing Trees and Shrubs**

**Job Sheet 1.4: Planting Balled and Burlapped Trees or Shrubs**

**Objective:** Upon completion of this job sheet the student will be able to plant B and B trees or shrubs.

**Materials and Supplies Needed:**

1. Spade
2. B and B plant material
3. Soil amendments, fertilizer (as determined in previous soil list)
4. Stakes, cord, and protective covering
5. Guying wire stakes, flags, and protective covering (See Lesson 2, Job Sheets 2.1 and 2.2 for instructions on staking and guying).

**Procedures:**

1. Be sure the plant material is adequately watered. B and B plants should not be soaked before planting or else the ball will fall apart.
2. Prepare the planting hole by digging the hole six inches wider than the ball width on all sides and the ball depth. Be sure the sides are straight down or flared out.
3. Roughen glazed sides.
4. Place the root ball in the center of the hole.
5. Untie or cut the string wrapped around the burlap surrounding the trunk.
6. Spread burlap open.
7. Fill in the hole with back-fill one-half full.
8. Firm the soil around the ball.
9. Stake, if necessary.
10. Fill in remainder of soil.
11. Cut away any excess burlap.
12. Build a berm (dish). It should be four to six inches high and at the outside edge of the planting hole.
13. Water thoroughly.
14. Add mulch.

## UNIT VI - INSTALLATION AND MAINTENANCE OF TREES AND SHRUBS

### Lesson 2: Post-Transplant Care

**Objective:** The student will be able to describe procedures to care for newly-transplanted trees and shrubs.

#### Study Questions

- 1. When and how is staking and guying used?**
- 2. Why and how are trees wrapped and when should wrapping be removed?**
- 3. What are the purposes of using anti-transpirants?**
- 4. Why are plants pruned or not pruned after being transplanted?**

#### References

1. Landscaping and Turf Management. (Student Reference). University of Missouri-Columbia: Instructional Materials Laboratory, 1990.
2. Job Sheets
  - a) JS 2.1: Staking a Tree
  - b) JS 2.2: Guying a Tree
  - c) JS 2.3: Wrapping a Tree

## UNIT VI - INSTALLATION AND MAINTENANCE OF TREES AND SHRUBS

### Lesson 2: Post-Transplant Care

#### TEACHING PROCEDURES

##### A. Review

Review the previous lesson.

##### B. Motivation

Homeowners spend a lot of money on trees, and the landscaper invests time planting the tree. Post-transplant care could mean the life or death of this investment and should always be practiced with caution.

##### C. Assignment

##### D. Supervised study

##### E. Discussion

1. Like young children, young trees are not always able to stand on their own. Ask the students what they would do to help a young tree until it gets established. Have students complete Job Sheets 2.1 and 2.2.

#### **When and how is staking and guying used?**

- a) Causes of weakness in trees:
  - 1) Staked and protected from wind and weather when young
  - 2) Grown too close together in the nursery
  - 3) Lower branches removed
- b) Staking is used for:
  - 1) Anchorage of roots until they are established
  - 2) Protection from injury
  - 3) Support
    - (a) If tree is too weak to stand alone
    - (b) To secure roots
    - (c) For smaller trees up to 1 1/2" in diameter, the one-stake or slant method will work fine.
    - (d) With trees from 1 1/2" in diameter, the two- or three-stake methods work fine.
    - (e) Larger trees should be guyed. When guying trees, use turnbuckles to keep the wires snug and use hazard markers to prevent people from tripping over the wires.
    - (f) Staking guidelines
      - (1) Stakes should be 18" deep and no higher than two-thirds height of tree
      - (2) Placed parallel to the trunk, unless using the slant method
      - (3) Ties looped around trunk and attached to stake two inches from top
      - (4) Crosstie placed at or below soil line
- c) Guying is used for:
  - 1) Same reasons as staking: greater support

- 2) Trees greater than three inches in diameter
    - (a) Three or four guy wires with compression springs or turnbuckles attached to a protective collar around tree trunk
    - (b) Ends of wires attached to stakes in the ground
    - (c) Stakes angled away from tree
    - (d) Flags of reflective material for visibility
    - (e) Guy wires at 45° angle with trunk and ground
  - d) Precautions for staking and guying
    - 1) Flexible material around tree
      - (a) Should not rub bark away
      - (b) Should not girdle tree
    - 2) Wire covered by rubber hose, or other protective covering
    - 3) Two stakes, not one, to prevent unnecessary rubbing
    - 4) Same holes for later, replacement stakes
    - 5) Staking and wiring only when necessary
2. An added protection for trees is wrapping. A paper, tree-wrap is most commonly used. Ask the students if they have ever used a tree-wrap. Have a sample to show students. Demonstrate how to wrap a tree with the paper, tree-wrap available at a local nursery. Have the students take turns trying it. Have the students complete Job Sheet 2.3.

**Why and how are trees wrapped and when should wrapping be removed?**

- a) Trunk protection from:
    - 1) Sunburn
    - 2) Sun scald - winter injury
    - 3) Water loss
    - 4) Animal damage
    - 5) Weed trimmer damage
  - b) Materials used:
    - 1) Paper or burlap
    - 2) Latex paint
    - 3) Tree wrapping paper - used most often
      - (a) Wrapped from the ground up
      - (b) Overlapped one-half the width of the paper
      - (c) Fastened with rope or electrical tape
  - c) Wrapping removed when it disintegrates or after one year
3. Ask the students to tell what they think an anti-transpirant does. Point out that these can be used when moving or planting trees in mid-summer, or when the temperatures are very hot. However, caution should be taken not to apply too much or too often. If the situation warrants, demonstrate the application of an anti-transpirant.

**What are the purposes of using anti-transpirants?**

- a) Purposes
  - 1) To cut down on moisture loss after a tree is transplanted
  - 2) To preserve moisture in plant during drought
  - 3) To prevent winter burn of evergreens in cold, dry winters
- b) Kinds
  - 1) Chemical to reflect light
  - 2) Wax, plastic, or latex spray to block stomata - used most often (such as Wilt Proof™)
  - 3) Chemical to prevent stomata opening

- c) Can be toxic - should be used with caution
- 4. Explain to students that reduction in roots caused by transplanting will require a reduction in top growth. Otherwise, there are not enough roots to support the plant. Pruning of young trees will be discussed in Lesson 3.

**Why are plants pruned or not pruned after transplanting?**

- a) Reduces leaf surface area to balance root loss
- b) Not necessary if irrigation is adequate
- c) Better not to prune although sometimes necessary; not necessary if plant has been recently pruned at nursery
- d) Alternatives to reducing size of plant
  - 1) Thinning out crossing branches
  - 2) Removing broken branches
  - 3) Correcting undesirable branching
  - 4) Pruning fruit trees to promote low branch growth

**F. Other Activities**

- 1. Stake a tree which is newly-transplanted.
- 2. Put guy wires on a tree.
- 3. Practice wrapping a tree.
- 4. Apply an anti-transpirant, if available.
- 5. Prune a newly-transplanted tree.

**G. Conclusion**

Although post-transplant care is essential for the health of a plant, it should be done with caution so the health of the newly-transplanted plant is not threatened.

**H. Competency**

Stake and guy a newly-planted tree; wrap, prune, and apply anti-transpirants to a young tree.

**I. Answers to Evaluation**

- 1. a
- 2. c
- 3. d
- 4. b
- 5. a
- 6. d
- 7. d
- 8. c
- 9. c
- 10. d
- 11. b

**UNIT VI - INSTALLATION AND MAINTENANCE  
OF TREES AND SHRUBS**

Name \_\_\_\_\_

Date \_\_\_\_\_

**Lesson 2: Post-Transplant Care**

**EVALUATION**

**Circle the letter that corresponds to the best answer.**

1. When staking a tree, what is characteristic of a girdled trunk?
  - a. Has been tied too tightly
  - b. Is below the top of the stake
  - c. Needs to be wrapped tighter
  - d. Provides support for the plant
2. Why is staking done?
  - a. To protect the bark of the tree
  - b. To support trees of six inches diameter and above
  - c. To anchor the roots until they are established
  - d. To reduce the leaf portion to be in balance with the roots
3. What should be considered when staking or guying a tree?
  - a. The tree should be anchored tightly enough that it cannot move.
  - b. The rootball should move but the branches should not.
  - c. The rootball should be the only part that does not move.
  - d. The tree should be able to bend slightly when the wind blows.
4. What degree should the angle of the wires to the ground be when guying a tree?
  - a. 15°
  - b. 45°
  - c. 65°
  - d. 90°
5. When guying a tree, where should the stakes in the ground be?
  - a. Angled away from the tree
  - b. Angled towards the tree
  - c. Straight up
  - d. At right angles to the tree
6. Where should the protective collar be placed, when guying a tree?
  - a. Below the third set of branches
  - b. Above the second set of branches
  - c. Below the first set of branches
  - d. Above the first set of branches

7. How tall should stakes be for staking a tree?
  - a. As tall as the tree
  - b. One-third the height of the tree
  - c. One-half the height of the tree
  - d. Two-thirds the height of the tree
8. Where should a tree-wrap begin on a tree?
  - a. At the top of the tree trunk
  - b. Below the first set of branches
  - c. At the bottom of the tree trunk
  - d. At the midpoint of the tree trunk
9. When should paper wrapping be removed from a tree?
  - a. After one month
  - b. After six months
  - c. After one year
  - d. Never
10. How often should anti-transpirants be used?
  - a. Every week
  - b. Every month
  - c. Every year
  - d. Only when necessary if moving trees in hot weather or during a drought
11. What pruning procedure should be taken after a tree is transplanted?
  - a. Always prune.
  - b. Prune if it was not recently pruned in the nursery.
  - c. Never prune.
  - d. Prune one-half of its top growth.

Lesson 2: Post-Transplant Care

Job Sheet 2.1: Staking a Tree

**Objective:** Upon completion of this job sheet, the student will be able to stake young trees.

**Note:** This job sheet should be done in conjunction with Unit VI, Lesson 1, Job Sheets 1.2 through 1.4.

**Materials and Supplies Needed:**

1. Two - 2" x 2" stakes - (The length depends on the size of the tree. They should be 18" deep in the ground, and no higher than two-thirds the height of the tree.)
2. Wires in protective covering (garden hose pieces)
3. Hammer

**Procedure:**

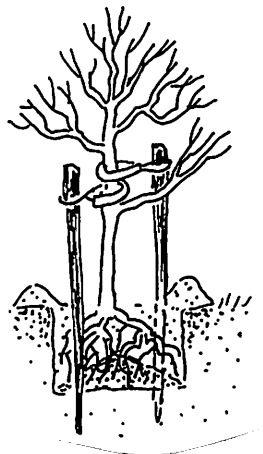
1. When the planting hole is half full of soil, drive in the stakes into the undisturbed soil beneath the rootball, and parallel to the tree trunk.

**NOTE:** A tree already growing may also be used.

2. Fill in the remainder of soil.

**Note:** If stakes are inserted after the tree is planted, avoid sticking the stakes through the rootball.

3. Loop the wires around the tree trunk and attach them to the stakes within two inches of the top of the stake.





## Lesson 2: Post-Transplant Care

## Job Sheet 2.2: Guying a Tree

**Objective:** Upon completion of this job sheet the student will be able to guy wire a tree.

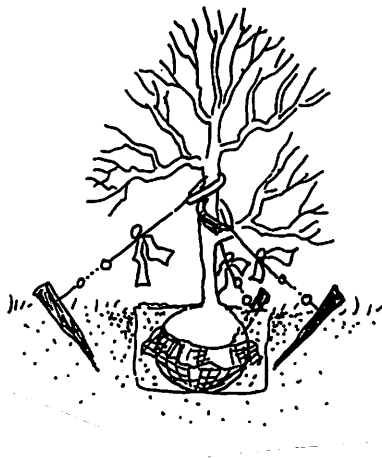
**Materials and Supplies Needed:**

1. Guy wires
2. 3-4 compression springs (or turnbuckles)
3. Reinforced material or rubber hose for trunk protection
4. 3-4 pins with looped ends
5. 3-4 six- to eight-inch stakes
6. Reflective flags

**Note:** A tree guying kit can be purchased instead of obtaining individual supplies.

**Procedure:**

1. Attach wire with protective covering around the tree trunk just above the first set of branches.
2. Attach pins to the ends of the wires.
3. Stretch the wires so they form a 45° angle from the trunk of the tree to the ground in order to measure for the location of the stakes.
4. Insert stakes in the ground seven inches deep angling away from the tree. Be sure they are low enough not to interfere with mowing.
5. If turnbuckles are used, tighten them snugly.
6. Tie reflective flags midway up the wire.



Lesson 2: Post-Transplant Care

Job Sheet 2.3: Wrapping a Tree

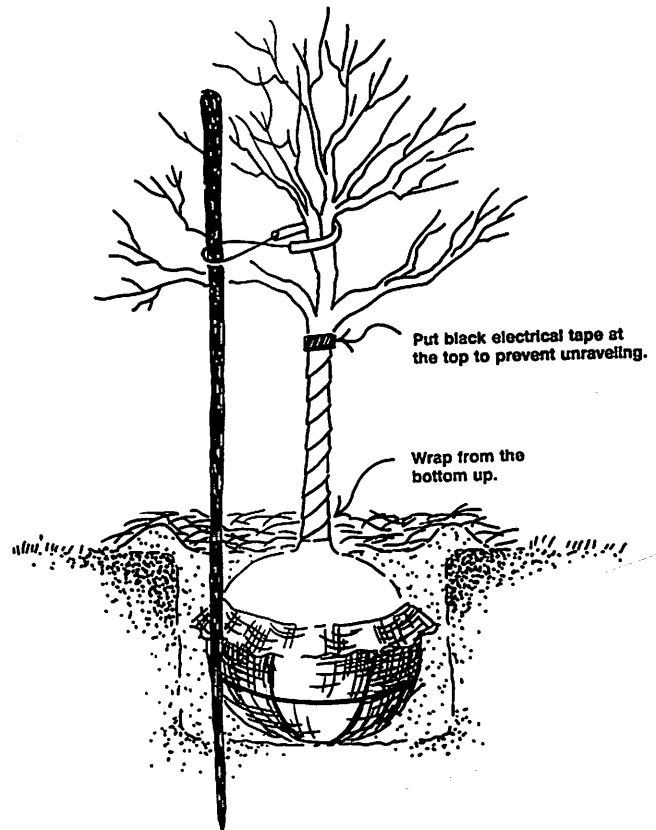
Objective: Upon completion of this job sheet, the student will be able to wrap a tree.

Materials and Supplies Needed:

1. A tree to wrap
2. Tree wrap
3. Twine or electrical tape

Procedure:

1. Beginning at the base of the trunk at ground level, spiral the wrap upward overlapping about one-half the width of the material.
2. Wrap to the first limb.
3. Fasten the wrap at the first limb by spiralling twine around the trunk in the opposite direction, or securing it with electrical tape.



## UNIT VI - INSTALLATION AND MAINTENANCE OF TREES AND SHRUBS

### Lesson 3: Pruning

**Objective:** The student will be able to prune evergreens, deciduous trees, shrubs, hedges, and roses.

#### Study Questions

- 1. What are the purposes of pruning?**
- 2. What are the plant's responses to pruning?**
- 3. How do the two types of pruning cuts affect the appearance and determine the growth habit of plants?**
- 4. What are the proper procedures for pruning branches?**
- 5. How do pruning procedures differ when pruning evergreen trees, deciduous trees, flowering shrubs, and hedges?**
- 6. What are the pruning procedures for roses?**

#### References

1. Landscaping and Turf Management. (Student Reference) University of Missouri-Columbia: Instructional Materials Laboratory, 1990.
2. Work Sheet
  - a) WS 3.1: Pruning Cuts
3. Job Sheet
  - a) JS 3.1: Making Pruning Cuts

## UNIT VI - INSTALLATION AND MAINTENANCE OF TREES AND SHRUBS

### Lesson 3: Pruning

#### TEACHING PROCEDURES

##### A. Review

Review the previous lesson.

##### B. Motivation

Pruning should begin just after the proper plant is selected for a site and it has been carefully planted. The first few years of a tree's life is indicative of the health of the tree. Proper pruning when a tree is young will help ensure a healthy tree when it is mature.

##### C. Assignment

##### D. Supervised study

##### E. Discussion

1. When a tree is in the forest in its natural surroundings, nature has ways to groom and protect the tree. A tree's neighbors help protect it from strong wind, prune its lower branches, and help it form a shapely crown. When a tree is planted in an open lawn, it must fend for itself unless it is helped by pruning.

#### **What are the purposes of pruning?**

- a) Increases survival rate when planting
- b) Alters size and shape of tree
- c) Corrects undesirable growth
  - 1) Crossing branches
  - 2) Weak, narrow, crotches
  - 3) Multiple leaders
  - 4) Water sprouts
- d) Removes low-hanging branches or ones that interfere with traffic
- e) Reduces heavy fruit load
- f) Reduces size of the plant
- g) Invigorates new growth
- h) Removes old, weak, wood; broken or dying branches caused by
  - 1) Excess shading
  - 2) Insects
  - 3) Diseases
  - 4) Mechanical injury
  - 5) Lightning injury
  - 6) Air pollution
  - 7) Root damage caused by
    - (a) Improper fertilization
    - (b) Drought
    - (c) Excess water
    - (d) Poor soil aeration
    - (e) Soil pollution

(f) Insects and diseases

2. Pruning creates one of three responses: dwarfing, invigoration, or change in growth habit. Ask the students to try to explain why a tree pruned early in the season shortly looks three times as big as it was.

**What are the plant's responses to pruning?**

- a) Dwarfing - overall size is reduced
  - b) Invigoration - more nitrogen supplied to fewer branches and leaves
  - c) Change in growth habit
    - 1) Apical dominance changed by pruning, causing lateral branches to grow
    - 2) Desirable in shrubs and hedges; not conifers and some deciduous trees
3. Try to get the students to understand the difference between "heading back" and "thinning out". "Thinning out" implies the branch is being completely taken out and in "heading back" is simply being trimmed back. Have students complete WS 3.1.

**How do the two types of pruning cuts affect the appearance and determine the growth habit of plants.**

- a) "Heading back" - cuts back part of the branch or limb
    - 1) Light cut
      - (a) Stimulates buds near cut
      - (b) Grows the direction the bud faces
    - 2) Heavy cutting - latent or buds further down are stimulated
    - 3) Creates a bushier, fuller looking plant
    - 4) Shearing - removes only tips of stem
      - (a) Hedges
      - (b) Formal look
      - (c) Dense foliage at outer extreme; bare on inside
  - b) "Thinning out" - removes entire shoot or branch
    - 1) Can remove a branch back to another branch
    - 2) Can remove entire shoot down to the ground
    - 3) Can create a more open, simplified look
4. Emphasize to the students that making an improper pruning cut can be more detrimental to a tree or shrub than not making a cut at all. An improper cut may take longer to heal, thus allowing greater susceptibility to pests and diseases. Have students complete JS 3.1. The instructor should demonstrate the procedure first.

**What are the proper procedures for pruning branches?**

- a) Pruning cut
  - 1) Cut one-fourth inch above the bud at a 45° angle.
  - 2) Use pruning shears.
  - 3) Never leave a stub.
- c) Smaller branches
  - 1) Use pruning shears or lopping shears.
  - 2) Place blade against the tree with hook to the outside.
  - 3) Cut flush with main trunk.
  - 4) Use a pruning saw for tight spaces.
    - (a) Make the first cut on the underside.
    - (b) Make the second cut on the upper side, making the cuts meet.

- d) Larger limbs
    - 1) Use a pruning saw.
    - 2) Make a three-part cut.
      - (a) Cut half way through the under side of the limb, three to four inches out.
      - (b) Cut half way through the upper side of the limb, three to four inches out from the first cut.
      - (c) With the third cut, remove most of the stub. Make the cut outside the wrinkled bark, which is the callus layer, on the upper side.
    - 3) Use sharp pruning shears when shearing hedges.
    - 4) Dress wounds over one and one-half inches wide with tree paint immediately after wound is made.
5. Point out to the students that each different type of tree or shrub has individual pruning requirements. They must know the flowering process of shrubs or else they might remove the flowering buds for the next season. A client will not be happy if this is done.

**How do pruning procedures differ when pruning evergreen trees, deciduous trees, flowering shrubs, and hedges?**

- a) Evergreen plants
  - 1) Whorl-branching (pine, fir, spruce, hemlock)
    - (a) Prune back to a lateral branch or a bud.
    - (b) On pines, pinch back candles to promote closer whorls.
    - (c) On spruces, cut half of the terminal shoot to close open spaces.
    - (d) Avoid damage to central leader or train a lateral to replace it if this happens.
    - (e) Never cut back to bare wood.
  - 2) Random - branching (juniper, yew, arborvitae)
    - (a) Prune almost anytime with severe pruning in April.
    - (b) Cut back long branches to a junction with a lateral.
    - (c) Prune in early spring.
    - (d) Make cuts "back in."
    - (e) Do not cut back junipers and arborvitae to bare wood.
    - (f) Yews can be cut back to an almost bare stub.
- b) Very young deciduous trees
  - 1) Pruning
    - (a) Determine the use of a tree in a landscape.
    - (b) Direct its growth habit.
    - (c) Correct structural weakness.
  - 2) Choose scaffold branches.
  - 3) Leave temporary branches on until caliper is two to three inches.
  - 4) Prune to regain central leader.
- c) Young to medium-age deciduous trees
  - 1) Remove branches with angles narrower than 45°.
  - 2) Choose scaffold branches.
    - (a) Leave branches 18 - 24 inches apart.
    - (b) Choose those spaced as well as possible around trunk.
    - (c) Leave more than needed the first year, and choose the strongest the second year.
  - 3) Choose well-placed branches.
  - 4) "Head back" branches that are larger than the one to which they are attached.
- d) Mature trees
  - 1) Not much pruning is needed, if well-maintained when younger.
  - 2) Do maintenance pruning; removing broken, dead, diseased, and crossing

- branches.
  - 3) Thin, to open canopy.
  - 4) Topping, heading, or stubbing should be done only when absolutely necessary.
  - 5) Pruning large trees is dangerous without proper equipment.
  - e) Ornamental deciduous trees
    - 1) They can be pruned throughout the whole year.
    - 2) Early spring is best for pruning.
      - (a) One can see all the branches.
      - (b) Buds are swelling.
    - 3) Summer pruning is sometimes done.
      - (a) It is a landscaper's slow time.
      - (b) One may not see all the branches through the leaves.
    - 4) Fall pruning may leave a tree susceptible to winter injury.
    - 5) Winter pruning is sometimes done.
      - (a) It is a landscaper's slow time.
      - (b) Winter injury is possible.
  - f) Shrubs
    - 1) Spring, flowering shrubs bloom from buds produced the previous season.
      - (a) Prune immediately after flowering.
      - (b) Remove weak growth; broken, diseased, and crossing branches first; using pruning shears.
      - (c) Remove older canes as needed; one-third to one-fourth of the canes each year, using lopping shears.
      - (d) Some shrubs bloom on wood older than one year old, so never prune excessively.
    - 2) Summer, flowering shrubs bloom from buds produced the current season.
      - (a) Prune anytime before growth starts in the spring.
      - (b) Prune with same methods as spring, flowering shrubs.
  - g) Hedges
    - 1) Prune often to keep in shape; anytime during the year.
    - 2) Prune wider at the base than the top.
    - 3) Hedges can be sheared but heading back looks more natural and informal.
6. Point out to students that roses require special pruning procedures according to climate and type of rose.

**What are the pruning procedures for roses?**

- a) Newly-established
  - 1) Do not cut flowers until fall of the first year.
  - 2) Leave two leaves on the stem.
  - 3) Do light, fall pruning and more thorough pruning in the spring.
- b) Hybrid teas, floribunda, and grandiflora
  - 1) In the fall, remove only the tops of the branches that catch in the wind.
  - 2) Remove not less than 18 inches, unless winter kills them.
- c) Climbing roses
  - 1) Prune in late spring immediately after flowering.
  - 2) Remove old canes past flowering close to base.
- d) Climbing hybrid teas and other everblooming climbers
  - 1) Do little or no pruning for the first two to three years.
  - 2) Prune only to shape and remove dead canes.
  - 3) Prune late in the dormant period as buds break.
  - 4) Leave only two to three major canes.
  - 5) Allow new ones to develop.

- 6) Remove old canes close to ground level.
- 7) Keep two to three main canes.
- e) Procedures for all roses
  - 1) Remove all dead wood.
  - 2) Remove diseased, broken, or injured wood.
  - 3) Remove shoots from the base that are not from the main plant.
  - 4) Remove crossing branches through the center of the plant or those that rub.
  - 5) Prune to enhance the shape of the plant.
  - 6) Remove branches to allow good air movement through the plant.
  - 7) Make cuts one-fourth inch above a strong bud facing the outside.
  - 8) Cover large cuts with pruning wound dressing.
  - 9) Make cuts clean and smooth by using sharp pruning shears.

**F. Other activities**

1. Obtain permission to prune the landscape plants outside school. Practice identifying what types of cutting needs to be done. Practice making proper cuts according to the procedure in the student reference. The students should know what tools should be used for each cut.
2. Take students on a field trip to practice identifying pruning cuts that need to be made.

**G. Conclusion**

Being able to identify the pruning cuts that need to be made, and then making the pruning cuts correctly, are the two keys to maintaining healthy trees and shrubs.

**H. Competency**

Prune trees, shrubs, hedges, and roses.

**I. Answers to Evaluation**

1. b
2. a
3. a
4. b
5. b
6. c
7. c
8. c
9. d
10. b
11. a
12. up to discretion of instructor

**J. Answers to Work Sheet 3.1**

1. a, b, e, f, g, j, m, o
2. d, e, f, g
3. b, c, h, i, j



EVALUATION

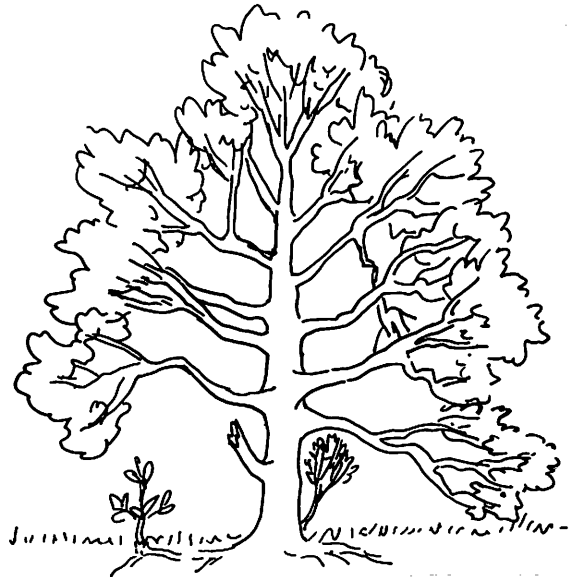
Circle the letter that corresponds to the best answer.

1. Where should a "heading back" cut be made when pruning a small branch?
  - a. In between the buds
  - b. Just above the bud
  - c. Just below the bud
  - d. Through the bud
2. Where do watersprouts grow?
  - a. Along horizontal branches
  - b. At the base of the tree
  - c. At the ends of branches
  - d. From terminal buds
3. When should spring flowering shrubs be pruned?
  - a. After they flower
  - b. Every two years
  - c. Just before they flower
  - d. When they are dormant
4. Where do tree suckers grow?
  - a. Along horizontal branches
  - b. At the base of the tree
  - c. At the ends of branches
  - d. From the terminal buds
5. How should shrubs be sheared into hedges?
  - a. The same width at the top and bottom
  - b. Wider at the bottom
  - c. Wider at the top
  - d. Vase-shaped
6. When can plant wounds be treated?
  - a. In the spring or early summer
  - b. After the wounds start to heal
  - c. As soon as they are made
  - d. When the plant is dormant

7. Where is the first cut made when making a three-part cut?
  - a. Lower side of the branch one to two inches away from the trunk
  - b. Upperside of the trunk one to two inches away from the trunk
  - c. Lower side of the branch three to four inches away from the trunk
  - d. Upper side of the branch three to four inches away from the trunk
8. Where should the blade be placed when pruning a branch with lopping shears?
  - a. Close to the trunk on the lower side
  - b. Away from the trunk on the lower side
  - c. Close to the trunk on the upper side
  - d. Away from the trunk on the upper side
9. Where should the third cut be made when cutting a large limb from a tree?
  - a. As close to the tree as possible
  - b. Halfway between the end of the stub and the trunk
  - c. Close to the trunk on the bottom and away from the trunk on the top of the stub
  - d. Past the wrinkled bark and angled slightly out
10. What is the most desirable angle for branch attachment?
  - a. A very narrow angle
  - b. At right angles or 45° angles
  - c. Hanging down from the trunk at 85°
  - d. Angle does not matter
11. Which of the following is true concerning topping a tree?
  - a. It is unsightly and should only be done if absolutely necessary.
  - b. It should never be done.
  - c. It produces the most beautiful trees.
  - d. It is the most desirable way to prune.

Select the branches that need to be pruned in the following diagram.

12.

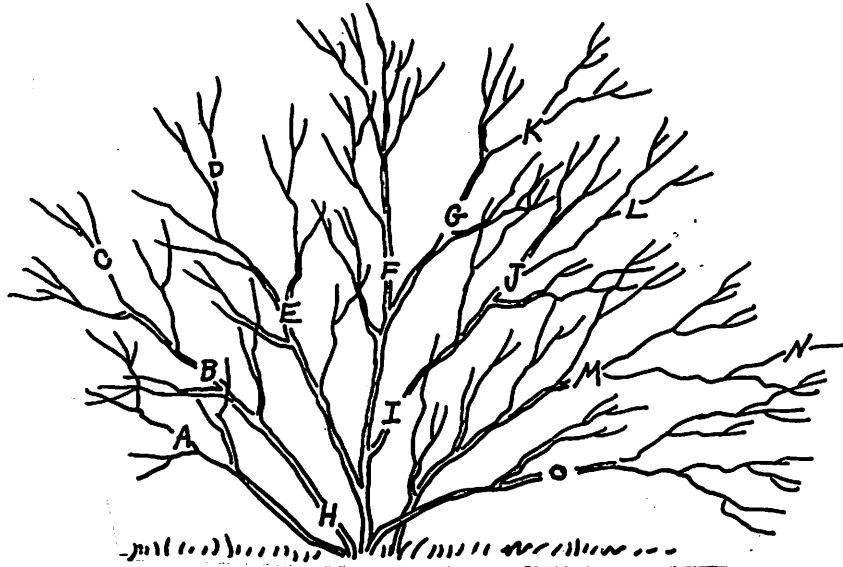


Lesson 3: Pruning

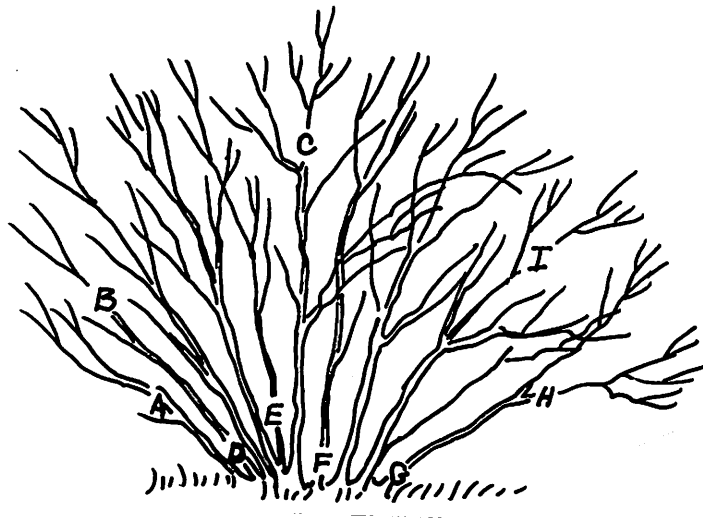
Work Sheet 3.1: Pruning Cuts

Answer the questions below by indicating which lettered branches should be removed.

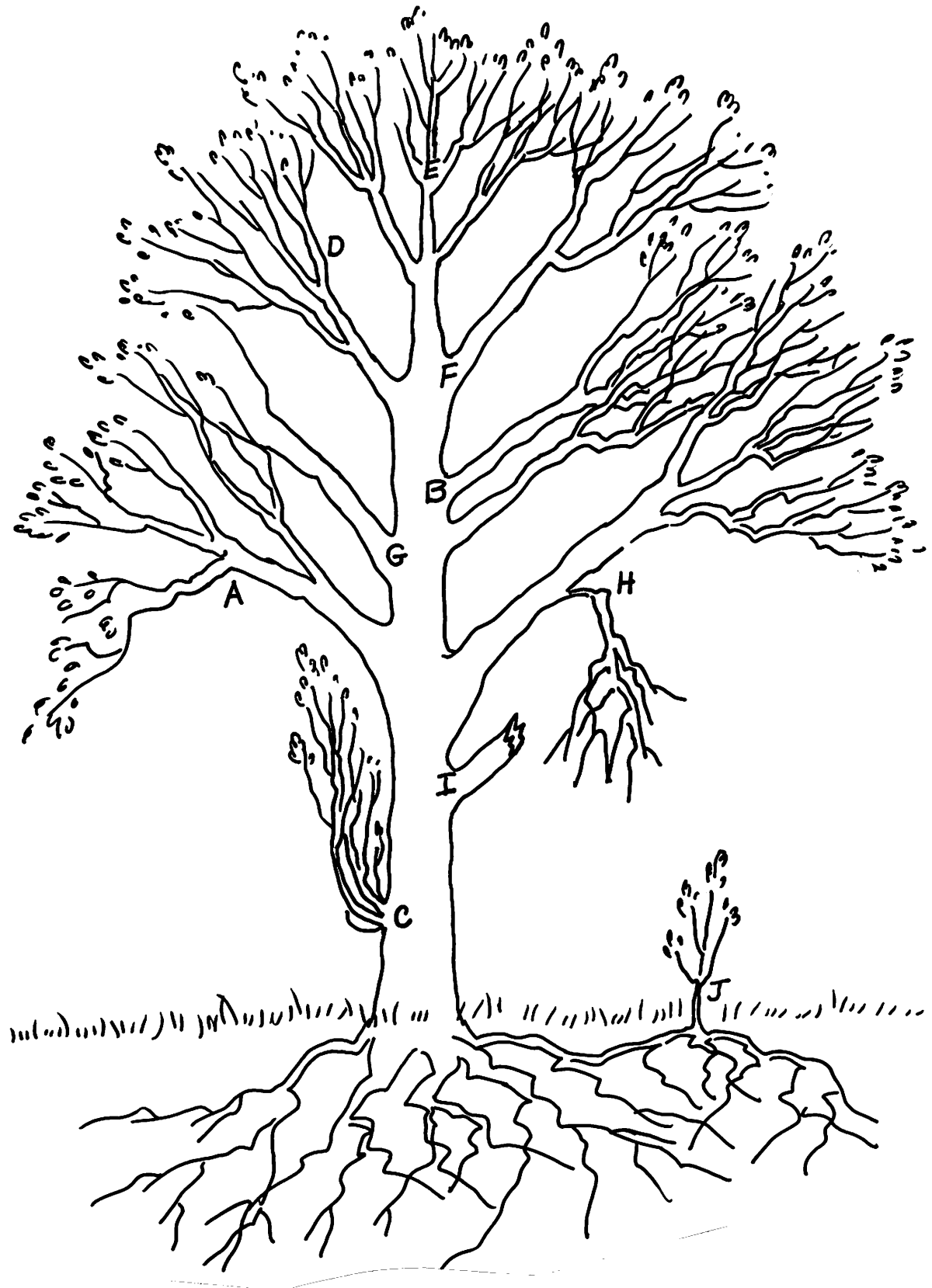
- Which eight branches should be removed to "head back" the shrub pictured below?



- Which five branches should be removed to "thin out" the shrub pictured below?



3. Which five branches should be pruned in the tree pictured below?



## Lesson 3: Pruning

## Job Sheet 3.1: Making Pruning Cuts

**Objective:** Upon completion of this job sheet the student will be able to make a pruning cut used for "heading back." This is for removing a small branch from a tree and removing a large branch from a tree.

**Materials and Supplies Needed:**

1. Hand pruning shears
2. Lopping shears
3. Pruning saw

**Procedures:**

1. "Heading back" using hand pruning shears (Figure 3.1)
  - a. Choose the place to cut. If the bud is facing outward the branch will face outward.
  - b. Make the cut one-fourth inch above the bud at a 45° angle.
2. Removing a small branch using lopping shears. (Figure 3.2)
  - a. Select the branch to be removed.
  - b. Place the lopping shears around the branch with the blade of the shears closest to the main trunk, and the hook below and away from the plant.
3. Removing a small branch using a pruning saw
  - a. Select the branch to be cut.
  - b. Make the first cut below the branch half way through the branch.
  - c. On the upperside of the branch, line the saw up with the lower cut.
  - d. Make the second cut on the upper side of the branch to meet the first, lower cut.
  - e. Be cautious of the falling branch.
  - f. Paint wound with pruning sealer.

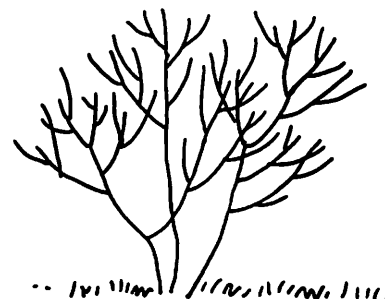


Figure 3.1

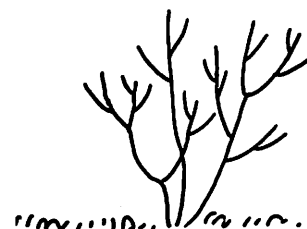


Figure 3.2

4. Removing a larger limb using a pruning saw (Figure 3.3)
  - a. Select the branch to be removed.
  - b. Make the first cut on the under side of the limb three to four inches out from the trunk.
  - c. Make the second cut on the upper side of the limb about one to two inches out from the trunk. The tree limb will fall away. Be cautious of the falling limb.
  - d. Make the third cut to remove the remaining stub. Cut outside the callus layer; do not cut flush with the trunk. A cut that is too close will cause slow healing and chance of disease invasion.

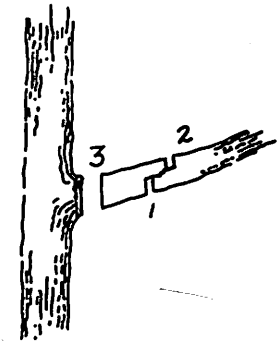


Figure 3.3

## UNIT VI - INSTALLATION AND MAINTENANCE OF TREES AND SHRUBS

### Lesson 4: Fertilizing

**Objective:** The student will be able to explain how to determine the nutrients needed by plants, their function in plants, symptoms of deficiency, and how to use a fertilizer label.

#### Study Questions

1. **Of the sixteen elements essential for proper plant growth, which are macronutrients and which are micronutrients?**
2. **How do these nutrients affect plant growth?**
3. **What are the visible symptoms of nutrient deficiency in plants?**
4. **What information is found on a fertilizer label?**
5. **In what three forms is nitrogen available to plants?**
6. **How does the type of soil and pH affect the absorption of nutrients to the plant?**
7. **In what ways can nutrient needs be determined for plants?**
8. **What are the benefits of fertilizing trees and shrubs?**
9. **What are three types of fertilizer?**
10. **What are the methods of applying fertilizer?**
11. **When should trees be fertilized?**
12. **What is the formula for figuring fertilizer cost?**

#### References

1. Landscaping and Turf Management (Student Reference). University of Missouri-Columbia: Instructional Materials Laboratory, 1990.
2. Transparency Master
  - a) TM 4.1: Fertilizer label
3. Work Sheet
  - a) WS 4.1: Fertilizer Calculations
4. Job Sheet
  - a) JS 4.1: Fertilizing a Tree Using the Soil Incorporation Method

## UNIT VI - INSTALLATION AND MAINTENANCE OF TREES AND SHRUBS

### Lesson 4: Fertilizing

#### TEACHING PROCEDURES

A. Review

Review previous lesson.

B. Motivation

Nutrients are essential for proper plant growth. Being able to diagnose and treat a nutrient deficiency, is necessary when maintaining a landscape.

C. Assignment

D. Supervised study

E. Discussion

1. Ask students to list the elements they think a plant needs for good growth. List them on the board. Write the mnemonic device on the board and explain. ("C. Hopkins Cafe managed by mine cousins Mo and Cleo).

**Of the sixteen elements essential for proper plant growth, which are macronutrients and which are micronutrients?**

a) Macronutrients

- 1) Carbon (C)
- 2) Hydrogen (H)
- 3) Oxygen (O)
- 4) Phosphorous (P)
- 5) Potassium (K)
- 6) Nitrogen (N)
- 7) Sulphur (S)
- 8) Calcium (Ca)
- 9) Magnesium (Mg)

b) Micronutrients

- 1) Iron (Fe)
- 2) Boron (B)
- 3) Manganese (Mn)
- 4) Copper (Cu)
- 5) Zinc (Zn)
- 6) Molybdenum (Mo)
- 7) Chloride (Cl)

2. Ask the students to give the function of each nutrient needed. List them on the board. (See Chart.)

**How do these nutrients affect plant growth?**

a) Role of phosphorus in plant growth



- 1) Stimulates root formation and growth
- 2) Gives a rapid and vigorous start to plants
- 3) Essential to energy transfer
- 4) Hastens maturity
- 5) Stimulates blooming
- 6) Promotes disease resistance
- b) Role of potassium in plant growth
  - 1) Promotes increased vigor and disease resistance to plants
  - 2) Essential to the formation and transfer of starches, sugars, and oils
  - 3) Promotes enzyme activation
- c) Role of nitrogen in plant growth
  - 1) Induces rapid vegetative growth
  - 2) Necessary for chlorophyll manufacture
  - 3) Produces a healthy, green color
  - 4) Important to synthesis and structure of protein molecules
- d) Role of sulphur in plant growth
  - 1) Encourages more vigorous growth
  - 2) Promotes root growth
  - 3) Essential to the formation of some proteins
- e) Role of calcium in plant growth
  - 1) Improves general plant vigor
  - 2) A component of the cell wall
  - 3) Needed for cell division
  - 4) Promotes early root formation and growth
  - 5) Influences the absorption of other plant nutrients
- f) Role of magnesium in plant growth
  - 1) Aids in the transport of phosphorus
  - 2) Influences absorption of other plant nutrients
  - 3) Aids in translocation of starch
- g) Role of iron in plant growth
  - 1) Acts as an electron carrier in enzyme systems that cause oxidation to occur
  - 2) Essential to chlorophyll production
- h) Role of boron in plant growth
  - 1) Influences water absorption
  - 2) Aids in translocation of sugar
- i) Role of manganese in plant growth
  - 1) Essential in plant metabolism
  - 2) Essential for certain nitrogen transformations in plants
- j) Role of copper in plant growth
  - 1) Acts as an electron carrier in enzyme systems
  - 2) Involved in plant respiration
  - 3) Aids in utilizing iron
  - 4) Needed for photosynthesis
- k) Role of zinc in plant growth
  - 1) Important to plant metabolism
  - 2) Involved in the formation of some growth hormones
  - 3) Involved in the reproduction processes of certain plants
  - 4) Important to protein synthesis
- l) Role of molybdenum in plant growth
  - 1) Essential to plant development and reproduction
  - 2) Acts as an electron carrier in enzyme systems which bring about oxidation reduction reaction in plants
  - 3) Does not take place in the absence of micro-nutrients
- m) Role of chlorine in plant growth

- 1) Affects root growth, but little more is known about effect on plants
  - 2) More likely to be toxic than deficient
3. Ask the students to name the nutrient deficiencies found in plants. List them on the board. (See chart.)

**What are the visible symptoms of nutrient deficiency in plants?**

- a) Deficiency symptoms of phosphorous
  - 1) Slow growth and maturity
  - 2) Purplish leaves, stems, and branches
  - 3) Stunting of growth
  - 4) Premature leaf drop
- b) Deficiency symptoms of potassium
  - 1) Mottling, spotting, streaking, or curling of leaves
  - 2) Leaves scorched on the margins or tips
  - 3) Burning at tip of leaf and proceeding downward
- c) Deficiency symptoms of nitrogen
  - 1) Sickly yellow-green color
  - 2) A distinct, slow and stunted growth
  - 3) Drying up or burning of leaves which starts at the bottom of the plant and proceeds upward; drying starts at the top of the bottom leaves and proceeds down the center along the mid-rib
  - 4) Increased fall color
- d) Deficiency symptoms of sulphur
  - 1) Young leaves light-green with even lighter veins
  - 2) Stalks short and slender
  - 3) Plant growth slow and stunted
- e) Deficiency symptoms of calcium
  - 1) Young leaves in terminal bud hooked in appearance, then die at the tips and along the margin
  - 2) Roots short and branched
  - 3) Leaves have wrinkled appearance
  - 4) Exhibits deficiency symptoms of other nutrient deficiencies, since the proper balance of calcium influences absorption of other nutrients.
- f) Deficiency symptoms of magnesium
  - 1) Loss of green color starting in the bottom leaves and later moving up the stalk - veins remaining green
  - 2) Slender and weak plant stem
  - 3) Mottled leaves
  - 4) Leaf tips turned or cupped upward
- g) Deficiency symptoms of iron
  - 1) Mottled young leaves, principal veins remain green
  - 2) Short and slender stalks
- h) Deficiency symptoms of boron
  - 1) Young leaves of terminal buds light-green at base, scorched bronze or red color
  - 2) In later growth, leaves twisted and stalk dries back to the terminal bud
  - 3) Stunted roots
  - 4) Stems cracked, brown inside
- i) Deficiency symptoms of manganese
  - 1) Spots of dead tissue scattered over leaves
  - 2) The smallest veins green producing a checkered effect
  - 3) Leaves limp and curled
- j) Deficiency symptoms of copper

- 1) Young leaves permanently wilted spotting or mottling only at tip
  - 2) The twig or stalk just below tip and seed head becomes weak
  - k) Deficiency symptoms of zinc
    - 1) Leaf spots in areas between veins and eventually secondary and even primary veins
    - 2) Leaves thick, small, pointed, and narrow
    - 3) Internodes short
  - l) Deficiency symptoms of molybdenum
    - 1) Leaves similar in color to those deficient in nitrogen (sickly, yellow-green)
    - 2) Marginal scorching and rolling with reduced width
    - 3) Short internodes with severe deficiency
    - 4) Flowers few and small with severe deficiency
  - m) Deficiency symptoms of chlorine - usually not deficient - no sign known
4. Show TM 4.1: Fertilizer Label. Ask the students to explain what each of the items are.

**What information is found on a fertilizer label?**

- a) Analysis
  - b) Ratio
    - 1) Low analysis
    - 2) High analysis
    - 3) Relative proportion
  - c) Fertilizer formula
  - d) Types of fertilizer
    - 1) Organic
    - 2) Dry inorganic
    - 3) Liquid inorganic
5. Humans need nutrients and minerals to keep their bodies healthy. Minerals are available in the form of rocks. Humans are unable to use a mineral in rock form. It must be broken down into small particles and absorbed by plants. People eat the plants to absorb needed minerals. Plants are similar in how they absorb nitrogen. The nitrogen must be in a form that the roots can absorb.

**In what three forms is nitrogen available to plants?**

- a) Sodium nitrate
    - 1) Highly soluble
    - 2) Lowers pH
    - 3) Organic
  - b) Ammonium nitrate
    - 1) Less soluble
    - 2) Lowers pH
  - c) Urea formaldehyde
    - 1) Soluble, but slow to release
    - 2) Lowers pH
    - 3) Organic
6. Refer the student to the pH availability figure in Unit II. If more and more fertilizer is applied to a plant and it still looks deficient in nutrients, it is because the pH is inhibiting the absorption of nutrients. Money is wasted on fertilizer if the pH will not let it be absorbed.

**How does the type of soil and pH affect the availability of nutrients to the plant?**

- a) Type of soil - clay and silt hold more nutrients
  - b) pH
    - 1) If too high or low, it can tie up nutrients.
    - 2) To lower pH use the following.
      - (a) Aluminum sulphate
      - (b) Sulphur
      - (c) Iron sulphate
    - 3) To raise pH use the following.
      - (a) Calcium (gypsum)
      - (b) Lime
    - 4) Be aware that one pH-altering substance can make some nutrients toxic, while making others unavailable.
7. Have students take a soil sample. Prepare it to send to the local county extension agent for analysis. Use UMC Guide 9109 "Submitting a Soil Sample for Testing". Ask the agent about having a foliar nutrient test done. Guide sheet 9110 "Sampling Your Soil for Testing" will be helpful for taking the sample. Guide 9111 "Using Your Soil Test Results" will be helpful in interpreting the results.

**In what ways can nutrient needs be determined for plants?**

- a) Signs of low nutrition
    - 1) Poor tree growth
    - 2) Pale green or yellow leaves
    - 3) Mottled patterns between veins
    - 4) Dead spots
    - 5) Stunted leaves or early loss of leaves
  - b) Measure tree growth
    - 1) Current season growth - from tip to first set of bud scale scars
    - 2) Previous season growth - the distance between these bud scale scars and the next set down
  - c) General tree vigor determined by measuring several twigs during past 3-4 years
8. Fertilizers are great to pick up where nature left off. All the nutrients a plant needs are not always found in the soil. Supplementing with fertilizer helps ensure that the life of a tree will be a long and healthy one. It is similar to the reason humans take vitamins, to ensure they get all the nutrients they need to stay healthy.

**What are the benefits of fertilizing trees and shrubs?**

- a) Improves the overall vigor
  - b) Makes leaves grow larger and darker green
  - c) Encourages rapid growth of young trees
  - d) Maintains general health of landscape plants
  - e) Makes plants less susceptible to certain pests and diseases
  - f) Prevents further decline
9. The type of fertilizer used depends on how often landscaper want or can make application. The liquid or water soluble fertilizers last the shortest amount of time. The slow release fertilizers tend to last the longest but are also more expensive. Landscapers have to determine what is more expensive; the fertilizer or the labor it takes to supply it.

**What are three types of fertilizer?**

- a) Dry
- b) Liquid
- c) Organic

10. Have the students fertilize an established tree on the school campus. Use JS 4.1.

**What are the methods of applying fertilizer?**

- a) Surface application
- b) Soil incorporation
- c) Follar sprays
- d) Fertilizer spikes and slow release pellets

11. Just as humans eat when they are the most hungry; trees should be fertilized when they most need it; when they are rapidly growing.

**When should trees be fertilized?**

- a) When rapidly growing
- b) Nitrogen - two weeks before spring growth
- c) Do not fertilize in late summer
  - 1) Results in winter damage
  - 2) Better fall color
- d) Follar sprays - after a few leaves reach mature size

12. Have the students complete WS 4.1. Estimating Fertilizer Cost

**What is the formula for figuring fertilizer cost?**

$$\begin{array}{ccccccc} \text{(A)rea} & & \text{(R)ate} & & \text{(N)utrient analysis} & & \\ 400 \text{ square feet} & \times & \frac{1 \text{ pound Nitrogen}}{1,000 \text{ square feet}} & \times & \frac{100 \text{ pounds fert.}}{10 \text{ pounds of N of fert.}} & = & 4 \text{ lbs} \end{array}$$

N= Nitrogen

**F. Other Activity**

Take the students on a field trip to identify as many nutrient deficiencies as possible in the plants they see. Have them recommend a nutrient that would correct the deficiency.

**G. Conclusion**

The macronutrients nitrogen, phosphorus, and potassium are the three most important nutrients to plants. Micronutrients are also essential, but in lesser amounts. All plants benefit from fertilizer applications.

**H. Competency**

Fertilize trees and shrubs.

I. Answers to Evaluation

1. c
2. a
3. c
4. d
5. c
6. b
7. a
8. c
9. a
10. c
11. a
12. d
13. b

J. Answers to Work Sheet 4.1

$$1. \quad 165 \text{ sq ft} \times \frac{3 \text{ lbs P}}{1,000 \text{ sq ft}} \times \frac{100 \text{ lbs fert.}}{8 \text{ lbs P}} = \frac{59,400}{8,000} = 7.43 \text{ lbs fert.}$$

$$2. \quad 707 \text{ sq ft} \times \frac{2 \text{ lbs N}}{1,000 \text{ sq ft}} \times \frac{100 \text{ lbs fert.}}{10 \text{ lbs N}} = \frac{141,400}{10,000} = 14.14 \text{ lbs fert.}$$

$$3. \quad 79 \text{ sq ft} \times \frac{3 \text{ lbs N}}{1,000 \text{ sq ft}} \times \frac{100 \text{ lbs fert.}}{10 \text{ lbs fert.}} \times \frac{\$7.99}{10 \text{ lbs N}} = \frac{189,363}{100,000} = \$1.89$$

$$4. \quad 64 \text{ sq ft} \times \frac{1 \text{ lb N}}{1,000 \text{ sq ft}} \times \frac{100 \text{ lbs fert.}}{6 \text{ lbs N}} \times \frac{\$2.25}{5 \text{ lbs fert.}} = \frac{14,400}{30,000} = \$ .48$$

EVALUATION

Circle the letter that corresponds to the best answer.

1. Which are macronutrients for plants?
  - a. Calcium, nitrogen, iron
  - b. Copper, sulphur, boron
  - c. Magnesium, potassium, sulphur
  - d. Phosphorous, potassium, manganese
2. Which are micronutrients for plants?
  - a. Boron, iron, copper
  - b. Chlorine, phosphorus, magnesium
  - c. Manganese, molybdenum, calcium
  - d. Zinc, chlorine, magnesium
3. How many pounds of 11-10-10 fertilizer should be applied to a bed that measures 15 by 75 feet if the desired rate of application is one pound of nitrogen per 1,000 square feet?
  - a. 7.5
  - b. 8.4
  - c. 10.2
  - d. 11.0
4. What may be caused by heavy nitrogen applications to plants?
  - a. Floral initiation
  - b. Lower soluble salts in the soil
  - c. Longer stem internodes
  - d. Vegetative growth
5. In what nutrient is a tree deficient when the leaves, stems, and branches turn a purplish color?
  - a. Iron
  - b. Nitrogen
  - c. Phosphorus
  - d. Potassium
6. What nutrient is deficient in a tree that has a sickly, yellow-green, leaf color, is slow growing, and the bottom leaves are browning?
  - a. Iron
  - b. Nitrogen
  - c. Phosphorous
  - d. Potassium

7. What will heavy phosphorous applications to plants cause?
- a. Floral initiation
  - b. Lower soluble salts in the soil
  - c. Longer stem internodes
  - d. Vegetative growth
8. What ratio does the fertilizer analysis 10-15-5 have?
- a. 1-1-1
  - b. 3-4-2
  - c. 2-3-1
  - d. 2-7.5-2.5
9. What could be mixed with soil to lower the pH?
- a. Aluminum sulphate
  - b. Agricultural lime
  - c. Nitrogen
  - d. Phosphorous
10. When is the best time to fertilize trees?
- a. In the early winter
  - b. In mid-August
  - c. In late winter
  - d. New Year's Day
11. Which of the following is not a reliable way to determine if your tree needs fertilizer?
- a. Bark analysis
  - b. Foliar analysis
  - c. Look at the tree
  - d. Soil test
12. How can tree growth be determined?
- a. By counting bud scale scars
  - b. By counting buds
  - c. By counting the number of leaves on the tree
  - d. By measuring the distance between bud scale scars
13. In what area should fertilizer be applied to trees?
- a. Just around the trunk
  - b. Slightly beyond the branch spread
  - c. Three feet out from the trunk
  - d. Twelve feet out from the trunk



Lesson 4: Fertilizing

Work Sheet 4.1: Fertilizer Calculations

**Complete the following questions.**

1. How many pounds of 6-8-4 fertilizer should be applied to an area 15 x 11 feet if three pounds P (phosphorus) is wanted per 1,000 square feet?
  
  
  
  
  
  
  
  
  
  
2. If the extension agent recommends an application of 10-20-10 fertilizer, at the rate of two pounds N per 1,000 square feet around a tree with a branch spread of 30 foot diameter, how much fertilizer would be needed?
  
  
  
  
  
  
  
  
  
  
3. A ten pound bag of 10-20-10 fertilizer costs \$7.99. what will it cost to apply three pounds of N per 1,000 square feet around a tree with a branch spread of 10 foot diameter?
  
  
  
  
  
  
  
  
  
  
4. The branch spread of a tree is has a 9 foot diameter canopy. How much would it cost to apply 1 pound of N per 1,000 square feet of a 6-8-4 fertilizer that costs \$2.25 per 5 pound bag?

## Lesson 4: Fertilizing

## Job Sheet 4.1: Fertilizing a Tree Using the Soil Incorporation Method

Objective: Upon completion of this job sheet, the student will be able to fertilize a tree.

## Materials and Supplies Needed:

1. Water sprinkler
2. Hose
3. Measuring tape
4. Soil auger or one inch iron rod
5. Measuring cup
6. 2-1-1 or 3-1-1 ratio fertilizer (granular)

## Procedure:

1. Soak the soil beneath the tree the day before the tree will be fertilized, if the soil is not moist.
2. Measure the tree trunk four and one-half feet from the ground. If the tree trunk is less than six inches use one to two pounds of fertilizer per year. If the tree is more than six inches use two to four pounds per year.
3. Calculate the amount of fertilizer by multiplying the tree trunk diameter by the proper rate of fertilizer. Example: four inches x two pounds per year = eight pounds fertilizer needed.
4. With a soil auger or one inch iron rod, drill 10-15 holes for every inch of trunk diameter.
5. Calculate the number of holes needed by multiplying the trunk diameter by the number of holes for each inch. Example: four inches x 15 holes = 60 holes total.
6. The holes should be 12" - 15" deep. Place the holes about two feet apart in concentric circles around the trunk. The inner circle should be two feet away from the trunk. The outer circle should be beyond the diameter of the branch spread.
7. Apply one-fourth to one-half cup of fertilizer to each hole.
8. Calculate exactly how much fertilizer should be applied to each hole by multiplying the number of pounds needed by 16 ounces (16 ounces in a pound) to get the total number of ounces needed. Then divide the number of ounces by the number of holes to get the number of ounces per hole. Then convert ounces to cups by dividing the number of ounces per hole by eight ounces (eight ounces in a cup). The decimal equivalent of one-fourth cup = .25, one-third cup = .33, and one-half cup = .5.  
  
Example:  $8 \text{ pounds} \times 16 \text{ ounces/pound} = 128 \text{ ounces}$   
 $128 \text{ ounces} \div 60 \text{ holes} = 2.13 \text{ ounces per hole}$   
 $2.13 \text{ ounces} \div 8 \text{ ounces/cup} = .266 \text{ cups per hole}$   
 $.266 = \text{slightly over one-fourth cup but not one-third cup}$
9. Soak the area with a lawn sprinkler. The holes may be left open or closed as desired.

## UNIT VI - INSTALLATION AND MAINTENANCE OF TREES AND SHRUBS

### Lesson 5: Irrigation and Drainage

**Objective:** The student will be able to determine when and how much to irrigate and what methods to use.

#### Study Questions

- 1. What factors should be considered when figuring how often and at what rate trees and shrubs should be watered?**
- 2. What makes the watering requirements different for established and newly-planted trees and shrubs?**
- 3. What are the various irrigation systems used when watering trees and shrubs?**
- 4. What irrigation and drainage factors should be considered for trees in landscape planters?**

#### References

- 1. Landscaping and Turf Management (Student Reference). University of Missouri-Columbia: Instructional Materials Laboratory, 1990.**
- 2. Job Sheet**
  - a) JS 5.1: Determining the Amount of Water Applied by a Sprinkler**

## UNIT VI - INSTALLATION AND MAINTENANCE OF TREES AND SHRUBS

### Lesson 5: Irrigation and Drainage

#### TEACHING PROCEDURES

A. Review Unit II, Lessons 2 and 3.

B. Motivation

Supplying enough moisture to a tree is not as easy as one may think. When applying water by hand, it is easy for the person to get tired before the tree gets enough water. Demonstrate watering a tree by hand. Water for one to two minutes then, with a spade, dig down into the soil to show how far the water has penetrated the soil. Probably it only penetrated two to three inches. Explain that most of the feeder roots (the roots that take up the most water) are three feet below the soil surface.

C. Assignment

D. Supervised study

E. Discussion

1. Create this scenario: a student, Joyce, was given a job of keeping a valuable tree alive one summer. Joyce will be paid \$500 at the end of the summer if the tree survives. Ask the students how they would determine how often and how much to water this valuable tree.

**What factors should be considered when figuring how often and at what rate trees and shrubs should be watered?**

- a) Individual plant requirements and age
- b) Weather
  - 1) Temperature
  - 2) Wind
  - 3) Humidity
  - 4) Hours of radiation
- c) Time and amount of last rainfall
- d) Root system
  - 1) Deep and wide spreading, more opportunity for water
  - 2) Shallow roots
    - (a) Only have top three feet of soil to get water from
    - (b) Need water more often
- e) Type of soil
  - 1) Sandy soil holds less water than a clay soil.
  - 2) Water moves more quickly through sand than clay.
  - 3) Plants absorb water between field capacity and wilting point.
  - 4) Water rarely moves sideways.
- f) Watering practices
  - 1) Thorough, but infrequent watering is best.
  - 2) Frequent, light watering causes shallow roots.
  - 3) Frequent, heavy watering causes waterlogged roots.
  - 4) Overwatering leaches out nutrients and drowns roots.
- g) Knowing when to water
  - 1) Signs from plant

- (a) Wilted leaves
    - (b) Change in leaf color, dark-green to gray-green
    - (c) Leaves changed from shiny to dull
  - 2) Evapotranspiration and available moisture
  - 3) Tensiometer
  - 4) Testing soil by feeling
2. Because a baby is smaller than adult, it cannot hold as much food or water as an adult. Therefore, a baby must be fed more often to supply the energy needed to survive. The same idea can be used for a small, newly-planted tree. The root system of a newly-planted tree is small and cannot absorb as much water as a large, established, root system. Therefore, it must be watered more often. A young tree will not handle moisture stress as well as an older, established tree. Since it is smaller it does not hold as much water in reserve as an older tree.

**What makes the watering requirements different for established and newly-planted trees and shrubs?**

- a) Newly-planted trees and shrubs have a very limited root system.
  - b) Established plants have a more extensive root system.
3. Based on time, money, size of land, and water supply; there is a watering system that will work in most situations. Ask the students how they would choose an irrigation system. Have sprinklers, soaker hoses, etc. on hand for the students to look at. Select an area outside and discuss the factors affecting the type of irrigation system needed to maintain it. Have the students complete Job Sheet 5.1.

**What are the various irrigation systems used when watering trees and shrubs?**

- a) Dish or berm
  - 1) Used for newly-transplanted trees
  - 2) As wide as the dripline
  - 3) Water applied by hose, soaker, or built-in bubblers
  - 4) Water not resting against trunk
- b) Furrow
  - 1) Used along a row of trees
  - 2) Fairly level, slight slope for water movement
  - 3) Water applied starting quickly, then diminishing
  - 4) Salt accumulation on top of ridges
- c) Sprinkler
  - 1) Easy to use
  - 2) Not always uniform
  - 3) Water often applied faster than soil can absorb
  - 4) Distribution effects of wind
  - 5) Flower damage
  - 6) Early in day so leaves can dry
  - 7) Measurement by placing cans to catch water
- d) Drip irrigation
  - 1) Cuts waste of water
  - 2) Delivers a small amount at a time to individual plants
  - 3) Distribution is uniform
  - 4) Plant stays dry
  - 5) Takes longer, but wastes little
  - 6) Good for use on slopes
- e) Root irrigator

- 1) Good for slopes
  - 2) Applied directly at the roots
  - 3) 12-18" in the ground
4. A landscape planter is 100% self-contained. The irrigation water, as well as an area for run off, must be provided within the planter. It is easy to overwater trees in planters so a planter must be carefully planned.

**What irrigation and drainage factors should be considered for trees in landscape planters?**

- a) Soil
  - 1) Should drain rapidly
  - 2) Texture and depth most important
  - 3) 50% coarse sand, 50% organic material
- b) Irrigation system
  - 1) Self-contained - low maintenance
  - 2) Low application rate - less overwatering and water waste
- c) Drainage system
  - 1) To handle the maximum amount of extra water
  - 2) Two percent slope on bottom of container
  - 3) Rapid draining of water to bottom
  - 4) Drain tile in the bottom
    - (a) One inch diameter plastic tube
    - (b) Cover with fiber glass filter

**F. Other activity**

Take the students on a field trip to see various irrigation systems in use, or have them recommend types of systems to use in areas visited.

**G. Conclusion**

There are many factors to consider when irrigating trees and shrubs. They must all be carefully evaluated so the proper amount of water requirement can be estimated, and method of irrigation can be decided.

**H. Competency**

Determine the best methods of irrigation in various situations.

**I. Answers to Evaluation**

1. a
2. a
3. d
4. b
5. d
6. c
7. a. x
- b. x
- c.
- d. x
- e.

- 8.
- |    |     |
|----|-----|
| f. |     |
| g. | x   |
| h. |     |
| i. | x   |
| j. | x   |
| k. | x   |
| a. | D,O |
| b. | D,O |
| c. | D   |
| d. | D,O |
| e. | D   |
| f. | O   |
| g. | D   |
| h. | O   |

UNIT VI - INSTALLATION AND MAINTENANCE OF  
TREES AND SHRUBS

Name \_\_\_\_\_

Lesson 5: Irrigation and Drainage

Date \_\_\_\_\_

EVALUATION

Circle the letter that corresponds to the best answer.

1. What is the result of infrequent, thorough watering?
  - a. Deep root system
  - b. Overwatering
  - c. Shallow root system
  - d. Underwatering
2. When is the best time to use sprinklers?
  - a. In early morning
  - b. In late evening
  - c. When temperatures are hot
  - d. When the wind is blowing
3. Where is basin irrigation best used?
  - a. On a grove of trees
  - b. On an older, established tree
  - c. On a row of trees
  - d. On newly-planted trees
4. What is the best irrigation system to use on a steep slope?
  - a. Dish irrigation
  - b. Drip irrigation
  - c. Furrow irrigation
  - d. Sprinkler
5. Which irrigation system should not be used if a tree needs to be watered, but the wind is blowing strongly?
  - a. Basin irrigation
  - b. Drip irrigation
  - c. Furrow irrigation
  - d. Sprinkler
6. What should be avoided when using landscape planters?
  - a. Anchorage
  - b. Fertilizing
  - c. Overwatering
  - d. Underwatering



**Mark an X next to the conditions that increase watering requirements.**

- 7.
- a. ☐ Newly-planted tree
  - b. ☐ Coarse-textured (sandy) soils
  - c. ☐ Fine-textured (clay) soils
  - d. ☐ High temperatures
  - e. ☐ Cool temperatures
  - f. ☐ High relative humidity
  - g. ☐ No mulch used
  - h. ☐ Plants are dormant
  - i. ☐ Grove of trees
  - j. ☐ Low relative humidity
  - k. ☐ Areas along driveways and curbs

**Indicate which of the following symptoms is from a tree deficient in water by marking a "D" in the blank. Mark an "O" in the blank next to the symptoms of overwatering a plant. Place a "D" and "O" in the blank next to those that are symptoms of both.**

- 8.
- a. ☐ Wilting
  - b. ☐ Leaf drop
  - c. ☐ Marginal necrosis
  - d. ☐ Reduced shoot growth
  - e. ☐ Gray-green, purplish leaf color
  - f. ☐ Yellow (chlorotic) look on new leaves
  - g. ☐ Few roots, bright-colored
  - h. ☐ Roots dark and spongy

Lesson 5: Irrigation and Drainage

Job Sheet 5.1: Determining the Amount of Water Applied by a Sprinkler

Objective: Upon completion of this job sheet, the student will be able to determine the amount of water applied by a sprinkler in one hour.

Materials and Supplies Needed:

1. Hose
2. Sprinkler
3. Containers - uniform size with wide, straight sides (number of containers depends on sprinkler area)
4. Ruler

Procedure:

1. Set up sprinkler.
2. Place uniform containers, no more than five feet apart throughout the sprinkler pattern.
3. Turn on water.
4. Operate for one hour (one-half hour if time is limited).
5. Measure the depth of water in inches in each container.
6. Add depths together and divide by the number of containers.
7. The result will be the average amount of water applied in one hour.
8. Answer the following questions.

How long does it take to get one inch of water?

Was the water applied uniformly?

## UNIT VI - INSTALLATION AND MAINTENANCE OF TREES AND SHRUBS

### Lesson 6: Disease and Pest Control

**Objective:** The student will be able to recognize and know control methods for common and destructive insects and diseases.

#### Study Questions

- 1. What are some of the most common and destructive insects and their means of control in Missouri's trees and shrubs?**
- 2. What are some of the most common and destructive diseases and their means of control in Missouri's trees and shrubs?**
- 3. What are the most common noninfectious disorders found in trees and shrubs?**
- 4. How is biological control used as a method to control insects and diseases?**

#### References

1. Landscaping and Turf Management (Student Reference). University of Missouri-Columbia: Instructional Materials Laboratory, 1990.
2. Work Sheets
  - a) WS 6.1: Identifying Plant Insects
  - b) WS 6.2: Identifying Plant Diseases

## UNIT VI - INSTALLATION AND MAINTENANCE OF TREES AND SHRUBS

### Lesson 6: Disease and Pest Control

#### TEACHING PROCEDURES

##### A. Review

Review previous lesson.

##### B. Motivation

Insects and diseases can seriously affect the appearance and value of horticulture crops. Part of landscape maintenance involves recognizing these pests and controlling them.

##### C. Assignment

##### D. Supervised study

##### E. Discussion

1. Discuss the stages of development and morphology (mouth parts) of insects and how they affect the control methods used. See Table 6.1 in the student reference.

**What are some of the most common and destructive plant insects and their means of control in Missouri's trees and shrubs?**

There are many common and destructive plant insects in Missouri, which are usually controlled by their feeding habits.

- a) Insect feeding methods
  - 1) Chewing
  - 2) Rasping-sucking
  - 3) Piercing-sucking
- b) Insect control methods
  - 1) Trap crops
  - 2) Radiation
  - 3) Beneficial Insects
  - 4) Life-cycle interruption
  - 5) Systemic insecticides
  - 6) Contact poisons

2. Explain that diseases do not just happen. They are introduced and are a result of pathogens. Sanitation can keep many diseases under control. See Table 6.2 in student reference.

**What are some of the most common and destructive diseases and their means of control in Missouri's trees and shrubs?**

- a) Diseases
  - 1) Pathogens
    - (a) Bacteria
    - (b) Fungi
    - (c) Viruses

- (d) Nematodes
  - 2) Host
  - 3) Correct environmental conditions
- b) Dissemination of pathogens
  - 1) Insects
  - 2) Splashing water
  - 3) Wind
  - 4) Animals (humans, too)
  - 5) Equipment and tools
- c) Pathogens' infectious stage
  - 1) Fungi spores
  - 2) Virus particle
  - 3) Strand of hyphae
  - 4) Bacterial ooze
- d) Method of pathogen entry
  - 1) Stomata
  - 2) Cuts
  - 3) Wounds
  - 4) Blossoms
  - 5) Roots
  - 6) Fruit
- e) Symptoms of diseases
  - 1) Wilting
  - 2) Color changes
  - 3) Rotting
  - 4) Death of tissue
  - 5) Increase in size (from malformed parts)
  - 6) Tunneling
  - 7) Holes
- f) Degrees of control
  - 1) Partial
  - 2) Absolute
  - 3) Profitable
- g) Control types and methods
  - 1) Prevention
    - (a) Pest-free stock
    - (b) Certified seeds
    - (c) Resistant varieties
    - (d) Cultural practices
    - (e) Sanitation
    - (f) Plant quarantines
    - (g) Chemical pesticides
  - 2) Suppression
    - (a) Sanitation
    - (b) Moisture modification
    - (c) pH modification
    - (d) Nutrient modification
    - (e) Chemical pesticides
    - (f) Biological control
  - 3) Eradication
    - (a) Hand pull weeds and cultivation
    - (b) Destruction of alternate host
    - (c) Crop rotation and soil treatment
    - (d) Remove rotten materials

- (e) Isolation or destruction of plant host
  - (f) Chemical pesticides
- 3. Take students on a field trip to look for any signs of plant pests, diseases, or noninfectious disorders that may be present. Have the students complete WS 6.1 and WS 6.2. Plants can be seriously damaged by disorders that are not only caused by insects or disease, but by natural occurrences and human error, as well.

**What are the most common noninfectious disorders found in trees and shrubs?**

- a) Soil or root problems
    - 1) Soil covering not allowing water or air to penetrate
    - 2) Toxic gases
    - 3) Damaged roots from construction
    - 4) Drought
    - 5) Girdling of roots or trunk
    - 6) Animal damage
  - b) Weather
    - 1) Extremely high or low temperature
    - 2) Extremely high or low moisture
  - c) Air quality - pollution
  - d) Chemical injury
    - 1) Herbicides
    - 2) Salts
  - e) Mechanical injury
    - 1) Automobiles
    - 2) Lawn mowers
    - 3) Vandalism
    - 4) Snow and ice damage
    - 5) Incorrect staking and guying
4. Discuss the damaging effect of chemicals on the environment and animals. Explain that "biological" control means natural control.

**How is biological control used as a method to control insects and diseases?**

- a) Natural enemies of pests
- b) Disease- and insect-resistant plants
- c) Crop rotation
- d) Natural pesticides taken from plants, i.e. chrysanthemum
  - 1) Pyrethroids
  - 2) Rotenone
- e) New strains of microbes

**F. Other activities**

Have students collect as many insects as they can that are discussed in this unit. Label, and display them.

**G. Conclusion**

While insects and diseases may be controlled to the point of preventing economic loss, it is difficult to completely eradicate them. Biological control should be used in all possible situations.

**H. Competency**

Recognize common insects and diseases, the type of damage or symptoms they cause, and recommended control methods.

**I. Answers to Evaluation**

1. c
2. c
3. a
4. a
5. c
6. d
7. b
8. c

**J. Answers to Work Sheets**

1. Work Sheet 6.1 - Identifying Plant Insects:  
Answers are up to discretion of instructor.
2. Work Sheet 6.2 - Identifying Plant Diseases:  
Answers are up to discretion of instructor.

UNIT VI - INSTALLATION AND MAINTENANCE OF  
TREES AND SHRUBS

Name \_\_\_\_\_

Date \_\_\_\_\_

Lesson 6: Disease and Pest Control

EVALUATION

Circle the letter that corresponds to the best answer.

1. Which pest is not an insect?
  - a. Aphids
  - b. Caterpillars
  - c. Mites
  - d. Scale
2. Which of the following is a noninfectious disorder?
  - a. Anthracnose
  - b. Crown Gall
  - c. Girdling of the roots
  - d. Powdery mildew
3. What type of control interferes with the reproduction of a pest?
  - a. Biological control
  - b. Chemical control
  - c. Mechanical control
  - d. Natural control
4. Which of the following is the best example of biological control of a pest?
  - a. Introducing a natural enemy of the pest
  - b. Removing the pest by hand
  - c. Spraying the plant with water
  - d. Spraying with a natural pesticide
5. Which pest control method is an example of mechanical control?
  - a. Birds eating grubs
  - b. Contact herbicides
  - c. Pulling weeds by hand
  - d. Releasing sterile males
6. Which includes prevention as a method of control?
  - a. Crop rotation
  - b. Destroying the plant host
  - c. Hand picking insects off plants
  - d. Using resistant varieties



7. Which includes using suppression as a type of control?
- a. Crop rotation
  - b. Modification of nutrient availability
  - c. Plant quarantines
  - d. Using certified seeds
8. Which indicates profitable control?
- a. Removing most, but not all of the pests
  - b. Removing all of the pests
  - c. Removing pests only if the benefits outweigh the cost
  - d. Removing all of the pests at any expense

Lesson 6: Disease and Pest Control

Work Sheet 6.1: Identifying Plant Insects

Collect two insects discussed in this unit. Tell what plant characteristics or symptoms were used to find the insects. Identify and display the insects. Tell what treatment or method of control could be used for each insect problem.

Lesson 6: Disease and Pest Control

Work Sheet 6.2: Identifying Plant Diseases

Collect samples of a tree or shrub that has signs of disease. Tell what characteristics were used to find the disease. Identify and display the samples. Tell what treatment could be used to control the disease.

## UNIT VII - INSTALLATION AND MAINTENANCE OF BEDDING PLANTS AND GROUND COVERS

### Lesson 1: Transplanting Bedding Plants and Ground Covers

**Objective:** The student will be able to transplant bedding plants and ground covers.

#### Study Questions

- 1. How should a planting area be prepared for flowers?**
- 2. How should flowers and ground covers be transplanted?**
- 3. What types of mulches can benefit bedding plant and ground cover plantings?**

#### References

1. Landscaping and Turf Management. (Student Reference). University of Missouri-Columbia: Instructional Materials Laboratory, 1990.
2. Work Sheet
  - a) WS 1.1: Determining Plant Spacing
3. Job Sheets
  - a) JS 1.1: Preparing the Flower Bed
  - b) JS 1.2: Transplanting Bedding Plants

## UNIT VII - INSTALLATION AND MAINTENANCE OF BEDDING PLANTS AND GROUND COVERS

### Lesson 1: Transplanting Bedding Plants and Ground Covers

#### TEACHING PROCEDURES

##### A. Introduction

Flower gardens, beds, and borders are a beautiful addition to a landscape. A landscaper must know how to properly prepare the soil, transplant flowers and ground covers, and use mulches, in order to install a successful garden, bed, or border.

##### B. Motivation

Show slides of beautiful flower gardens, beds, and borders. Point out the sequence of heights; tallest in the back to shortest in the front. Also point out proper spacing in width.

##### C. Assignment

##### D. Supervised study

##### E. Discussion

1. Select a site on the school campus to create a flower bed or border. Have the students prepare the bed for planting flowers. The soil test should have been done in unit II. If not, test the soil. Have the students complete Job Sheet 1.1.

#### **How should a planting area be prepared for flowers?**

- a) Prepare the whole area, rather than individual holes.
- b) Take a soil test.
- c) Remove all weeds.
- d) Organic matter can be spread two inches thick over the soil.
- e) Add lime or sulphur, if needed, to adjust the pH.
- f) Add two to three pounds of fertilizer per 100 square feet.
- g) Work additions into the top six inches of soil.
- h) Rake the area smooth.

2. Have the students complete WS 1.1 and JS 1.2 after discussion of this material.

#### **How should flowers and ground covers be planted?**

- a) Be sure the ground temperature is warm enough.
- b) Determine the spacing before planting.
  - 1) Annuals
    - (a) Follow the guidelines on the seed packet or label.
    - (b) Close spacing allows for a quick fill-in. Negative factors are:
      - (1) It is more expensive.
      - (2) It increases chance for disease.
  - 2) Ground covers
    - (a) In a highly visible area plant closer together
    - (b) A staggered arrangement fills in more quickly.
- c) Follow the cultural requirements of a plant. Therefore, plant:

- 1) Sun-loving plants in sun.
  - 2) Shade-loving plants shade.
  - d) Do not plant shorter plants behind taller ones.
  - e) Remove plants from the container.
    - 1) Plastic packs
      - (a) Push the bottom with thumb.
      - (b) Lift the rootball out of pack.
      - (c) Straighten the roots coiled around the bottom.
    - 2) Individual clay or plastic pots
      - (a) Tip upside down while holding a hand over the soil.
      - (b) Tap the edge of the pot on a solid surface.
      - (c) Let the rootball fall into the hand.
    - 3) Peat pots
      - (a) Pots can be planted with the plant.
      - (b) Remove the top rim down to soil line.
      - (c) Wet the pot.
      - (d) Bury completely.
  - f) All plants should be moist when planted.
  - g) Using a trowel, dig a hole slightly larger than the rootball.
  - h) Plant at the same soil level as container.
  - i) Tamp the soil in around roots.
  - j) Water thoroughly.
3. Ask the students what mulch they have seen used most in the community. Shredded hardwood mulch is a very popular one to use. Point out that mulches are not only used for aesthetics; but are also important in conserving water, keeping weeds down, and keeping temperatures more constant.

**What types of mulches can benefit bedding plant and ground cover plantings?**

- a) Purposes of mulches
  - 1) Conserving moisture
  - 2) Keeping weeds down
  - 3) Modifying temperatures
  - 4) Cutting down on weeding and cultivation
- b) Possible types of mulches
  - 1) Shredded bark
  - 2) Old sawdust
  - 3) Pebbles
  - 4) Sphagnum moss
  - 5) Leaf mold
  - 6) Rotted manure
  - 7) Compost
  - 8) Rice, almond, or bean hulls
- c) Soil changes from mulches
  - 1) Added nutrients
  - 2) Altered pH
  - 3) Nitrogen used by microorganisms in organic mulches
- d) Application of mulch to ground covers after the ground freezes to keep it frozen

**F. Other activity**

After the students complete WS 1.2, have them determine the cost involved in covering the area with plants. Then have them space the plants closer together to fit more in the area (move on paper not

the real bed) and determine the plant cost. Stress the point that this significantly increases the cost, and in the landscaping business a landscaper may lose profit if an excess of plants is used.

**G. Conclusion**

A showy bed of flowers can add to the beauty of a landscape design. It is essential to properly plan the spacing, plant selection, as well as to properly install the plants in order to have a successful design.

**H. Competency**

Prepare the soil of a flower bed, determine the number of plants to use, and transplant bedding plants and ground covers.

**I. Answers to Evaluation**

1. c
2. a
3. d
4. d
5. d
6. b
7. a
8. a

**J. Answers to work sheet**

WS 1.1: Determining Plant Spacing  
Correct answers are up to instructor's discretion.

UNIT VII - INSTALLATION AND MAINTENANCE OF BEDDING  
PLANTS AND GROUND COVERS

Name \_\_\_\_\_

Date \_\_\_\_\_

Lesson 1: Transplanting Bedding Plants and Ground Covers

EVALUATION

Circle the letter that corresponds to the best answer.

1. When is the best time to add sulphur to a soil that will be planted with acid-loving plants?
  - a. After applying the mulch
  - b. After watering the plants in
  - c. When preparing the soil
  - d. When transplanting the plants
2. How much organic material should be added to the soil when preparing the flower bed?
  - a. One-third of the final mix
  - b. One-half of the final mix
  - c. Two-thirds of the final mix
  - d. Three-fourths of the final mix
3. How should plants be removed from cell packs?
  - a. Plastic container should be planted with the plant
  - b. Pulled out by the leaves
  - c. Pulled out by the stem
  - d. Pushed out from bottom of the container
4. When should tender annuals be planted?
  - a. Two weeks before the last killing frost
  - b. The day after the last killing frost
  - c. One week after the last killing frost
  - d. Two weeks after the last killing frost
5. How should plants in peat pots be planted?
  - a. Pot must be removed.
  - b. Pot must be buried one inch underground.
  - c. Rim of the pot must be sticking up above ground.
  - d. Rim of the pot should be removed, and plant planted at the same level as the soil in the pot.
6. Which is not a reason for using mulches?
  - a. To conserve moisture
  - b. To enhance the soil structure
  - c. To keep weeds down
  - d. To modify temperatures



7. At what depth should bedding plants be planted?
- a. At the same level they were in the pot
  - b. One inch deeper than they were in the pot
  - c. One inch higher than they were in the pot
  - d. Up to the first set of leaves
8. Why must nitrogen be added to the soil when certain mulches are used?
- a. Microorganisms that break mulch down use nitrogen in the soil, stealing it from plants.
  - b. Mulches need nitrogen to live.
  - c. Mulches need nitrogen to work.
  - d. When using mulch, the plants use more nitrogen.

## UNIT VII - INSTALLATION AND MAINTENANCE OF BEDDING PLANTS AND GROUND COVERS WS 1.1

### Lesson 1: Transplanting Bedding Plants and Ground Covers

#### Work Sheet 1.1: Determining Plant Spacing

Follow the steps below to determine plant spacing.

1. Measure the area to be planted.
2. List the plants to be planted. Beside each plant name, list the height and width the plant will reach when mature. This information can be found in Unit X, the plant label, or other resource.

Name

Height

Width

- a.
  - b.
  - c.
  - d.
  - e.
3. Based on the width of the plant, determine how many plants will be needed. Example: the area is 48" long; Marigolds spread to eight inches wide; therefore, six marigolds will fill in one 48" row.
  4. Based on the height of the plants, determine which plants will be in the back, middle, and front of the bed.
  5. Draw a sketch of the area prepared for planting. Using a different symbol for each different species used, arrange the plants in the design to be planted.

Example:

marigolds = x (8")  
dusty miller = o (6")  
salvia = Δ (8")

Δ	Δ	Δ	Δ	Δ	Δ
x	x	x	x	x	x
o	o	o	o	o	o

## UNIT VII - INSTALLATION AND MAINTENANCE OF BEDDING PLANTS AND GROUND COVERS JS 1.1

### Lesson 1: Transplanting Bedding Plants and Ground Covers

#### Job Sheet 1.1: Preparing the Flower Bed

**Objective:** Upon completion of this job sheet, the student will be able to prepare a flower bed.

**Materials and Supplies Needed:**

1. Garden hoe
2. Spade or rototiller
3. Fertilizer
4. Organic material (peat, manure, etc.)
5. Sulphur or lime according to soil test results

**Procedure:**

1. A soil test should have been taken previously, if not follow procedures in Unit II, JS 2.1.
2. Remove weeds from area to be worked.
3. Spread organic material two inches thick over area.
4. Spread fertilizer over area as indicated by soil test.
5. Spread sulphur or lime at rate recommended on package, if a need is indicated by a soil test.
6. Work it into top six inches of soil, by turning the soil over with a spade, or using a rototiller.
7. Rake the soil smooth.

## **UNIT VII - INSTALLATION AND MAINTENANCE OF BEDDING PLANTS AND GROUND COVERS JS 1.2**

### **Lesson 1: Transplanting Bedding Plants and Ground Covers**

#### **Job Sheet 1.2: Transplanting Bedding Plants**

**Objective:** Upon completion of this job sheet, the student will be able to transplant bedding plants.

#### **Materials and Supplies Needed:**

1. Bedding plants in packs or pots.
2. Hand trowel

#### **Procedure:**

1. Prepare planting site. See Job Sheet 1.1.
2. Determine spacing. See Work Sheet 1.1.
3. With trowel, dig a hole for the plants slightly larger than each rootball.
4. Remove plants from containers.
5. Place plants in hole at the same soil level as they were in the pot.
6. Gently tamp the soil down around the roots.
7. Mulch.
8. Water thoroughly.

## UNIT VII - INSTALLATION AND MAINTENANCE OF BEDDING PLANTS AND GROUND COVERS

### Lesson 2: Maintaining Bedding Plants and Ground Covers

**Objective:** The student will be able to maintain bedding plants and ground covers.

#### Study Questions

- 1. What are the water requirements of bedding plants and ground covers?**
- 2. When, and at what rate, are bedding plants and ground covers fertilized?**
- 3. When is pruning or grooming appropriate?**

#### References

1. Landscaping and Turf Management. (Student Reference). University of Missouri-Columbia: Instructional Materials Laboratory, 1990.

## UNIT VII - INSTALLATION AND MAINTENANCE OF BEDDING PLANTS AND GROUND COVERS

### Lesson 2: Maintaining Bedding Plants and Ground Covers

#### TEACHING PROCEDURES

##### A. Review

Review the previous lesson.

##### B. Motivation

Bedding plants are very showy and ground covers very useful. However, without the proper maintenance, bedding plants can lose their brilliance and ground covers will look drab and out of hand.

##### C. Assignment

##### D. Supervised study

##### E. Discussion

1. In most areas, water supply is not a problem. Stress to the students that there is no excuse for not keeping bedding plants well-watered after having gone to the trouble of planning and planting the plants. Have the students maintain the bed they have planted until the end of the school year. Seek volunteers to maintain it through the summer. Stress to students that it is better to water less frequently and more thoroughly, than to water lightly every other day. Mention that watering can become a boring job if a large area needs to be done by hand. It is easy for the person watering to get in a hurry and not give the plants enough water. They must be patient to be sure each plant gets enough. Demonstrate proper watering techniques to the students. Have each student water an area of the flower bed so they can get the experience of how much water to apply. Avoid wetting flowers and foliage, if possible.

#### **What are the water requirements of bedding plants and ground covers?**

- a) Frequent (once a week), until established
  - b) Once established; less frequent, deep, thorough watering
  - c) Follow individual cultural requirements
  - d) Water in the morning
  - c) Keep foliage dry
2. Even though bedding plants are not heavy feeders, they will still benefit by a feeding once a month during the season. This will result in large, lush plants with more blooms and fewer problems with pests and diseases. Actively growing plants are less susceptible to pests and diseases. Seek volunteers to keep the plants fertilized during the summer. Demonstrate fertilizing practices, both dry application and liquid application. Then have the students try applying fertilizer.

#### **When, and at what rate, are bedding plants and ground covers fertilized?**

- a) Bedding plants
  - 1) Once a month after established
  - 2) Two to three pounds of 1-2-1 fertilizer per 100 square feet

- 3) Sprinkled on surface and watered in
  - b) Ground covers
    - 1) Soil test yearly
    - 2) Three pounds of 1-2-1 fertilizer per 100 square feet
    - 3) Applied in early spring
  - c) According to cultural requirements of specific plants
3. Trailing or spreading ground covers can get out of hand if not pruned to keep them in bounds. They also start to look drab if too much growth is kept on year after year. This causes the overall growth and vigor to slow down. Weekly "dead-heading" will lengthen the blooming time of annuals. If an established bed is available on the school campus, have the students practice removing dead flowers. If not available, make arrangements with the city park, a nursery, a garden center, or a greenhouse to try techniques on home grown plants.

**When is pruning and grooming appropriate?**

- a) Ground covers
  - 1) Prune when it looks dull or builds up thatch.
  - 2) The best time is early spring before growth starts.
  - 3) A lawn mower, string trimmer, or hand pruners can be used.
- b) Bedding plants
  - 1) "Dead-head" weekly.
    - (a) Plants look better
    - (b) Prolongs blooming period
  - 2) Pinch when transplanting some bedding plants.
    - (a) Promotes a bushier plant
    - (b) Promotes more flowers
  - 3) Stake tall plants.
    - (a) Keeps plants upright
    - (b) Protects from wind and rain damage
- c) Ornamental grasses should not be cut back until spring.
- d) Follow the cultural requirements for each plant.

**F. Other activity**

Have students observe and evaluate maintenance techniques at a park, nursery, or greenhouse.

**G. Conclusion**

Proper maintenance of bedding plants and ground covers will ensure vigorous, healthy, growth throughout the growing season.

**H. Competency**

Maintain bedding plants and ground covers.

**I. Answers to Evaluation**

- |      |      |
|------|------|
| 1. c | 5. a |
| 2. d | 6. b |
| 3. c | 7. d |
| 4. b |      |

UNIT VII - INSTALLATION AND MAINTENANCE OF BEDDING PLANTS  
AND GROUND COVERS

Name \_\_\_\_\_

Lesson 2: Maintaining Bedding Plants and Ground Covers

Date \_\_\_\_\_

EVALUATION

Circle the letter that corresponds to the best answer.

1. How often do newly-planted bedding plants need to be watered?
  - a. Once a month
  - b. Once a day
  - c. Once a week until established
  - d. Once a week throughout the season.
2. Which is not true of watering established bedding plants?
  - a. They should be watered less frequently, but more thoroughly after they are established.
  - b. It is best to water in the morning before the sun is high in the sky.
  - c. The cultural requirements of each plant should be followed when watering.
  - d. It is best to water in the late evening when the sun is down.
3. When should bedding plants be fertilized?
  - a. Every three days
  - b. Once a week
  - c. Once a month
  - d. Once during the season, in early spring.
4. What is the benefit of "dead-heading" bedding plants or ground covers?
  - a. They grow bushier.
  - b. They bloom for a longer period of time.
  - c. It promotes seed development.
  - d. It promotes foliage growth.
5. What results when pinching a bedding plant or ground cover?
  - a. A bushier plant with more stems to bear flowers
  - b. A longer blooming period
  - c. A taller plant
  - d. Increased bloom production
6. When should ornamental grasses be cut back?
  - a. After they bloom
  - b. In early spring
  - c. In fall
  - d. In winter



7. When should ground covers be fertilized?
- a. Once every three days
  - b. Once a week
  - c. Once a month
  - d. Once during the season, in early spring

## UNIT VIII - TURFGRASS

### Lesson 1: Turfgrass Growth and Classification

**Objective:** The student will be able to explain the growth habits of turfgrass, its seasons of growth, and advantages and disadvantages of different turfgrasses.

#### Study Questions

- 1. What are the different growth habits of turfgrass?**
- 2. What are the differences between cool-season and warm-season turfgrasses?**
- 3. What are the major advantages and disadvantages of: Kentucky bluegrass, tall fescue, fine fescue, perennial ryegrass, bermudagrass, and zoysiagrass?**

#### Reference

1. Landscaping and Turf Management (Student Reference). University of Missouri-Columbia: Instructional Materials Laboratory, 1990.

## UNIT VIII - TURFGRASS

### Lesson 1: Turfgrass Growth and Classification

#### TEACHING PROCEDURES

##### A. Review

Review Unit III, Lesson 6 to recall the six main turfgrasses grown in Missouri.

##### B. Motivation

Place pots of the six most common turfgrasses in front of the students. Ask them which turfgrasses grow in their yards. Then ask students if they know how each turfgrass grows, or any characteristic they might be aware of that distinguishes each turfgrass.

##### C. Assignment

##### D. Supervised study

##### E. Discussion

1. Ask students to discuss the growth habits of turfgrass.

#### **What are the different growth habits of turfgrass?**

- a) Spreading
    - 1) Rhizomes are underground stems forming new independent plants with their own root systems that surface at a short distance from the mother plant.
    - 2) Stolons are aboveground stems forming new, independent plants with their own root systems that surface at a short distance from the mother plant.
  - b) Bunching is the formation of new shoots or tillers only at the crown of the mother plant.
2. Ask students if they know what kind of turfgrass they have growing in their yards. Have them discuss when the grass appears to be actively growing and when it is dormant.

#### **What are the differences between cool-season and warm-season turfgrasses?**

- a) Cool-season turfgrasses
    - 1) Grow best with daytime temperatures between 60°-75° F
    - 2) Green early in spring with very good growth
    - 3) Grow slowly in hot, summer and sometimes become dormant
    - 4) Green again in autumn with good growth
  - b) Warm-season turfgrasses
    - 1) Grow best with daytime temperatures between 80°-95° F
    - 2) Grow actively during summer
    - 3) Green four to six weeks later in the spring than cool-season grasses.
    - 4) Turn straw-colored and become dormant after first autumn frost
3. Ask students if they know of any advantages or disadvantages one turfgrass might have over another, now that they know about warm-season and cool-season grasses.

**What are the major advantages and disadvantages of Kentucky bluegrass, tall fescue, fine fescue, perennial ryegrass, bermudagrass, and zoysiagrass?**

- a) Kentucky bluegrass
  - 1) Sod-forming grass
  - 2) Grows best in unshaded areas
  - 3) Grows aggressively under favorable soil conditions
  - 4) Recovers with rhizomes following wear or injury
  - 5) Survives severe winter without damage
  - 6) Effective in seed blends and mixtures
  - 7) Effective establishment of lawn from seed
  - 8) Becomes dormant in hot and dry summers
  - 9) Moderately susceptible to diseases and insects
  - 10) Grows poorly in dense shade
- b) Tall fescue
  - 1) Bunch grass
  - 2) Grows well in sun and moderate shade
  - 3) Withstands heavy traffic
  - 4) Grows well during extreme periods of drought
  - 5) Fewer disease problems
  - 6) Good resistance to insects
  - 7) Germinates rapidly
  - 8) Potential for clumping if stand is thinned
- c) Fine fescue
  - 1) Grows exceptionally well in shade
  - 2) Usually mixed with Kentucky bluegrass or perennial ryegrass
  - 3) Performs well on droughty, infertile, coarse-textured soils
  - 4) Low fertility requirement
  - 5) Sensitive to some pesticides
  - 6) Not very resistant to disease
  - 7) Not very resistant to insects
- d) Perennial ryegrass
  - 1) Germinates quickly
  - 2) Establishes in short period of time
  - 3) Excellent traffic tolerance
  - 4) Good for athletic fields
  - 5) Moderate degree of resistance to disease
  - 6) Some resistance to insects
  - 7) Does not tolerate hot, dry, summer conditions
- e) Bermudagrass
  - 1) Aggressively spreading grass
  - 2) Recovers from damage and renovates quickly
  - 3) Grows exceptionally well in full sun
  - 4) Poor winter tolerance
  - 5) Good salt-tolerance
  - 6) Grows well during summer conditions
  - 7) Improved cultivars available
  - 8) Propagates only by sprigging, sodding, or plugging
  - 9) Very drought-tolerant
- f) Zoysia grass
  - 1) Grows aggressively
  - 2) Performs best in full sun
  - 3) Moderate shade tolerance
  - 4) Grows well in most soil types

- 5) Propagates by sprigging, sodding, or plugging
- 6) Very drought-tolerant
- 7) Problems with thatch

**F. Other activities**

- 1. Take students outside on school grounds to identify turfgrasses growing on campus and their growth habits.
- 2. Have students plant and grow seeds from each of the six major types of turfgrasses.
- 3. Have a BOAC take care of a public community area.

**G. Conclusion**

Turfgrasses can be classified according to their growth habits and the season in which they grow. There are many advantages and disadvantages of turfgrasses depending on growth habits and seasons.

**H. Competency**

List advantages and disadvantages of the six major turfgrasses grown in Missouri.

**I. Answers to Evaluation**

- 1. d
- 2. d
- 3. a
- 4. d
- 5. b
- 6. c
- 7. Include two of the following:
  - a) Recovers from damage and renovation
  - b) Grows well in full sun
  - c) Grows aggressively
  - d) Good Insect resistance

UNIT VIII - TURFGRASS

Name \_\_\_\_\_

Lesson 1: Turfgrass Growth and Classification

Date \_\_\_\_\_

EVALUATION

Circle the letter that corresponds to the best answer.

1. Which is not a characteristic of cool-season turfgrasses?
  - a. Becomes dormant in summer
  - b. Greens again in autumn
  - c. Greens early in spring
  - d. Grows best with daytime temperatures between 80-95°F
2. Which is a warm-season turfgrass?
  - a. Kentucky bluegrass
  - b. Perennial ryegrass
  - c. Tall fescue
  - d. Zoysia
3. Which is not a cool-season turfgrass?
  - a. Bermudagrass
  - b. Fine fescue
  - c. Kentucky bluegrass
  - d. Perennial ryegrass
4. What are grasses that spread by forming new, independent plants a short distance from the mother plant called?
  - a. Branch
  - b. Bunch
  - c. Rhizome
  - d. Sod forming
5. What are grasses that slowly spread by stems below ground that form only tillers at the crown of the mother plant called?
  - a. Branch
  - b. Bunch
  - c. Rhizome
  - d. Sod forming
6. Which is a disadvantage of using tall fescue?
  - a. Germinates rapidly
  - b. Grows well during extreme drought
  - c. Potential for clumping if stand is thinned
  - d. Withstands heavy traffic

**Complete the following short answer question.**

7. What are two advantages of using Bermudagrass?
  - a.
  - b.

## UNIT VIII - TURFGRASS

### Lesson 2: Turfgrass Establishment

Objective: The student will be able to describe the procedure for installing a lawn.

#### Study Questions

1. **How is an area prepared for the establishment of turf?**
2. **What are the procedures for installing turf?**
3. **Why is the time of planting grasses important?**
4. **What are important considerations when selecting turfgrass seed?**

#### Reference

1. Landscaping and Turf Management (Student Reference). University of Missouri-Columbia: Instructional Materials Laboratory, 1990.
2. **Work Sheets**
  - a) WS 2.1: Figuring Area
  - b) WS 2.2: Determining Seed and Sod Requirements for Lawn Areas



## UNIT VIII - TURFGRASS

### Lesson 2: Turfgrass Establishment

#### TEACHING PROCEDURES

##### A. Review

Review previous lesson. Review soil sampling.

##### B. Motivation

Having a well-established turf looks attractive and ties the landscape together.

##### C. Assignment

##### D. Supervised study

##### E. Discussion

1. Ask students if any of them have prepared a site for installation of turf. Ask them what steps they may have taken.

#### **How is an area prepared for the establishment of turf?**

- a) Test soil, if necessary.
- b) Remove debris from area.
- c) Remove topsoil and construct rough grade.
- d) Add lime, fertilizers, and soil amendments.
- e) Establish final grade.

2. Ask students if any have actually installed turf. Ask what methods they used and what steps they followed.

#### **What are the procedures for installing turf?**

- a) Seeding
  - 1) Sow seed.
  - 2) Rake seed in and roll.
  - 3) Mulch.
  - 4) Water.
- b) Sodding - commercially grown turf cut into strips, equaling nine square feet or one square yard, with attached roots, rhizomes, or stolons
  - 1) Start with straight edge.
  - 2) Roll out strips.
  - 3) Place edges tightly together.
  - 4) Cut pieces to fit gaps.
  - 5) Roll.
  - 6) Water.
- c) Plugging - small squares or circles of sod placed at intervals of six to twelve inches
  - 1) Roll.
  - 2) Water.

- d) Sprigging - pieces of turf planted in furrows, usually containing a stolon with roots and up to four nodes
  - 1) Press into the ground at desired intervals or broadcast and cover with soil.
  - 2) Water.
- 3. Ask students when they think the best times are to plant warm-season and cool-season turfgrasses.

**Why is the time of planting grasses important?**

- a) Cool-season turfgrasses are planted in late summer to benefit from cool autumn temperatures and to have less competition from annual weeds in warmer weather.

NOTE: Early spring planting is all right if fall planting is not practical.

- b) Warm-season turfgrasses are planted in late spring or early summer to receive optimum temperatures for growth.
- 4. Ask students if any of them have bought grass seed or other seed. Ask students what information they might find on a package of grass seed.

**What are important considerations when selecting turfgrass seed?**

- a) Percentage of germination to expect
- b) Percentage of crop and weed seeds
- c) Percentage of noxious weeds

**F. Other activities**

- 1. Have students prepare a site for turfgrass installation.
- 2. Have students choose an appropriate method of installation for installing turfgrass in the prepared site.

**G. Conclusion**

Correctly preparing a site for turfgrass installation will help save needless hours of work at a later time. There are six major turfgrasses grown in Missouri. Each has advantages and disadvantages. There are four methods of installing turfgrass; seeding, sodding, plugging, and sprigging.

**H. Competency**

Describe the procedure for installing a lawn.

**I. Answers to Evaluation**

- 1. d
- 2. a
- 3. b
- 4. c
- 5. d

J. Answers to Work Sheets

WS 2.1

1.  $L \times W = \text{area}$        $30' \times 25' = 750 \text{ sq. ft.}$
2.  $L \times W = \text{area}$        $40' \times 10' = 400 \text{ sq. ft.}$
3.  $\pi r^2 = \text{area}$        $3.14 \times 7.52 = 177 \text{ sq. ft.}$
4.  $\frac{B \times H}{2} = \text{area}$        $\frac{25' \times 15'}{2} = 187.5 \text{ sq. ft.}$
5.  $L \times W = \text{area}$        $45' \times 15' = 675 \text{ sq. ft.}$

WS 2.2

1.  $145' \times 85' = 12,325 \text{ sq. ft.}$
2.  $30' \times 77.5' = 2,325 \text{ sq. ft.}$
3.  $40' \times 20' = 400 \text{ sq. ft.}$
4. Drive  $25' \times 25' = 625 \text{ sq. ft.}$ ; walk  $25' \times 7.5' = 187.5 \text{ sq. ft.}$   
 $625 \text{ sq. ft.} + 187.5 \text{ sq. ft.} = 812.5 \text{ sq. ft.}$  (total area of walk and drive)
5.  $35' \times 25' = 875 \text{ sq. ft.}$
6.  $(12,325) - (2,325 + 400 + 812.5 + 875) = 7,912.5 \text{ sq. ft.}$
7.  $7,912.5 \text{ sq. ft.} \div 9 \text{ sq. ft.} = 879.167 \text{ rolls}$  (9 sq. ft. in one roll of sod)
8.  $145' \times 55' = 7,975 \text{ sq. ft.}$   
 $7,975 \text{ sq. ft.} - (2,325 \text{ sq. ft.} + 812.5 \text{ sq. ft.}) = 4,837.5 \text{ sq. ft.}$   
 $4,837.5 \text{ sq. ft.} \div 9 \text{ sq. ft.} = 537.5 \text{ sq. ft.}$
9.  $7,912.5 \text{ sq. ft.} \times \frac{3 \text{ lbs.}}{1,000 \text{ sq. ft.}} = 23.74 \text{ lbs. seed}$

EVALUATION

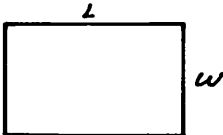
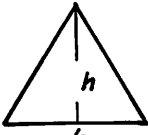
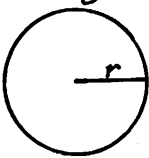
Circle the letter that corresponds to the best answer.

1. What is the first step when preparing an area for installation of turfgrass?
  - a. Add soil amendments
  - b. Install underground sprinkler system
  - c. Remove debris
  - d. Take a soil test
2. What are small circles or squares of turf called?
  - a. Plugs
  - b. Seeds
  - c. Sod
  - d. Sprigs
3. Which is not a method of sprigging?
  - a. Broadcasting and covering lightly with soil
  - b. Spreading with a drop seeder
  - c. Planting in furrows
  - d. Pressing into the ground
4. When is the best time to plant warm-season turfgrasses?
  - c. Early autumn
  - d. Early spring
  - c. Late spring
  - d. Late summer
5. When is the best time to plant cool-season turfgrasses?
  - a. Early summer
  - b. Late autumn
  - c. Late spring
  - d. Late summer

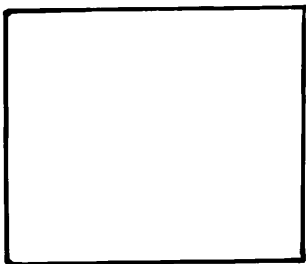
## Lesson 2: Turfgrass Establishment

## Work Sheet 2.1: Figuring Area

Using the given formulas, figure the area of the following shapes. Use a 1" = 20' scale. (Show your work.)

rectangle/square		area = length x width
triangle		area = base x height ÷ 2
circle		area = $\pi r^2$ $\pi = 3.14$ r = radius

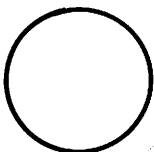
1.



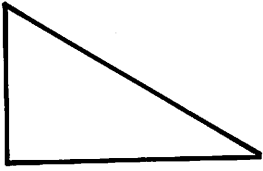
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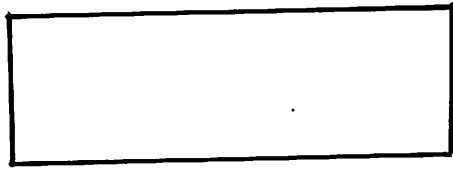
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4.



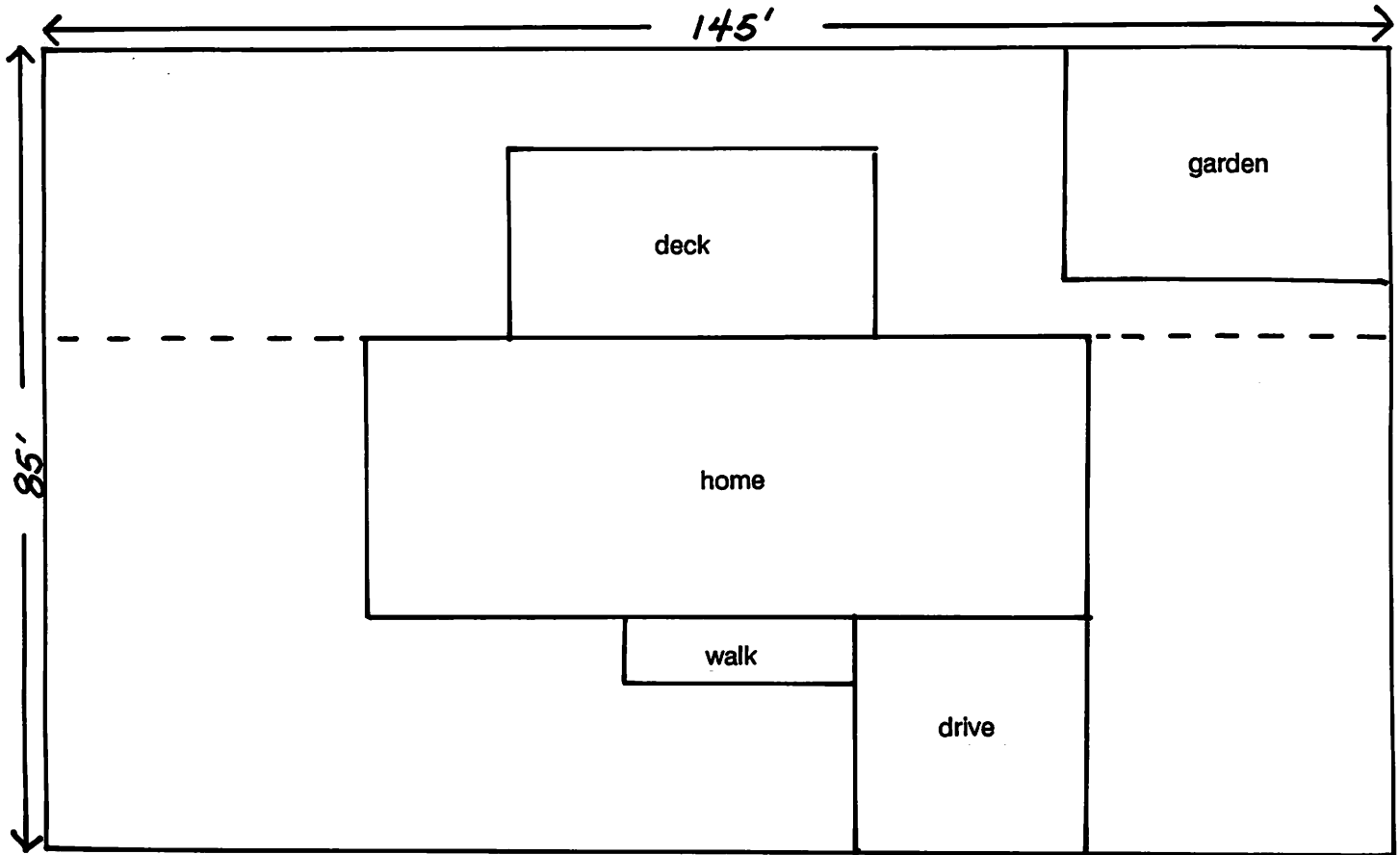
5.



## Lesson 2: Turfgrass Establishment

## Work Sheet 2.2: Determining Seed and Sod Requirements for Lawn Areas

Answer the questions based on the home lot given. The scale is 1" = 20'.



1. What is the total area of the lot?

2. What is the area of the house?

3. What is the area of the deck?
4. What is the area of the drive and walk?
5. What is the area of the garden?
6. By subtracting the area in questions 2, 3, 4 and 5 from the area of the lot (Q1), determine the area of the lawn.
7. How many rolls of sod (1 square yard) would be needed to sod the entire lawn?



- VIII-21

## UNIT VIII - TURFGRASS

### Lesson 3: Turfgrass Maintenance

**Objective:** The student will be able to describe procedures to follow to successfully water, fertilize, and mow turfgrass.

#### Study Questions

- 1. What are the fertility requirements for warm-season and cool-season turfgrasses?**
- 2. How are frequency and rate of irrigation determined?**
- 3. When is the appropriate time to mow turfgrass?**

#### References

1. Landscaping and Turf Management (Student Reference). University of Missouri-Columbia: Instructional Materials Laboratory, 1990.
2. Work Sheets
  - a) WS 3.1: Figuring Area for Fertilizer Applications
  - b) WS 3.2: Calculating Lawn Areas for Fertilizer Requirements
3. Job Sheet
  - a) JS 3.1: Spreader Calibrations

## UNIT VIII - TURFGRASS

### Lesson 3: Turfgrass Maintenance

#### TEACHING PROCEDURES

##### A. Review

Review the previous lesson.

##### B. Motivation

Middle and upper class Americans generally hire individuals or companies to provide goods or services, rather than perform those tasks themselves. Lawn care businesses offering services such as mowing, watering, fertilizing, edging, and other turf maintenance jobs; have recently developed into a profitable service industry.

##### C. Assignment

##### D. Supervised study

##### E. Discussion

1. Ask students if their lawns are fertilized. Ask what fertilizer they apply. Ask what equipment is used when applying fertilizer.

**What are the fertility requirements for warm-season and cool-season turfgrasses?**

In general, turfgrasses require a complete fertilizer containing nitrogen, phosphorous, and potassium. A fertilizer ratio of 3-1-2 is ideal. Warm-season grasses prefer slow-release fertilizer during the summer while cool-season grasses require fertilizer mostly in fall with some in spring.

2. Ask students if they irrigate their lawns. Ask how frequently they water.

**How are frequency and rate of irrigation determined?**

- a) Dependent on soil type
- b) Dependent on grass type
- c) Dependent on temperature
- d) Dependent on growing season
- e) Dependent on root growth

3. Ask how many students mow their lawns. Ask how often they mow their lawns.

**When is the appropriate time to mow turfgrass?**

- a) Dependent on grass type
- b) Dependent on fertilizer maintenance
- c) Dependent on watering

F. Other activities

1. Maintain school fields by mowing.
2. Maintain school fields by watering.
3. Maintain school fields by fertilizing.

G. Conclusion

Proper maintenance by fertilizing, mowing, and watering; will produce healthy turf. Fertility rates for warm- and cool-season grasses vary. A 3-1-2 ratio is recommended. Mowing heights are dependent on the kind of grass being cut. Usually one-third of the leaf blade is removed. An inch of water should be applied to the turf every seven to ten days.

H. Competency

Maintain turf by properly fertilizing, watering, and mowing.

I. Answers to Evaluation

1. b
2. c
3. a
4. b
5. d
6. b
7. c
8. c
9. c
10. c

J. Answers to Work Sheets

WS 3.1

1.  $L \times W = \text{area}; 30 \text{ ft.} \times 15 \text{ ft.} = 450 \text{ sq. ft.}$
2.  $L \times W = \text{area}; 40 \text{ ft.} \times 5 \text{ ft.} = 200 \text{ sq. ft.}$
3. Visualize it as a rectangle with a triangle on each end. Combine triangle A with C to make a rectangle or measure the two triangles and the rectangle separately.  $45 \text{ ft.} \times 10 \text{ ft.} = 450 \text{ sq. ft.}$
4.  $\frac{\pi r^2}{2} = \text{area of } 1/2 \text{ circle}$
5.  $L \times W = \text{area}; 40 \text{ ft.} \times 20 \text{ ft.} = 800 \text{ sq. ft.}$   
 $\frac{3.14 \times 15^2}{2} = 353.25 \text{ sq. ft.}$

WS 3.2

1.  $145' \times 85' = 12,325 \text{ sq. ft.}$
2.  $30' \times 77.5' = 2,325 \text{ sq. ft.}$
3.  $35' \times 15' = 525 \text{ sq. ft.}$
4.  $(D \ 25 \times 20 = 500) + (W \ 25 \times 5 = 125) = 625 \text{ sq. ft.}$
5.  $25' \times 30' = 750 \text{ sq. ft.}$
6.  $12,325 - (2,325 + 525 + 625 + 750) = 8,100 \text{ sq. ft.}$
7. 
$$\frac{8,100 \text{ sq. ft.}}{1} \times \frac{1 \text{ lb. N}}{1,000 \text{ sq. ft.}} \times \frac{100 \text{ lbs. fert.}}{21 \text{ lb. N}} = 38.57 \text{ lbs. fertilizer}$$
8. 
$$38.57 \text{ lbs. fert.} \times \frac{\$16.00}{50 \text{ lbs. fert.}} = \$12.35$$

UNIT VIII - TURFGRASS

Name \_\_\_\_\_

Lesson 3: Turfgrass Maintenance

Date \_\_\_\_\_

EVALUATION

Circle the letter that corresponds to the best answer.

1. Which essential element will stimulate vegetative growth in turf?
  - a. Calcium
  - b. Nitrogen
  - c. Phosphorous
  - d. Potassium
2. Which essential element will stimulate good root growth?
  - a. Calcium
  - b. Nitrogen
  - c. Phosphorous
  - d. Potassium
3. Which of the following ratios is advised for general turf fertilizer?
  - a. 3-1-2
  - b. 2-3-1
  - c. 2-1-3
  - d. 1-2-3
4. How is spray, liquid-feed fertilizer applied?
  - a. By broadcasting
  - b. By using a hose end proportioner
  - c. By hopper feeder
  - d. By spreader
5. When should warm-season grasses be fertilized?
  - a. Autumn
  - b. Early spring and late summer
  - c. Early spring and midsummer
  - d. Summer
6. Which of the following is not a factor for how often to water?
  - a. Growing season
  - b. Location of trees
  - c. Soil type
  - d. Temperature

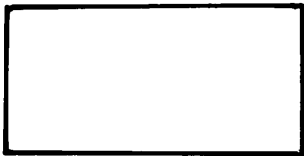
7. In general, how deep will one inch of water wet the soil?
- a. To one inch
  - b. To three inches
  - c. To six inches
  - d. To twelve inches
8. What is the ideal time to water?
- a. Afternoon
  - b. Evening
  - c. Morning
  - d. Night
9. What is the recommended portion of leaf blade to be removed in mowing?
- a. one-eighth
  - b. one-fourth
  - c. one-third
  - d. one-half
10. Which is not a characteristic of a reel mower?
- a. Has no catcher
  - b. Has scissors action
  - c. Mows in a forward and backward movement
  - d. Typically has five blades

Lesson 3: Turfgrass Maintenance

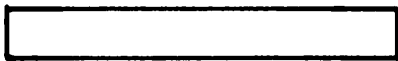
Work Sheet 3.1: Figuring Area for Fertilizer Application

Figure the area of the following shapes. Use a 1" = 20' scale. (Show your work.)

1.



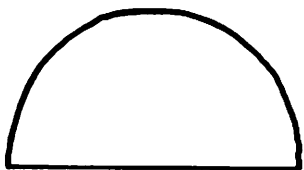
2.



3.

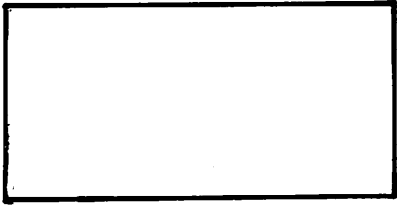


4.





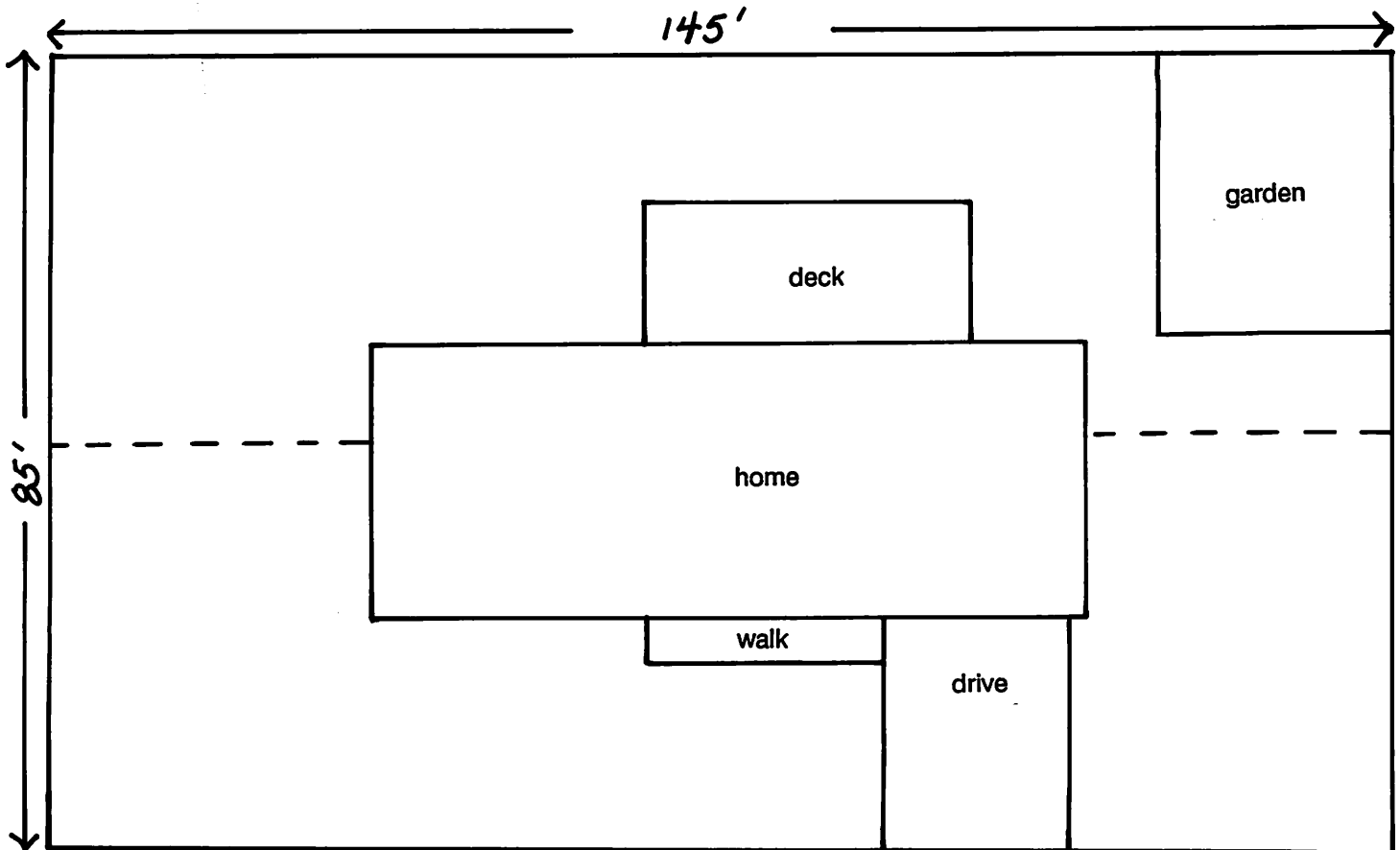
5.



## Lesson 3: Turfgrass Maintenance

## Work Sheet 3.2: Calculating Lawn Areas for Fertilizer Requirements

Calculate the areas as indicated to determine the amount of fertilizer required for the lawn. The scale is  $1'' = 20'$ .



1. What is the total area of the lot?

2. What is the area of the house?

3. What is the area of the deck?
4. What is the area of the drive and sidewalk?
5. What is the area of the garden?
6. By subtracting the area in questions 2, 3, 4 and 5 from the area of the lot (Q1), determine the area of the lawn.
7. How much 21-0-0 fertilizer would be needed to fertilize the lawn at a rate of one pound of nitrogen per 1,000 square feet?
8. If a fifty pound bag of 21-0-0 fertilizer costs \$16., how much will it cost to fertilize the lawn?

Lesson 3: Turfgrass Maintenance

Job Sheet 3.1: Spreader Calibrations

Objective: Upon completion of this job sheet, the student will be able to accurately calibrate a spreader.

Materials and Supplies Needed:

1. Spreader
2. Fertilizer, herbicide, or seed
3. Tape measure
4. Broom
5. Scale

Procedure:

1. Measure a square ten feet by ten feet. The area should be clean and smooth, such as a driveway or patio.
2. Fill the spreader with fertilizer, herbicide, or seed.
3. Spread the material to cover the ten by ten area.
4. Sweep and pick up the material that was spread in the square and weigh it.
5. Multiply the weight of the material times 100 to find the amount this particular calibration will spread over 1000 square feet.
6. If the amount is too much or not enough, change the calibration setting and repeat the procedure until the correct calibration is reached.

## UNIT VIII - TURFGRASS

### Lesson 4: Lawn Cultivation and Renovation

**Objective:** The student will be able to explain how to take a failing, established lawn and either cultivate or renovate it.

#### Study Questions

- 1. What are some common reasons lawns fail?**
- 2. What is thatch and how can it be controlled?**
- 3. How can compacted soils be cultivated?**
- 4. How can a lawn be renovated?**

#### Reference

1. Landscaping and Turf Management (Student Reference). University of Missouri-Columbia: Instructional Materials Laboratory, 1990.

## UNIT VIII - TURFGRASS

### Lesson 4: Lawn Cultivation and Renovation

#### TEACHING PROCEDURES

##### A. Review

Review the previous lesson.

##### B. Motivation

Since cultivation and renovation can be large jobs, many homeowners hire a landscape maintenance company to complete them.

##### C. Assignment

##### D. Supervised study

##### E. Discussion

1. Ask students if they have what they consider a perfect lawn. If not, ask what problems their lawn might have.

**What are some common reasons lawns fail?**

- a) Disease
- b) Insects
- c) Weeds
- d) Drought
- e) Compaction
- f) Thatch

2. Discuss the fact that all plants grow and die. Ask students what happens to dead grass.

**What is thatch and how can it be controlled?**

Thatch is a layer of decomposing grass, leaves, and stems that lies below the leaf blades of a lawn, but above the soil. There are two primary ways of controlling thatch; controlling through prevention, and controlling through removal.

- a) Control through prevention
  - 1) Moderate and regular (but not excessive) fertilization to maintain good growth
  - 2) Regular mowing at recommended height
  - 3) Deep irrigation every 10-14 days during drought to promote deep root growth
  - 4) Annual raking before new flush of growth
  - 5) Coring to improve water and fertilizer penetration
  - 6) Top dressing to promote decomposition of thatch
- b) Control through removal
  - 1) Coring (aerification)
  - 2) Spiking
  - 3) Slicing
  - 4) Vertical mowing

5) Raking

3. Ask students why turf does not grow very well on baseball, soccer, and football fields.

**How can compacted soils be cultivated?**

- a) Water the day before if necessary.
- b) Remove small cores.
- c) Topdress the area.

4. Ask students how they would repair a weak or damaged lawn.

**How can a lawn be renovated?**

- a) Remove all weeds and damaged turf in the area to be renovated.
- b) Verticut the rest of the lawn.
- c) Aerate the soil.
- d) Add topsoil to change grade.
- e) Rake for final grade.
- f) Incorporate lime and fertilizers.
- g) Sow seed, sprig, plug, or sod.

F. Other activities

- 1. Dethatch fields on school grounds.
- 2. Renovate fields on school grounds.
- 3. Test different areas for thatch.

G. Conclusion

If turfgrass is not properly cultivated it can develop a variety of problems, such as thatch or compaction. These problems can be remedied by performing proper maintenance procedures. These include: adequate watering, fertilizing, and mowing. In some cases where deterioration is too extreme for repair, renovation or replanting turf is necessary.

H. Competency

Explain how to successfully cultivate or renovate a lawn.

I. Answers to Evaluation

- 1. c
- 2. b
- 3. d
- 4. a
- 5. c
- 6. a
- 7. a
- 8. d

UNIT VIII - TURFGRASS

Name \_\_\_\_\_

Lesson 4: Lawn Cultivation and Renovation

Date \_\_\_\_\_

EVALUATION

Circle the letter that corresponds to the best answer.

1. Which best defines cultivation?
  - a. Cultivating new plants
  - b. Mechanical removal of insects
  - c. Mechanical removal of thatch
  - d. Using proper cultivation practices
2. Which is not included in renovation?
  - a. Cultivation
  - b. Moving the entire turf to another area
  - c. Reseeding and replanting
  - d. Turf improvement
3. What is a layer of decomposing grass found between the grass blades and the soil layer called?
  - a. Cultivation
  - b. Penetration
  - c. Renovation
  - d. Thatch
4. Which is not a cause of thatch?
  - a. Lawn clippings
  - b. Excessive growth
  - c. Over fertilization
  - d. Prolonged drought
5. Which is an example of a cultural practice to help prevent thatch?
  - a. Mow tall
  - b. Overfertilizing
  - c. Fertilize with modest amounts of nitrogen
  - d. Underwatering
6. When should cool-season grasses be dethatched?
  - a. Autumn
  - b. Early summer
  - c. Late summer
  - d. Winter



7. Which results in the most aeration of a lawn.
- a. Coring
  - b. Spiking
  - c. Splicing
  - d. Vertical mowing
8. How often is vertical mowing recommended?
- a. Every year
  - b. Every 2 years
  - c. Every 4 years
  - d. Depends on rate of thatch build up

## UNIT VIII - TURFGRASS

### Lesson 5: Pest Identification and Control

**Objective:** The student will be able to identify common weeds, insects, and diseases that damage the turf; and explain how these pests are controlled.

#### Study Questions

- 1. Why do pests develop in a lawn?**
- 2. What are ten broadleaf and grassy turfgrass weeds?**
- 3. What steps should be taken to control turfgrass weeds?**
- 4. What are the different turfgrass diseases that occur in Missouri during spring, summer, and autumn?**
- 5. What steps should be taken to control turfgrass diseases?**
- 6. What are the two most common turfgrass insects?**
- 7. What steps should be taken to control turfgrass insects?**

#### Reference

1. Landscaping and Turf Management (Student Reference). University of Missouri-Columbia: Instructional Materials Laboratory, 1990.

## UNIT VIII - TURFGRASS

### Lesson 5: Pest Identification and Control

#### TEACHING PROCEDURES

##### A. Review

Review previous lesson.

##### B. Motivation

Explain that insects, diseases, and weeds can totally destroy a lawn. Early identification of pests can prevent extensive damage to the turf and, therefore, save money.

##### C. Assignment

##### D. Supervised study

##### E. Discussion

1. Ask students if they have weeds in their lawns.

**Why do pests develop in a lawn?**

Results of poor cultural management

2. Ask students who have weeds in their lawns if they can identify any of the weeds.

**What are ten broadleaf and grassy turfgrass weeds.**

- a) Crabgrass
- b) Plantain
  - 1) Broadleaf
  - 2) Buckhorn
- c) White Clover
- d) Dandelion
- e) Nutsedge
- f) Henbit
- g) Prostrate spurge
- h) Curly dock
- i) Common chickweed
- j) Wild onion

3. Ask students if any have tried to control weeds in their lawns and how they controlled them.

**What steps should be taken to control turfgrass weeds?**

- a) Nonchemical control - appropriate cultural management practices
- b) Chemical control
  - 1) Preemergence herbicides - applied to soil before weeds germinate
  - 2) Postemergence herbicides - applied to weeds when they are actively growing
  - 3) Selective herbicides - kills some weeds but not others

- 4) Nonselective herbicides - kills all plants

- 4. Ask students if they have had any diseases in their lawns.

**What are the different turfgrass diseases that occur in Missouri during spring, summer, and autumn?**

- a) Snow mold - late winter and early spring
- b) Pythium blight - summer
- c) Fairy rings - spring, summer, and autumn
- d) Dollar spot - spring, summer, and autumn
- e) Fusarium blight - summer
- f) Brown patch - summer

- 5. Ask students if they have tried to control diseases and how they controlled them.

**What steps should be taken to control turfgrass diseases?**

- a) Nonchemical control
  - 1) Planting grasses with high disease resistance
  - 2) Using proper cultural management practices
- b) Chemical control-fungicides
  - 1) Systemic
  - 2) Nonsystemic

- 6. Ask students if they have had problems with insects in their lawns. Ask students to identify which insects caused the problems.

**What are the two most common turfgrass insects?**

- a) White grubs
- b) Sod webworms

- 7. Ask students if they have had problems with insects and how they controlled them.

**What steps should be taken to control turfgrass insects?**

Nonchemical (dethatching) and chemical control should be used together.

#### F. Other activities

- 1. Take students outside on school grounds to identify weeds, to detect and identify diseases, and to detect and identify insects.
- 2. Make a weed collection of those weeds listed in the student's reference.

#### G. Conclusion

Weeds, diseases, and insects occur in turf mainly as a result of poor cultural management practices; and can be controlled by either chemical or nonchemical practices.

#### H. Competency

Identify common pests in turfgrass and explain how to control these pests.

**I.     Answers to Evaluation**

- 1.     b**
- 2.     c**
- 3.     d**
- 4.     d**
- 5.     a**
- 6.     d**
- 7.     b**
- 8.     a**
- 9.     d**
- 10.    b**

EVALUATION

Circle the letter that corresponds to the best answer.

1. Which is the "king" of grassy weeds?
  - a. Buckhorn plantain
  - b. Crabgrass
  - c. Henbit
  - d. Wild onion
2. Which of the following is a broadleaf perennial weed with a fleshy taproot and yellow flower?
  - a. Clover
  - b. Crabgrass
  - c. Dandelion
  - d. Nutsedge
3. Which of the following weeds oozes a white, milky sap?
  - a. Broadleaf plantain
  - b. Common chickweed
  - c. Curly dock
  - d. Prostrate spurge
4. Which of the following weeds has a strong odor?
  - a. Curly dock
  - b. Dandelion
  - c. Henbit
  - d. Wild onion
5. Which of the following herbicides will kill any plant that it contacts?
  - a. Nonselective
  - b. Postemergence
  - c. Preemergence
  - d. Selective
6. Which of the following diseases thrives at or near freezing temperatures?
  - a. Brown patch
  - b. Fairy rings
  - c. Pythium blight
  - d. Snow mold

7. Which of the following diseases has mushrooms or puffballs?
- a. Dollar spot
  - b. Fairy rings
  - c. Fusarium blight
  - d. Snow mold
8. Which of the following diseases mainly attacks tall fescue?
- a. Brown patch
  - b. Dollar spot
  - c. Fairy rings
  - d. Snow mold
9. Which of the following move within the the plant as a preventative measure for diseases?
- a. Nonselective herbicides
  - b. Nonsystemic fungicides
  - c. Preemergence herbicides
  - d. Systemic fungicides
10. How many white grubs per square feet does it take to indicate need for eradication?
- a. Two
  - b. Seven
  - c. Fifteen
  - d. Fifty

## UNIT IX - SITE ANALYSIS AND EVALUATION

### Lesson 1: Introduction to Landscape Design

Objective: The student will be able to analyze a landscape site.

#### Study Questions

1. **What is meant by landscape design?**
2. **What is the purpose of a landscape design?**
3. **What do the terms site, on-site, and off-site mean?**
4. **What factors should be considered when preparing a landscape design?**
5. **What are the three major use areas of a landscape design?**
6. **What does a landscape designer need to know about zoning regulations?**

#### References

1. Landscaping and Turf Management. (Student Reference). University of Missouri-Columbia: Instructional Materials Laboratory, 1990.
2. Work Sheet
  - a) WS 1.1: Calculating Slope
3. Job Sheet
  - a) JS 1.1: Site Analysis and Family Needs Checklist



## UNIT IX - SITE ANALYSIS AND EVALUATION

### Lesson 1: Introduction to Landscape Design

#### TEACHING PROCEDURES

##### A. Review

Review previous lesson.

##### B. Motivation

Before a landscape can be designed, the site must be evaluated. Some plants on the site may need to be removed while others can be used in the new landscape plan. Using existing plants will save money for the homeowner or client.

##### C. Assignment

##### D. Supervised study

##### E. Discussion

1. Ask the students to define a landscape design.

#### **What is meant by landscape design?**

Landscape design is an art combined with practical science that produces a unified, working composition.

2. Ask students why they think a landscape design is important.

#### **What is the purpose of a landscape design?**

Landscape design is the written and drawn form of communication between the designer and client. It is important in showing interrelationships of the areas of the design. Written and drawn ideas have less chance of being forgotten.

3. Ask students to give definitions of site, on-site, and off-site.

#### **What do the terms site, on-site, and off-site mean?**

- a) Site - an area to be, designed, installed, and maintained
- b) On-site - any vegetation, features, and buildings already existing on the area
- c) Off-site - any vegetation, features, and buildings existing within sight or sound of the area, but not located on the area; e.g., highway, trash area, and trees

4. Ask students what questions are important to ask a client before the actual design process begins. Have students complete WS 1.1. The site analysis and analysis of family needs are discussed more in unit XI, Lesson 5.

#### **What factors should be considered when preparing a landscape design?**

- a) Site analysis - any information about the physical site

- b) Analysis of family needs - how a family's desires can be considered in the landscape plan in order to meet personal needs
- 5. Ask students what rooms exist in their homes. Ask students what "rooms" might exist in a landscape design.

**What are the three major use areas of a landscape design?**

- a) Public area - part of site open to public view at all times
  - b) Private area - part of site intended for private use
  - c) Service area - part of site for utility or work
6. Ask students to define zoning regulations.

**What does a landscape designer need to know about zoning regulations?**

Zoning regulations are important to know before any construction is planned or additions are made in a landscape. The purpose of these regulations is public safety. The regulations can be obtained from the local city hall.

**F. Other activities**

- 1. Have students site-analyze the classroom.
- 2. Have students "Interview" potential clients using a checklist.
- 3. Invite someone from city hall to visit the classroom and explain zoning regulations.

**G. Conclusion**

Analyzing the site is a step in the process of designing the landscape. Knowing what is already present on a site and the needs of the client are important to analysis. A landscape design usually includes three use areas. A designer must be aware of local zoning regulations.

**H. Competency**

Analyze a landscape site.

**I. Answers to Evaluation**

- 1. c
- 2. b
- 3. b
- 4. c
- 5. d
- 6. Answers may include three of the following:
  - a) Terrain
  - b) Vegetation, house; other buildings and objects on-site
  - c) Regional factors
  - d) Zoning regulations
  - e) Location of utilities
  - f) Off-site features
  - g) Directions of prevailing seasonal winds

h) Location of North in relation to site

7. Answers may include three of the following:

- a) Age, sex, and hobbies of each family member
- b) Personal plant preferences
- c) Amount of time available for maintenance
- d) Whether home is permanent or temporary residence
- e) Location of service areas
- f) Additions to existing buildings; decks, patios, or a swimming pool

J. Answers to Work Sheet

W.S. 1.1

1. a)  $\frac{12}{50} \times 100 = 24\%$

b) Plant groundcovers and/or shrubs on bank.

2. a)  $\frac{6}{75} \times 100 = 8\%$

b) Yes

3. a)  $\frac{18}{40} \times 100 = 45\%$

b) Steps or terracing will be required.

4. a)  $\frac{1}{17} \times 100 = 6\% (5.88)$

b) No

UNIT IX - SITE ANALYSIS AND EVALUATION

Name \_\_\_\_\_

Lesson 1: Introduction to Landscape Design

Date \_\_\_\_\_

EVALUATION

**Circle the letter that corresponds to the best answer.**

1. What is the definition of landscape design?
  - a. An art
  - b. A practical science
  - c. Combination of an art and practical science
  - d. Elements and principles
2. What is the term for any vegetation, buildings, or objects existing within sight or sound of site?
  - a. Near-site
  - b. Off-site
  - c. On-site
  - d. Site
3. Where is the public use area usually located?
  - a. In the back yard
  - b. In the front yard
  - c. In the side yard
  - d. Near the driveway
4. Which use area is also considered the utility area?
  - a. Private
  - b. Public
  - c. Service
  - d. None of the above
5. Which is true of zoning regulations?
  - a. Are the same for each state
  - b. Are the same for each town
  - c. Differ for each home
  - d. Differ for each town

**Complete the following short answer questions.**

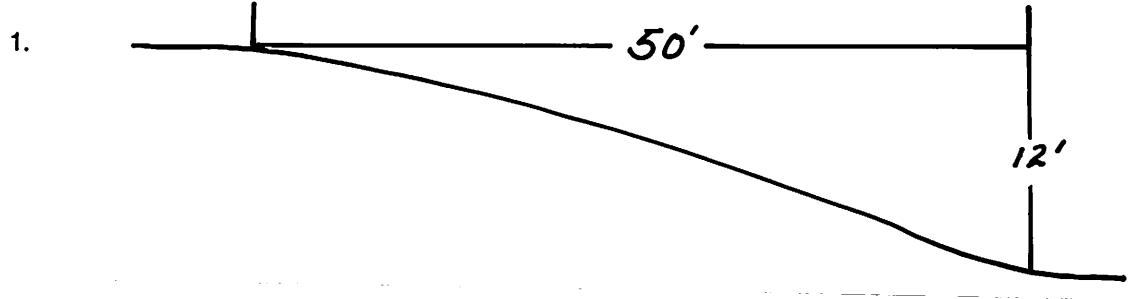
6. What are three factors that should be considered in a site analysis?
  - a.
  - b.
  - c.

7. What are three factors that should be considered for analysis of family needs?
- a.
  - b.
  - c.

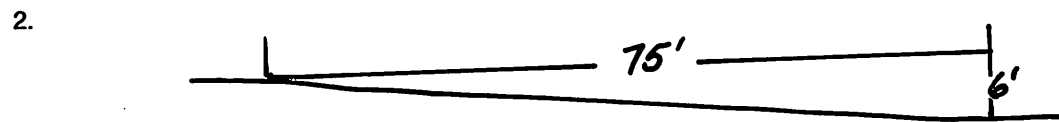
## Lesson 1: Introduction to Landscape Design

## Work Sheet 1.1: Calculating Slope

Calculate the percentage of slope and answer the questions for the following. (Show your work.)

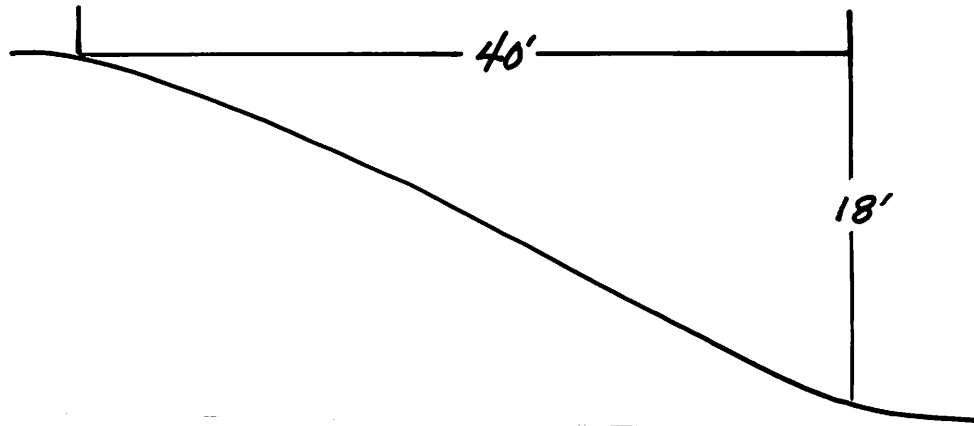


- a) Percentage of slope
- b) What is the suggested landscape use for this slope?



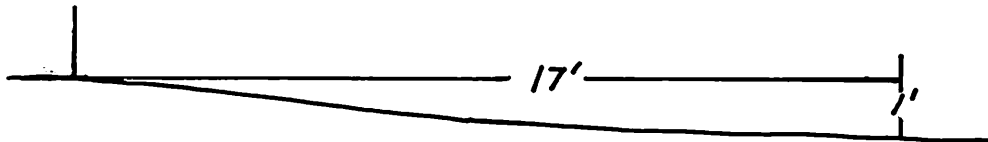
- a) Percentage of slope
- b) Is this slope suitable for a drive?

3.



- a) Percentage of slope
- b) What is the suggested landscape use for this slope?

4.



- a) Percentage of slope
- b) Is this slope suitable for a patio?

## **UNIT IX - SITE ANALYSIS AND EVALUATION**

**JS 1.1**

### **Lesson 1: Introduction to Landscape Design**

#### **Job Sheet 1.1: Site Analysis and Family Needs Checklist**

**Objective:** Upon completion of this job sheet, the student will be able to interview a potential client with a site analysis checklist and family needs checklist.

#### **Materials and Supplies Needed:**

1. Site analysis checklist
2. Family needs checklist
3. Pencil
4. Potential client
5. Site

#### **Procedure:**

1. If necessary, call client for appointment.
2. Interview client with family needs checklist.
3. Analyze site with site analysis checklist.
4. Roughly sketch site in space provided below.



## UNIT IX - SITE ANALYSIS AND EVALUATION

### Lesson 2: Drawing a Base Map

**Objective:** The student will be able to accurately measure a landscape site and draw a base map to scale.

#### Study Questions

- 1. What information is provided on a base map?**
- 2. How are structures located on a base map?**
- 3. What tools and equipment are needed to draw a base map?**
- 4. What types of scales can be used on a base map?**

#### References

1. Landscaping and Turf Management (Student Reference)., University of Missouri-Columbia: Instructional Materials Laboratory, 1990.
2. Job Sheets
  - a) JS 2.1: Measuring a Site
  - b) JS 2.2: Drawing a Base Map

## UNIT IX - SITE ANALYSIS AND EVALUATION

### Lesson 2: Drawing a Base Map

#### TEACHING PROCEDURES

##### A. Review

Review previous lesson. Review measuring techniques.

##### B. Motivation

Before any landscape plan can be drawn or designed, measurements are necessary. Accurate and proper measurements will help ensure a successful placement of elements in a landscape design.

##### C. Assignment

##### D. Supervised study

##### E. Discussion

1. Ask the students what features might be found on a landscape site.

#### **What information is provided on a base map?**

A base map includes any information gained by a site analysis; such as existing buildings, north direction arrow, and vegetation.

2. Ask students how they are able to find cities and distances between cities on a map.

#### **How are structures located on a base map?**

Using graph paper, orient the map to existing road or boundary lines; then step-off or measure existing features of the site, and draw them in.

3. Ask students what tools and equipment are needed for painting a picture or making a drawing; then ask which of these tools could be used for drawing a base map.

#### **What tools and equipment are needed to draw a base map?**

##### a) Primary tools and equipment

- 1) Pencil (sharp, fine lead, number two)
- 2) Tracing paper or graph paper - 11" x 17" suggested
- 3) Drafting tape
- 4) Sketch paper or pad
- 5) Eraser

##### b) Supportive drawing equipment

- 1) Drawing table or drafting board
- 2) T-square or parallel rule
- 3) Triangles
- 4) Templates
- 5) Lettering guides

4. Ask students what kinds of scales can be used for measuring.

**What types of scales can be used on a base map?**

- a) Architect's scale
- b) Engineer's scale
- c) Metric scale

**F. Other activities**

1. Have students determine their natural stride (step-off).
2. Have students practice using an architect's scale.

**G. Conclusion**

In order to design a landscape, the site must be accurately measured and drawn to scale on a base map.

**H. Competency**

Draw a base map to scale.

**I. Answers to Evaluation**

1. Answers should include five of the following:  
north arrow  
utility line location  
existing vegetation, buildings, and features  
sunrise and sunset positions  
good views and poor views  
measurements
2. Answers should include five of the following:  
pencils  
tracing paper or graph paper  
drafting tape  
sketch paper or pads  
drawing table or drafting board  
T-square or parallel rule  
triangles  
templates  
lettering guides
3. The instructor needs to determine if this was completed satisfactorily.

UNIT IX - SITE ANALYSIS AND EVALUATION

Name \_\_\_\_\_

Lesson 2: Drawing a Base Map

Date \_\_\_\_\_

EVALUATION

**Complete the following short answer questions.**

1. List five items that can be found on a base map.
  - a.
  - b.
  - c.
  - d.
  - e.
2. List five tools or pieces of equipment used in drawing a base map.
  - a.
  - b.
  - c.
  - d.
  - e.
3. If you have not completed JS 2.1 and 2.2, check with your instructor about completing them at this time.

## Lesson 2: Drawing a Base Map

## Job Sheet 2.1: Measuring a Site

Objective: Upon completion of this job sheet the student will be able to measure a site with accuracy.

## Materials and Supplies Needed:

1. Tape measure
2. Paper and pencil
3. Site - to be determined by teacher

## Procedure:

1. Work in pairs.
2. Roughly sketch the site on a separate sheet of paper, writing in the measurements. Be sure to measure in feet and inches.
3. Measure the dimensions, both length and width of the property boundaries of the site.
4. Measure the dimensions of the house and any other buildings on the property.
5. Measure the distance from the house to the property boundaries by locating a corner of the house. See Figure 1.1. If the house is not parallel to property lines, locate two corners of the house. See Figure 1.2.
6. Measure all existing traffic patterns (sidewalks, driveways, pathways, etc.) in location to the house.
7. Measure existing vegetation or garden areas from a well-established point, such as from the house. Trees and shrubs should be measured from their centers. Indicate names of plants, if known. See Figure 1.3.
8. Measure any existing slope.
9. Measure base and heights of windows and doorways of house and put measurements on a separate sheet of paper for future reference. Roughly sketch the placement of windows and doorways.

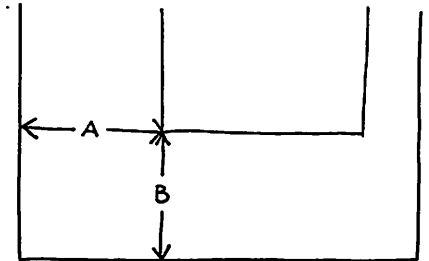


Figure 1.1

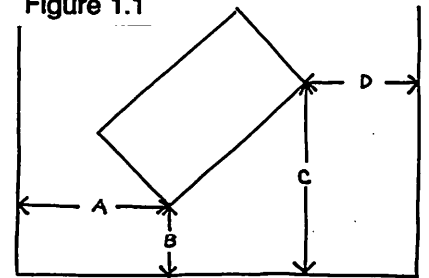


Figure 1.2

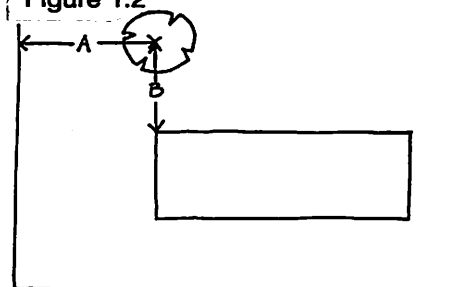


Figure 1.3

## Lesson 2: Drawing a Base Map

## Job Sheet 2.2: Drawing a Base Map

**Objective:** Upon completion of this job sheet the student will be able to draw a base map.

**Materials and Supplies Needed:**

1. Pencil and eraser
2. Graph paper - 11 x 17 is suggested
3. Ruler
4. Measurements and notes from JS 2.1

**Procedure:**

1. Draw the measurements taken from JS 2.1 to scale using a 1/10 scale. Be sure to make the base map structures as large as possible to fit the piece of paper.
2. Draw property boundaries first.
3. Next draw the house using one or two corners of the house to accurately place it on the property. Make the house dimensions with a thicker line than the boundary line. See Figure 2.1.
4. Draw in windows and doorways of the house. See Figure 2.2.
5. Draw traffic patterns from a well-established point.
6. Draw in any vegetation from a well-established point.
7. Add any helpful notes or information to the base map.

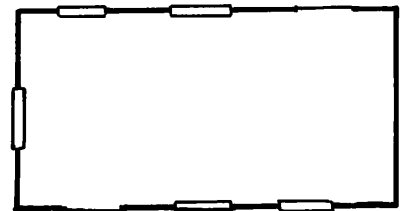


Figure 2.1

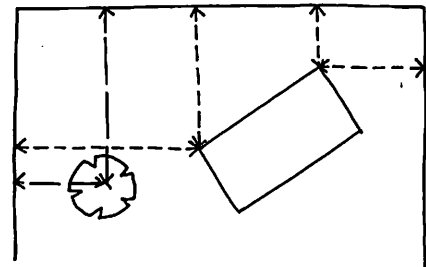


Figure 2.2

## UNIT IX - SITE ANALYSIS AND EVALUATION

### Lesson 3: Interpreting a Landscape Plan

**Objective:** The student will be able to effectively use symbols on a landscape plan.

#### Study Questions

- 1. What are the major features on a landscape plan?**
- 2. What information is used in a title block?**
- 3. What additional types of drawings are used to illustrate a landscape plan to the client?**

#### References

1. Landscaping and Turf Management (Student Reference). University of Missouri-Columbia: Instructional Materials Laboratory, 1990.
2. Work Sheet
  - a) WS 3.1: Title Blocks

## UNIT IX - SITE ANALYSIS AND EVALUATION

### Lesson 3: Interpreting a Landscape Plan

#### TEACHING PROCEDURES

##### A. Review

Review Unit IX, Lesson 2.

##### B. Motivation

A clean, concise landscape plan effectively represented with symbols will help sell a landscape design. It will communicate to the client exactly what the landscape designer's ideas are.

##### C. Assignment

##### D. Supervised study

##### E. Discussion

1. Ask the students to list typical symbols seen daily, such as stop signs. Ask students what features of a landscape plan might need a symbol.

#### **What are the major features on a landscape plan?**

- a) Design symbols
    - 1) Variations of circles
      - (a) Deciduous trees
      - (b) Evergreen trees
    - 2) Variations of lines
    - 3) Written scale
    - 4) Directional indicator
  - b) Plant list
  - c) Letterings
  - d) Title block
2. Ask students what information is found in a legend of a map.

#### **What information is used in a title block?**

- a) Title of the project
- b) Name of client
- c) Address of property designed
- d) Name or initials of designer or company
- e) Date design was completed
- f) Scale used
- g) Directional indicator



3. Ask students how else a designer might communicate ideas to the client.

**What additional types of drawings are used to illustrate a landscape plan to a client?**

- a) Elevational drawing
- b) Perspective view drawing
- c) Construction-detail drawing

**F. Other activities**

1. Have students practice drawing design symbols.
2. Have students practice placing and filling in title blocks.
3. Have students practice lettering, with emphasis on legibility.

**G. Conclusion**

Design symbols and a title block on the landscape plan are important data that communicate the designer's ideas to a potential client.

**H. Competency**

Effectively use design symbols in a landscape plan.

**I. Answers to Evaluation**

1. b
2. a
3. d
4. a
5. c
6. Answers should include three of the following: botanical name; size; quantity; conditions of plants; client's name.
7. Answers should include three of the following: title of project; designer's initials; name of landscape firm; date plan was completed; address of property.
8. up to the teacher's discretion

**J. Answers to WS 3.1 - up to the teacher's discretion**

UNIT IX - SITE ANALYSIS AND EVALUATION

Name \_\_\_\_\_

Lesson 3: Interpreting a Landscape Plan

Date \_\_\_\_\_

EVALUATION

**Circle the letter that corresponds to the best answer.**

1. Variations of what symbol represent ground cover?
  - a. Circle
  - b. Color
  - c. Lettering
  - d. Line
2. What do symbols represent in landscape designs?
  - a. Drawings of overhead views of features
  - b. Exact placements
  - c. Perspective view drawings
  - d. Title blocks
3. Which of the following is not a symbol?
  - a. Directional indicator
  - b. Lettering
  - c. Lines
  - d. Title block
4. Which of the following is the most common method of lettering?
  - a. Freehand
  - b. Lettering guides
  - c. Lettering tape machine
  - d. Waxed press-on letters
5. Which of the following is not a type of drawing used to illustrate a landscape plan?
  - a. Construction-detail drawing
  - b. Elevational drawing
  - c. Landscape method drawing
  - d. Perspective view drawing

**Complete the following short answer questions.**

6. What are three items found in a plant list?
  - a.
  - b.
  - c.

- 
- 
-

Lesson 3: Interpreting a Landscape Plan

Work Sheet 3.1: Title Blocks

**Add the following information in block title form to your base map drawing (JS 2.2).**

1. Scale of drawing
2. Owner's name
3. Property address
4. North directional arrow
5. Date
6. Title of the project
7. Name or initials of designer or company

## UNIT X - SELECTING AND USING PLANTS IN THE LANDSCAPE

### Lesson 1: Selecting Trees for the Landscape

**Objective:** The student will be able to describe the purposes of trees in the landscape and factors considered in selecting trees.

#### Study Questions

- 1. What are the purposes of trees in the landscape?**
- 2. What should be considered when selecting trees for the landscape?**
- 3. What are the selection criteria for common trees?**

#### Reference

- 1. Landscaping and Turf Management (Student Reference). University of Missouri-Columbia: Instructional Materials Laboratory, 1990.**

## UNIT X - SELECTING AND USING PLANTS IN THE LANDSCAPE

### Lesson 1: Selecting Trees for the Landscape

#### TEACHING PROCEDURES

##### A. Introduction

Since trees are the largest and most dominant element in a landscape, appropriate selection is extremely important. A landscaper must be able to select trees according to the theme of the design, functions required, and personal desires of the client.

##### B. Motivation

Explain that trees are the most permanent element in the landscape and that their selection is important to the theme of the design. The tree selected should fulfill the purpose intended.

##### C. Assignment

##### D. Supervised study

##### E. Discussion

1. Ask students to think of ways they have seen trees used in the landscape.

#### **What are the purposes of trees in the landscape?**

##### a) Climatic Effects

- 1) Help purify air
- 2) Reduce noise levels
- 3) Help control erosion
- 4) Increase or decrease wind
- 5) Cool air through transpiration
- 6) Provide shade, reducing room and ground temperature, and blocking direct rays from sun
- 7) Obstruct, deflect, and filter air flow for the benefit of small plants, animals, and property

##### b) Aesthetics

- 1) Ceiling for an outdoor room
- 2) Create feeling of intimacy
- 3) Variety of colors, forms, textures, and patterns
- 4) Frame and accentuate design and structure detail of a house
- 5) Soften or complement architectural lines
- 6) Provide welcoming effect for an entrance
- 7) Frame views, provide focal points, and form vistas
- 8) Spark up monotony of pavement and masonry
- 9) Provide play areas
- 10) Provide shade
- 11) Screen out unsightly views
- 12) Provide privacy
- 13) Provide flowery fragrances, peaceful sounds
- 14) Provide a flowering, focal point
- 15) Provide seasonal variety

- 16) Help new residences look established
  - 17) Provide backdrop for other plant material
  - 18) Attract birds
  - c) Economic value - Increase property value
  - d) Psychological effect
    - 1) Increase social activity
    - 2) Promote good community relations
    - 3) Increase productivity and lower absenteeism in industry
  - e) Purposes of deciduous trees
    - 1) Seasonal changes of color, line, texture, and pattern
    - 2) Energy conservation
      - (a) Shade in summer
      - (b) Planting only deciduous plants on south side of house so in the winter sun's rays can filter through and help heat house
  - f) Purposes of evergreens
    - 1) As screens, sound barriers, to provide privacy, and as backdrops for other plantings
    - 2) On north side of house, keeps winds from reducing heat inside house
    - 3) Only slight, seasonal color change
    - 4) May produce flowers and fruits
2. Ask students to think about what they should know about a tree before selecting it for landscape.

**What should be considered when selecting trees for the landscape?**

- a) Location
- b) Purpose of tree
- c) Avoidance of:
  - 1) Those susceptible to storm damage
  - 2) Those with weak wood
  - 3) Those susceptible to pests and diseases
  - 4) Those that produce unwanted seeds or fruit
- d) Existing conditions
  - 1) Room for top and root growth
  - 2) Soil type
  - 3) pH
  - 4) Subsurface drainage
  - 5) Amount of available light
- e) Plant characteristics
  - 1) Hardiness of plant and hardiness zone of location
  - 2) Height at maturity
  - 3) Width at maturity
  - 4) Form
  - 5) Growth habit
  - 6) Branching habit
  - 7) Rate of growth
  - 8) Water, light, fertilization, and temperature requirements
  - 9) Leaf color (in all seasons)
  - 10) Flower color, type, and time of bloom
  - 11) Fruit type, color, and time of production
  - 12) Texture
  - 13) Disease, insect problems, and control methods
  - 14) Pruning requirements

- 15) Ability to be transplanted
  - 16) Life span
  - 17) Availability
  - 18) Function in landscape
  - 19) Salt tolerance
  - 20) Spacing
  - 21) Maintenance
- e) Considerations in selecting street trees
- 1) Ability to permit free pedestrian and traffic movement
  - 2) Ability to avoid interference with overhead or underground utility installation
  - 3) Ability to avoid interference of traffic sighting distance
  - 4) Ability to provide desired shade and appearance
  - 5) Suitability to available space
  - 6) Hardiness and maintenance requirements
3. Take the class on a field trip to see how trees are used in the landscape. Ask the students to critique the landscape using the information in the charts as a basis for the correct use of trees. Have them tell if the tree is or is not an appropriate choice and why. If it is not, ask what would be a better choice. Have the students continue filling out the work sheet started in Unit III.

NOTE: All tree selection tables are in the student reference.

#### What are the selection criteria for common trees?

- a) Shade trees
- 1) Acer rubrum - red maple
  - 2) Acer saccharum - sugar maple
  - 3) Betula nigra - river birch
  - 4) Betula pendula - European white birch
  - 5) Fraxinus Pennsylvanica - green ash
  - 6) Gleditsia triacanthos var. inermis - thornless honey locust
  - 7) Liquidamba styraciflua - sweet gum
  - 8) Liriodendron tulipifera - tulip tree
  - 9) Platanus occidentalis - sycamore
  - 10) Quercus palustris - pin oak
  - 11) Tilia cordata - little leaf linden
- b) Flowering trees
- 1) Albizia julibrissin - mimosa
  - 2) Cercis canadensis - eastern redbud
  - 3) Cornus florida - flowering dogwood
  - 4) Crataegus phaenopyrum - Washington Hawthorne
  - 5) Koelreuteria paniculata - golden raintree
  - 6) Magnolia soulangeana - saucer magnolia
  - 7) Malus species - flowering crabapple
  - 8) Pyrus calleryana 'Bradford' - Bradford pear
- c) Evergreen trees
- 1) Ilex opaca - American holly
  - 2) Juniperus virginiana - canary juniper
  - 3) Magnolia grandiflora - southern magnolia
  - 4) Picea abies - Norway spruce
  - 5) Picea pungens glauca var. - blue spruce
  - 6) Pinus nigra - Austrian pine
  - 7) Pinus strobus - white pine



- 8) Pinus sylvestris - Scotch pine
- 9) Tsuga canadensis - hemlock

F. Other activity

Have the students select a location to plant a tree (on the school campus). Then have them select a tree that would suit the chosen location based on information found in the lesson. Have them plant their selection (obtain plants from local nursery/garden center).

G. Conclusion

Trees perform various functions in a landscape. Trees add climatic, aesthetic, economic, and psychological value to a landscape. Criteria such as location, purpose, existing conditions, and plant characteristics should be considered before selecting a tree. Each tree has unique characteristics which help determine if the tree will be a good choice.

H. Competency

Select trees for specific purposes in the landscape.

I. Answers to Evaluation

- 1. b
- 2. a
- 3. d
- 4. c
- 5. d
- 6. d
- 7. Up to instructor's discretion

## EVALUATION

**Circle the letter that corresponds to the best answer.**

1. Ted wants to plant a tree in his mother's yard for a Mother's Day gift. Which of the following should not be a consideration before planting the tree?
  - a. Existing conditions in planting location such as soil type, pH, drainage, and amount of light available
  - b. If it is a fast growing tree which will quickly fill in space
  - c. Location and purpose the tree will serve
  - d. Plant characteristics such as height to expect at maturity, soil preference, form, growth habit, and water requirements
2. The following characteristics belong to which tree? It is used for quick shade, has winged seeds for fruit, is drought resistant, and Marshall's seedless is a cultivar.
  - a. Green ash
  - b. Honey locust
  - c. Littleleaf linden
  - d. Red maple
3. What is the Missouri State Tree, which is an understory tree growing to less than 25 feet, and blooming in the early spring with white flowers?
  - a. Bradford pear
  - b. Eastern redbud
  - c. Flowering crabapple
  - d. Flowering dogwood
4. Of the three pine trees studied, which one is a poor choice as an ornamental tree because of nematode problems?
  - a. White pine
  - b. Austrian pine
  - c. Scotch pine
  - d. None of the above
5. What is a narrow-leaf evergreen tree, used as an understory tree; that should be planted on a north exposure, does not like dry winds or prolonged heat, and gets sun scorch in temperature over 95°F?
  - a. Austrian pine
  - b. Blue spruce
  - c. Eastern red cedar
  - d. Hemlock

6. What is a hardy tree that grows to 70 feet, has exfoliating bark, tolerates many soils including alkaline, can tolerate city conditions; but should not be used there since it has messy, prickly balls that remain on the tree after the leaves fall and drop periodically during the winter?
- a. Tulip tree
  - b. Sugar maple
  - c. Sweet gum
  - d. Sycamore

**Complete the following short answer question.**

7. What are five purposes trees serve in the landscape?
- a.
  - b.
  - c.
  - d.
  - e.

## UNIT X - SELECTING AND USING PLANTS IN THE LANDSCAPE

### Lesson 2: Selecting Shrubs and Hedges for the Landscape

**Objective:** The student will be able to select shrubs or hedges to fulfill desired purposes in a landscape plan.

#### Study Questions

- 1. What are the purposes of shrubs and hedges in the landscape?**
- 2. What should be considered when selecting shrubs and hedges for the landscape?**
- 3. What are the selection criteria for common shrubs?**

#### Reference

1. Landscaping and Turf Management (Student Reference). University of Missouri-Columbia: Instructional Materials Laboratory, 1990.

## UNIT X - SELECTING AND USING PLANTS IN THE LANDSCAPE

### Lesson 2: Selecting Shrubs and Hedges for the Landscape

#### TEACHING PROCEDURES

##### A. Review

Review previous lesson. Review Unit III, Lesson 5.

##### B. Motivation

With the wide range of sizes, shapes, and varieties of shrubs; the selection process becomes a very important step in landscape design. Proper selection offers effective transition from trees and structures to ground, as well as fulfills various other purposes desired in a landscape plan.

##### C. Assignment

##### D. Supervised study

##### E. Discussion

1. Ask the students if they have shrubs or hedges in their yards. Have them describe where they are in the landscape and if they know why they were placed there. Ask them if they know the purposes of having shrubs or hedges.

#### **What are the purposes of shrubs and hedges in the landscape?**

##### a) Shrubs

- 1) Wall element in outdoor room
- 2) Enclose spaces
- 3) Define spaces
- 4) Transition plant from trees and structures to ground
- 5) Specimen or accent plant
- 6) Privacy and security - should be six feet tall, wide and dense
- 7) Screen
- 8) Help direct traffic
- 9) Focal point and seasonal effects
- 10) Soften harsh building lines
- 11) Absorb noise and serve as a windbreak
- 12) Air purifier

##### b) Hedges

- 1) Fence or screen for privacy
- 2) Low hedge (one foot or less) - border for flower beds and walks
- 3) Medium hedge (up to six feet)
  - (a) Property border
  - (b) Backdrop for other plants
- 4) Tall hedge (over six feet)
  - (a) Helps block wind and sun
  - (b) Screens unsightly objects or views

2. Ask the students if they were going to plant a shrub in their yard what would they want to know about the shrub and the location before planting. Ask them if the size or form of shrub would matter, or if the acidic soil or shade at the location would matter.

**What should be considered when selecting shrubs and hedges for the landscape?**

- a) Criteria listed for selection of trees
  - b) Texture
    - 1) Fine-textured shrubs
      - (a) Spaces appear larger
      - (b) Good backdrop for flowers
    - 2) Coarse-textured shrubs
      - (a) Better for large spaces
      - (b) Attract attention - counterbalance with more fine-textured plants
  - c) Size - varies widely, determination of mature size
  - d) Broad-leaved evergreens - reflect light making them look lighter in weight
  - e) Narrow-leaved evergreens
    - 1) Absorb light making them look heavy in weight
    - 2) Care must be used when planting with deciduous shrubs
  - f) Deciduous shrubs - winter stem colors vary
  - g) Consider mature form - pruning requires high maintenance
  - h) Formal or informal landscape - must be determined before selection
3. Take the class on a field trip to see how shrubs and hedges are used in a landscape. Ask the students to critique the landscape using the information in the charts as a guide. Have them tell if the shrub or hedge is or is not the correct choice for the location and why. If it is not, ask them for alternative choices. Have the students continue filling out the work sheet started in Unit III.

NOTE: All shrub selection tables are in the student reference

**What are the selection criteria for common shrubs?**

- a) Flowering Shrubs
  - 1) Berberis thunbergii - Japanese barberry
  - 2) Cornus sericea - redosier dogwood
  - 3) Chaenomeles speciosa - flowering quince
  - 4) Euonymus alatus - winged euonymus
  - 5) Forsythia x intermedia - border forsythia
  - 6) Ligustrum japonicum - wax leaf privet
  - 7) Nandina domesticum - nandina
  - 8) Pyracantha coccinea - scarlet firethorn
  - 9) Salix gracilistyla - rosegold pussywillow
  - 10) Spiraea vanhouttei - Vanhoutte spirea
  - 11) Syringa vulgaris - common lilac
- b) Evergreen Shrubs
  - 1) Buxus microphylla - Korean boxwood
  - 2) Euonymus kirutschovicus - spreading euonymus
  - 3) Ilex crenata 'helleri' - Japanese holly
  - 4) Juniperus chinensis 'hetzii' - hetzii juniper
  - 5) Juniperus chinensis 'phitzeriana' - phitzer juniper
  - 6) Mahonia aquifolium - Oregon grape holly
  - 7) Pinus mugo - mugo pine

- 8) Phododendron catawbiense - catawba rhododendron
- 9) Taxus cuspidata - Japanese yew
- 10) Thuja occidentalis - Eastern or American arborvitae or white cedar
- 11) Viburnum x rhytidophullodles - leatherleaf viburnum

F. Other activity

Have the students select a location for planting one or more shrubs on the school campus. Have them assess the campus to see if a hedge is needed to help direct traffic, or as a specimen, a windblock, or a screen (e.g. around trash dumpster). Then have them select a shrub to suit the location using the information found in the lesson. Have them plant their selection.

G. Conclusion

Shrubs serve as a transition from trees to the ground, help add depth and texture, define and enclose spaces, serve as specimen plants, and have many other purposes. Each shrub has its own unique characteristics that must be considered when selecting it for the landscape. Hedges serve to help direct traffic, provide a fence or screen, and they add a formal look to the landscape. Texture, size, form, and type (broad or narrow evergreen or deciduous) are major considerations in selecting shrubs.

H. Competency

Select effective shrubs and hedges for the landscape.

I. Answers to Evaluation

1. b
2. d
3. c
4. d
5. b
6. c
7. b
8. b

## EVALUATION

Circle the letter that corresponds to the best answer.

1. Which statement best describes hedges?
  - a) Hedges are several small hedge plants in a row.
  - b) Hedges are shrubs that are usually massed together to form an unbroken line, and are trimmed to have a formal look.
  - c) Shrubs are hedges that are usually massed together to form an unbroken line and are trimmed to have a formal look.
  - d) Hedges are planted in a scattered arrangement throughout the lawn.
2. Which is not a purpose served by shrubs?
  - a) To enclose spaces
  - b) To help direct traffic
  - c) To serve as a transition from trees to the ground
  - d) To serve as a ceiling in the outdoor room
3. Which is a hedge that is used to help block wind, sun, and unsightly objects or views?
  - a) Low hedge, one foot or less
  - b) Medium hedge, up to six feet tall
  - c) Tall hedge, over six feet tall
  - d) Extra-tall hedge, over 15 feet tall
4. What is an important element to consider when selecting a shrub, since it is at eye level in the landscape?
  - a) Form
  - b) Hardiness
  - c) Line
  - d) Texture
5. Which of the following shrubs would be a good choice to use for a hedge to help direct traffic?
  - a) Common lilac
  - b) Japanese barberry
  - c) Rosegold pussy willow
  - d) Vanhoutte spirea
6. For which of the following shrubs would the winter stem color be an important characteristic to consider, when selecting a shrub to fit into a specific color scheme?
  - a) Border forsythia
  - b) Flowering quince
  - c) Redosier dogwood
  - d) Scarlet firethorn



7. Which broad-leaf evergreen should be grown in the following conditions; north or east exposure, soil high in organic matter, slightly acidic soil, partial shade, and protected from drying winds?
- a) Japanese holly
  - b) Korean boxwood
  - c) Spreading euonymus
  - d) Winged euonymus
8. Which is one of the most frequently used evergreen shrubs; being very hardy, tolerant of poor soils, tolerant of sun or shade, upright or used as a hedge, free of serious pests or diseases, and easily pruned to keep its shape?
- a) American arborvitae
  - b) Japanese yew
  - c) Mugo pine
  - d) Oregon grape holly

## UNIT X - SELECTING AND USING PLANTS IN THE LANDSCAPE

### Lesson 3: Selecting Ground Covers and Vines

**Objective:** The student will be able to select vines and ground covers for effective use in a landscape.

#### Study Questions

- 1. What are the purposes of ground covers in the landscape?**
- 2. What should be considered when selecting ground covers for the landscape?**
- 3. What are the purposes of vines in the landscape?**
- 4. What should be considered when selecting vines for the landscape?**
- 5. What are the selection criteria for common ground covers and vines?**

#### Reference

1. Landscaping and Turf Management (Student Reference). University of Missouri-Columbia: Instructional Materials Laboratory, 1990.

## UNIT X - SELECTING AND USING PLANTS IN THE LANDSCAPE

### Lesson 3: Selecting Ground Covers and Vines

#### TEACHING PROCEDURES

##### A. Review

Review previous lesson and review Unit III, Lesson 6.

##### B. Motivation

Ground covers and vines are the landscape plants that can be used in small areas or areas where other plants will not work. Learning their purposes and how to select them can help a landscaper liven up an area that would otherwise not be landscaped.

##### C. Assignment

##### D. Supervised study

##### E. Discussion

1. Ask the students what they would do for a client who wanted something planted in a very narrow area, on a steep slope with heavy shade, or dry soil that gets heavy, goat traffic. Suggest the use of ground covers.

#### **What are the purposes of ground covers in the landscape?**

##### a) Uses

- 1) Steep slopes
- 2) Sunny or shady areas
- 3) Too wet or dry soil
- 4) Too acidic or alkaline soil
- 5) Hard-to-mow areas
  - (a) Along highways
  - (b) Around trees
- 6) Control of erosion
- 7) Narrow areas not suitable for turf
- 8) Along paths, and around stepping stones in a garden
- 9) Reduction of glare
- 10) Prevention of rapid drying of soil
- 11) Protection of shallow roots of trees and shrubs
- 12) Help prevent weeds

##### b) Aesthetic benefits

- 1) Integration of shrub or tree planting
- 2) Define ground planes
- 3) Variety of colors, textures, and patterns
- 4) Transition from turf to other plants or objects
- 5) Creation of harmony and tranquility in landscape

2. Continue the discussion from question 1. If the student chooses a favorite ground cover; that requires full sun, moist soil, and cannot withstand foot traffic, without checking into its cultural requirements; the plant may suffer and die.

**What should be considered when selecting ground covers for the landscape?**

- a) Determination of the status of existing site
    - 1) Shady or sunny
    - 2) Wet or dry soil
    - 3) Acidic or alkaline soil
    - 4) Hardiness zone - high and low temperatures
  - b) Determination of growth habit of ground cover
    - 1) Types of growth habit
      - (a) Vining
      - (b) Creeping - underground stolon
      - (c) Prostrate
    - 2) Mature size
    - 3) Cultural requirements - light, water, and temperature
    - 4) Planting time
      - (a) Avoiding winter heaving
      - (b) Allowing time to get it established before winter
3. Ask the students what they would do, as landscapers, for a client who had a huge bare wall on the south side of the house and wanted to mask it, but had only a 12 inch strip of soil along the house in which to plant. Suggest vines.

**What are the purposes of vines in the landscape?**

- a) Uses
    - 1) Provides more show for the least amount of ground space
    - 2) Screens
      - (a) Privacy
      - (b) Shade
    - 3) Beautifies fences or trellises
    - 4) Hides old tree stumps, utility poles, or dead trees
    - 5) Decorates rock walls
    - 6) As evergreen - year-round foliage
    - 7) As deciduous
      - (a) Seasonal interest - winter stem pattern
      - (b) Lets sun filter through in winter
  - c) Aesthetic benefits
    - 1) Softens fences, walls, and harsh architectural lines
    - 2) Creates a sense of ceiling and shelter
    - 3) Brings landscape down to human scale
4. Suppose the client described in the discussion before study question 3 had wet soil and wood siding on the house. Ask the students if these things would matter when they chose a vine to plant.

**What should be considered when selecting vines for the landscape?**

- a) Existing soil and climate conditions
- b) Method of climbing
  - 1) Twining
  - 2) Tendrils
  - 3) Clinging - not for use on wood
    - (a) Suction cups
    - (b) Aerial rootlets

- c) Rate of growth
  - d) Mature size - height and width
  - e) Texture, density, and color
  - f) Seasonal features
5. Take the students to sites around town where vines and ground covers are used. Have them critique the uses as outlined in lessons 1 and 2. Also take them to sites where ground covers or vines are not used, but could be. Have them determine which vine or ground cover would be appropriate for the location by using the tables in the student reference. Have the students continue filling in the work sheets started in Unit III.

NOTE: All selection criteria are located in the tables in the student reference.

**What are the selection criteria for common ground covers and vines?**

- a) Vines
  - 1) Celastrus scandens - American bittersweet
  - 2) Euonymus fortunei radicans - bigleaf wintercreeper  
NOTE: This is also a ground cover.
  - 3) Lonicera japonica 'Halliana' - Hall's honeysuckle
- b) Ground Covers
  - 1) Ajuga reptans - ajuga or bugleweed
  - 2) Coronilla varis - crown vetch
  - 3) Hedra helix - English Ivy  
NOTE: This is also a vine.
  - 4) Juniperus horizontalis - creeping juniper
  - 5) Vincia minor - creeping myrtle or periwinkle

**F. Other activity**

Have the students assess the school campus to see if the use of ground covers or vines would be beneficial in any area. Have them select the proper ground cover or vine for the location. Have them plant the selection. (Obtain plants from local nursery/garden center or grow in greenhouse).

**G. Conclusion**

Ground covers and vines can be used in many hard-to-grow places. Their versatility is helpful in the landscape. Some ground covers can be used as vines with the proper support. Vines must be chosen carefully to provide the proper surface on which they may grow.

**H. Competency**

Know the uses of vines and ground covers and select the species to suit the location to be planted.

**I. Answers to Evaluation**

- 1. b
- 2. d
- 3. a
- 4. a
- 5. d
- 6. b
- 7. d

## EVALUATION

Circle the letter that corresponds to the best answer.

1. Which is not a purpose served by ground covers in the landscape?
  - a. Used as a matrix to integrate and accent shrubs and borders
  - b. Used as a wall element in the outdoor room
  - c. Used in areas too narrow or small for other plants
  - d. Used in problem areas such as steep slopes, too wet or dry areas
2. Which of the following should not be considered when selecting ground covers?
  - a. Growth habit
  - b. Height
  - c. Sunlight and water requirements
  - d. Width
3. Which of the following is not a function of vines?
  - a. Used as a matrix to integrate and accent shrubs and borders
  - b. Used as a screen for privacy and shade
  - c. Used to fill in a large area with use of little ground space
  - d. Used to reduce heat and glare
4. What type of vines should not be used on wooden surfaces?
  - a. Clinging
  - b. Tendril climbing
  - c. Twining
  - d. Winding
5. Sue has an area in her backyard where she needs a ground cover and a vine. She wants to use the same plant for both purposes. There is a brick wall that will support the vine. The area is sunny in the morning and shady in the afternoon. Which of the following should she use?
  - a. Bugleweed
  - b. Creeping juniper
  - c. Crown vetch
  - d. English ivy
6. Tom has an area on a hillside that is in full sun and fairly dry where he wants to use a ground cover. He wants a fine-textured evergreen plant that has a bluish tint to it. Which of the following could be suggested?
  - a. American bittersweet
  - b. Creeping juniper
  - c. Crown vetch
  - d. Hall's honeysuckle

7. Bill has a steep hillside that cannot be mowed. This hill has poor soil and is eroding. It has a southern exposure. He wants a low-maintenance ground cover that blooms in summer. He wants this area to fill in quickly to prevent further erosion. Which of the following ground covers would be the best choice?
- a. Big leaf wintercreeper
  - b. Bugleweed or ajuga
  - c. Creeping juniper
  - d. Crown vetch

## UNIT X - SELECTING AND USING PLANTS IN THE LANDSCAPE

### Lesson 4: Selecting Flowers

**Objective:** The student will be able to describe the purposes of flowers and how to select flowers for the landscape.

#### Study Questions

- 1. What are the three groups of flowers?**
- 2. What are the purposes of flowers in the landscape?**
- 3. What should be considered when selecting flowers for the landscape?**
- 4. What are the selection criteria for common perennials?**

#### Reference

1. Landscaping and Turf Management (Student Reference). University of Missouri-Columbia: Instructional Materials Laboratory, 1990.



## UNIT X - SELECTING AND USING PLANTS IN THE LANDSCAPE

### Lesson 4: Selecting Flowers

#### TEACHING PROCEDURES

A. Review

B. Motivation

Flowers are the showiest element of the landscape. When the proper flowers are used in the proper context, a spectacular landscaping design can be made. Have some sample plants in pots on the desk or around the room for the students to see.

C. Assignment

D. Supervised study

E. Discussion

1. Ask students what various types of flowers they have planted or watched others plant.

**What are the three groups of flowers?**

- a) Annuals - bloom throughout season
    - 1) Hardy - can tolerate cool temperatures or frost
    - 2) Tender - cannot tolerate cool temperatures
  - b) Perennials - one blooming period per season
    - 1) Hardy - can winter outdoors
    - 2) Tender - must be brought in for winter
  - c) Biennials - 2 seasons: first year, vegetative; second year, flowering
2. Ask the students if they have been to an amusement park such as Six Flags or Worlds of Fun. Ask them if they noticed all of the many flower beds planted there. Ask them to imagine the park with out the flowers. Flowers can be displayed in many different ways and serve various purposes in landscape design.

**What are the purposes of flowers in the landscape?**

- a) Bed
  - 1) Focal point of design
  - 2) Viewed from all sides
  - 3) Does not have backdrop
  - 4) Not to be used in public area
- b) Border
  - 1) Placed in front of backdrop - house, sidewalk, fence
  - 2) Viewed from only one side
  - 3) Softens the edges of buildings, sidewalks, fences, and lawns
- c) Other uses
  - 1) Containers
  - 2) Rock gardens
  - 3) Mass plantings
  - 4) Edgings

- 5) Ground covers
  - 6) Hanging baskets
  - 7) Rock walls
  - 8) House plants
  - 9) Specimens
  - 10) Carpet and pattern beds
  - 11) Cut flowers
  - 12) Dried flowers
3. Perennials, as well as other flowers, are displayed in many different ways; including bed or border, hanging baskets, or containers. A perennial bed can be designed to have continuous color throughout the season. In order to do this, many factors must be considered such as when the plant blooms, and its height. Show the students slides or pictures of the same bed or border at different times in the summer. Point out that something is in bloom at all times and that this takes careful planning.

**What should be considered when selecting flowers for the landscape?**

- a) Existing site conditions
  - b) Design decisions
    - 1) Bed or border
    - 2) Informal or formal
    - 3) Color scheme
  - c) Other characteristics
    - 1) Height
    - 2) Color
    - 3) Spread (width)
    - 4) Form
    - 5) Texture
    - 6) Blooming season
    - 7) Length of blooming time
4. Each perennial has its own characteristics that make it unique. These characteristics must be known before one can select a plant for a landscape design. For example; some are sun lovers, and some are shade lovers. Take the students on a field trip to see perennial beds or borders. Have the students continue filling out the work sheet started in Unit III.

NOTE: All selection criteria are located in the tables in the student reference.

**What are the selection criteria for common perennials?**

- a) Artemisia schmidtiana - silver mound or silver king
- b) Astilbe x ardendsii - false spirea
- c) Aquilegia hybrids - columbine
- d) Chrysanthemum hybrids - mum
- e) Coreopsis lanceolata - coreopsis
- f) Hemerocallis hybrids - day lily
- g) Heuchera sanguinea - coral bells
- h) Hosta species - plantin lily
- i) Liriope spicata - lily turf
- j) Phlox subulata - creeping phlox

**F. Other activity**

Have the students choose a proper location for a perennial bed or border. Have the students choose perennials that would best suit the location. Have them design the bed or border so that something is in bloom all season long. Have them plant the perennials.

**G. Conclusion**

With the variety of color, texture, and seasonal interest flowers allow, they should be used often, but selected with care. Knowledge of individual characteristics of flowers help a landscaper make successful selections for a landscape plan.

**H. Competency**

Select a location and plants for a perennial bed or border.

**I. Answers to Evaluation**

1. d
2. a
3. b
4. b
5. c

6. Answers may include: plant height, flower color, plant width, form, texture, length of blooming time, and blooming season.

7. 1 (astilbe), 3 (garden mum), 2 (columbine)
8. b, d, c, a

EVALUATION

Circle the letter that corresponds to the best answer.

1. Which best describes perennials?
  - a. Complete their life cycle in one growing season
  - b. Complete their life cycle in two growing seasons
  - c. Grow vegetatively the first year and flower the second year
  - d. Live from year to year, dying in the winter and growing back the next year
2. What is characteristic of a group of flowers that the focal point of a design, is viewed from all sides, stands alone with no backdrop, and is not used in the public area of a yard?
  - a. Bed
  - b. Border
  - c. Garden
  - d. Mass planting
3. What are tubers, corms, rhizomes, and tuberous roots all examples of?
  - a. Bulbous annuals
  - b. Bulbous perennials
  - c. Hardy annuals
  - d. Tender annuals
4. What is characteristic of a group of flowers that is used in front of a backdrop of plants or a house, is viewed from only one side, and is no more than five feet deep?
  - a. Bed
  - b. Border
  - c. Edge planting
  - d. Garden
5. Which of the following perennials will grow best in full shade?
  - a. Coral bells
  - b. Lily turf
  - c. Plantin lily
  - d. Silver mound

**Complete the following short answer questions.**

6. What are six of the factors to be considered when selecting a perennial to be planted in a flower bed?

a.

b.

c.

d.

e.

f.

7. Place the following perennials in the proper order for flowering sequence, with the first blooming earliest in the spring the third blooming last in the fall.

Astilbe

Garden mum

Columbine

8. Place the following list of perennials in order from shortest to tallest.

a. Day lily

b. Lily turf

c. Plantin lily

d. Silver mound

## UNIT X - SELECTING AND USING PLANTS IN THE LANDSCAPE

### Lesson 5: Selecting Turfgrasses

**Objective:** The student will be able to describe the purpose of turfgrass in landscaping and the criteria to consider when selecting a turfgrass.

#### Study Questions

- 1. What are the purposes of lawns in the landscape?**
- 2. What should be considered when selecting turfgrasses for the landscape?**
- 3. What are the characteristics for the six major turfgrasses used in Missouri?**

#### Reference

1. Landscaping and Turf Management (Student Reference). University of Missouri-Columbia: Instructional Materials Laboratory, 1990.

## UNIT X - SELECTING AND USING PLANTS IN THE LANDSCAPE

### Lesson 5: Selecting Turfgrasses

#### TEACHING PROCEDURES

##### A. Review

Review the previous lesson. Review Unit III, Lesson 7.

##### B. Motivation

In order to install and maintain a healthy turf, a landscaper must know how to select the grass that will be best suited for the area.

##### C. Assignment

##### D. Supervised study

##### E. Discussion

1. Ask the student to list all the ways they can think of that they have seen grass used.

#### **What are the purposes of lawns in the landscape?**

- a) Landscaping design
  - 1) Lowest growing plant material
  - 2) Finest texture
  - 3) Low, level foreground to build on
- b) Aesthetics
  - 1) Provide appealing, inviting, carpet around home
  - 2) Unify tree and flower plantings
  - 3) Provide play or work area
- c) Environment control
  - 1) Help control erosion
  - 2) Reduce sun's heat
  - 3) Reduce sun's glare

2. Ask the students to explain how they would choose a grass for their lawn.

#### **What should be considered when selecting turfgrasses for the landscape?**

- a) Microclimate factors
  - 1) Hardiness zone
  - 2) Average temperatures
  - 3) Moisture conditions
  - 4) Sunny or shady areas
  - 5) Slopes, if any
  - 6) Soil condition
    - (a) Texture
    - (b) pH
- b) Species characteristics
  - 1) Temperature requirements

- (a) Cool-season
  - (b) Warm-season
- 2) Moisture tolerance
  - (a) Drought-tolerant
  - (b) Needs moisture
- 3) Annual or perennial
- 4) Light requirements
  - (a) Sun
  - (b) Shade
  - (c) Part sun, part shade
- 5) Durability
  - (a) Light traffic
  - (b) Heavy traffic
- 6) Habit of growth
  - (a) Creeping
  - (b) Bunching
- 7) Planting method
  - (a) Seeding
  - (b) Sprigging or plugging
- 8) Planting time
  - (a) Spring
  - (b) Fall
- 9) Planting rate
  - (a) Pounds of seed per square foot
  - (b) Sprigs per square foot
- 10) Rate of growth
- 11) Fertilization requirements
  - (a) Heavy
  - (b) Medium
  - (c) Low
- 12) Time of fertilization
  - (a) Spring
  - (b) Summer
  - (c) Fall
  - (d) Winter
- 13) Pests and diseases
  - (a) Resistance
  - (b) Susceptibility
- 14) Mowing height
- 15) Natural height
- 16) Used as a single species or a mixture

3. Take the students on a field trip to see as many of the types of grasses as possible. Notice the locations they are growing in and the purposes they serve. (football field, meadow, lawn, high traffic area, etc.) Notice their habit of growth (creeping or bunching).

NOTE: All selection criteria are located in the table in the student reference.

**What are the characteristics for the six major turfgrasses used in Missouri?**

- a. *Cynodon dactylon* - Bermudagrass
- b. *Festuca arundinacea* - Tall fescue
- c. *Festuca rubra* - Red fescue
- d. *Lodium perenne* - Perennial ryegrass



- e. *Poa pratensis* - Kentucky bluegrass
- f. *Zoysia japonica* - Zoysia grass

**F. Other activity**

Have the students select a location on the school grounds that needs to have grass planted. Have them select the grass that would serve the purpose needed and that will grow in the location. Have them sow seed or plant sprigs.

**G. Conclusion**

Turfgrasses are used to create appealing lawns that serve to unify tree and flower plantings around a home. Turfgrasses are also used for parks, commercial sites, and athletic fields. The existing conditions on a site, as well as characteristics of an individual turfgrass, must be known in order to select a successful turfgrass for a growing site.

**H. Competency**

Select a turfgrass for a specific growing site.

**I. Answers to Evaluation**

1. c
2. b
3. d
4. a
5. b
6. b
7. Answers may include the following: provide a carpet of green, unify trees and flower plantings, control erosion, reduce glare, reduce heat, provide play or work area.

## EVALUATION

Circle the letter that corresponds to the best answer.

1. Which is not an important consideration when assessing a prospective site for planting turfgrass?
  - a. The amount of sunlight it receives
  - b. The average temperature
  - c. The planting time
  - d. The soil texture and pH
2. Kenny planted Bermudagrass under a grove of oak trees. His grass died. What did Kenny fail to check concerning the grass?
  - a. Disease problems
  - b. Light requirements
  - c. Moisture requirements
  - d. Seeding rate
3. Joe needs a warm-season, perennial grass that will spread to fill a large area and can be planted in late April. His lawn receives sun, but is partially shaded. What should he use?
  - a. Kentucky bluegrass
  - b. Perennial ryegrass
  - c. Tall fescue
  - d. Zoysia grass
4. Which of the following turfgrasses has a blue-green color?
  - a. Bermudagrass
  - b. Perennial ryegrass
  - c. Red fescue
  - d. Zoysia grass
5. Which is cool-season grass that has a rapid establishment time and is a creeping type of grass?
  - a. Bermudagrass
  - b. Kentucky blue grass
  - c. Red fescue
  - d. Zoysia grass
6. Which is a shade-tolerant grass that will not tolerate high heat and requires very little fertilizer?
  - a. Bermuda grass
  - b. Red fescue
  - c. Tall fescue
  - d. Zoysia grass

**Complete the following short answer question.**

7. What are five purposes of turfgrasses?

- a.
- b.
- c.
- d.
- e.

## UNIT XI - LANDSCAPE DESIGNING

### Lesson 1: Design Elements

**Objective:** The student will be able to identify and explain the four elements of landscape design.

#### Study Questions

- 1. How can various textures be used in the landscape?**
- 2. What are the basic plant forms?**
- 3. What environmental factors affect the impact of color in the landscape?**
- 4. How does line contribute to the landscape?**
- 5. How can the landscape design stimulate emotion?**

#### Reference

1. Landscaping and Turf Management (Student Reference). University of Missouri-Columbia, Instructional Materials Laboratory, 1990.

## UNIT XI - LANDSCAPE DESIGNING

### Lesson 1: Design Elements

#### TEACHING PROCEDURES

##### A. Introduction

Landscape design is not just choosing any plant to fit into a landscape. It is choosing the correct plant to fit a landscape plan, according to the plant's physical features.

##### B. Motivation

Landscape designers need to understand the design elements in order to create a unified landscape plan. An appealing landscape design will be saleable to the client.

##### C. Assignment

##### D. Supervised study

##### E. Discussion

1. Show class three plants with various textures and ask the students to compare and contrast the textures of these plants.

**How can various textures be used in the landscape?**

- a) Texture is relative to what is being compared.
  - b) Texture creates an illusion of depth.
    - 1) Fine textures recede.
    - 2) Coarse textures advance.
2. Provide students with three plants with different forms and ask them to compare and contrast the forms.

**What are the basic plant forms?**

- a) Vertical or upright
  - b) Horizontal or spreading
  - c) Pendulous
  - d) Trailing
  - e) Mounding
  - f) Irregular
  - g) Pyramidal
  - h) Columnar
  - i) Rounded
  - j) Oval
  - k) Vase-shaped
3. Ask students to name the primary colors. Ask students to compare and contrast the colors of three plants with different colors of green foliage.

**What environmental factors affect the impact of color in the landscape?**

- a) Season
- b) Weather conditions
- c) Time of day
- d) Distance
- e) Light intensity
- f) Background against which the color is placed

4. Provide students with three different plants and ask them to discuss the line of each.

**How does line contribute to the landscape?**

- a) Line defines form.
- b) Line gives direction.

5. Show students three different plants and ask them to discuss which plant they like best and why.

**How can the landscape design help to stimulate emotion?**

- a) Choice of size
- b) Choice of line
- c) Choice of color - warm and cool

**F. Other activities**

- 1. Have students make a texture chart, line chart, form chart, or color chart.
- 2. Take students on a field trip to a landscaped home and discuss the four elements of design in this particular landscape.

**G. Conclusion**

Line, form, color, and texture are the four elements of landscape design. These elements help to enhance a landscape design.

**H. Competency**

Identify and explain the four elements of landscape design.

**I. Answers to Evaluation**

- 1. d
- 2. a
- 3. a
- 4. c
- 5. b
- 6. d
- 7. b
- 8. c
- 9. a. Irregular  
b. Pyramidal  
c. Columnar

EVALUATION

Circle the letter that corresponds to the best answer.

1. Which is not a physical feature of a plant in relation to texture?
  - a. Bark
  - b. Branches
  - c. Foliage
  - d. Roots
2. What is simple leaf texture?
  - a. Coarse
  - b. Fine
  - c. Medium
  - d. Receding
3. Where is the best place for coarse plants in the landscape?
  - a. In the foreground
  - b. In the background
  - c. Under trees
  - d. Directly next to fine texture plants
4. How many dimensions does a plant form have?
  - a. One
  - b. Two
  - c. Three
  - d. Four
5. Which of the following will plants in their native habitat tend to grow as?
  - a. Pyramidal
  - b. Irregular
  - c. The weather
  - d. The terrain
6. Which of the following give the longest lasting color in the environment?
  - a. Bark
  - b. Buds
  - c. Flowers
  - d. Foliage

7. Which is not an environmental factor affecting color?

- a. Background
- b. Client's choice of color
- c. Season
- d. Time of day

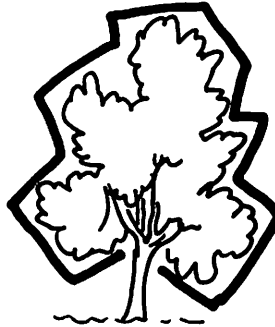
8. What feeling does tone in color help create?

- a. Craziness
- b. Happiness
- c. Peacefulness
- d. Sadness

Complete the following short answer question.

9. What are the following forms of plants?

a. \_\_\_\_\_



b. \_\_\_\_\_



c. \_\_\_\_\_





## UNIT XI - LANDSCAPE DESIGNING

### Lesson 2: Landscape Enrichments

**Objective:** The student will be able to implement the use of natural and manufactured materials in a landscape plan.

#### Study Questions

1. **What are the purposes of landscape enrichments?**
2. **What are some natural enrichments?**
3. **What should be considered when selecting natural enrichments for the landscape?**
4. **What are some types of manufactured enrichments?**
5. **What outdoor surfacing materials are used in the landscape?**

#### References

1. Landscaping and Turf Management (Student Reference). University of Missouri-Columbia: Instructional Materials Laboratory, 1990.
2. Work Sheet
  - a) WS 2.1: Landscape Enrichments

## UNIT XI - LANDSCAPE DESIGNING

### Lesson 2: Landscape Enrichments

#### TEACHING PROCEDURES

##### A. Review

Review the previous lesson.

##### B. Motivation

Landscaped areas can be enhanced with beautiful and properly placed plants. A landscaped area's attractiveness, as well as its monetary value, can be increased further by using natural and manufactured enrichments.

##### C. Assignment

##### D. Supervised study

##### E. Discussion

1. Ask students what the word "enrichment" means. Break the word down into its root word if they have difficulty with the meaning.

#### **What are the purposes of landscape enrichments?**

- a) Natural enrichments
    - 1) Enhance the landscape
    - 2) Create beauty and serenity in the landscape
  - b) Manufactured enrichments
    - 1) Add unity and harmony to the landscape plan
2. Ask students to recall a pleasant experience in nature and what elements added to their enjoyment of that place.

#### **What are some natural enrichments?**

- a) Tangible
    - 1) Stones, rocks, boulders
    - 2) Plants
    - 3) Water
    - 4) Animals
  - b) Intangible
    - 1) Sounds of nature; birds, wind, running water
    - 2) Scents of flowers and blossoms on shrubs and trees
    - 3) Taste of fruit and vegetables from garden areas
3. Ask students what they consider when selecting clothes; including the look, fit, and color coordination.

**What should be considered when selecting natural enrichments for the landscape?**

- a) Theme of landscape design
- b) Smell/allergies
- c) Attraction of unwanted animals

4. Ask students what manufactured means. Ask them to list manufactured items.

**What are some manufactured enrichments?**

- a) Outdoor furniture
- b) Outdoor art
- c) Pools and fountains
- d) Night lighting
  - 1) Silhouette lighting
  - 2) Shadow lighting
  - 3) Up lighting
  - 4) Down lighting

5. Discuss with students the materials needed to build a house.

**What outdoor surfacing materials can be used in the landscape?**

- a) Turf
- b) Ground covers
- c) Flowers
- d) Paving
  - 1) Hard
  - 2) Soft

F. Other activity

Take a field trip to see different types of construction materials and surfacing materials.

G. Conclusion

The landscape can be enhanced not only by proper placement of plants, but also with the addition of natural and manufactured enrichments. Natural enrichments are any objects of nature that can enhance the landscape. Construction and surfacing materials are manufactured enrichments that can be added to the landscape.

H. Competency

Implement the use of natural and manufactured enrichments in a landscape plan.

I. Answers to Evaluation

- 1. d
- 2. c
- 3. d
- 4. c
- 5. b

6. Answers may include: rocks, stones, decayed wood, boulders, plants, water, and animals.

7. Answers may include: sounds of animals; taste of fruit or vegetables; fragrance of flowers, trees, shrubs; songs of birds; sound of running water; wind in trees.

J. Answers to Work Sheet

Up to teacher's discretion

EVALUATION

**Circle the letter that best corresponds to the best answer.**

1. What are the purposes of manufactured enrichments?
  - a. Focal points and distinction
  - b. Grace and elegance
  - c. Line and distinction
  - d. Unity and harmony
2. A bird bath is what type of manufactured enrichment?
  - a. Night lighting
  - b. Outdoor furniture
  - c. Outdoor sculpture
  - d. Pools and fountains
3. Which of the following is a disadvantage of pools and fountains?
  - a. Being installed above ground
  - b. Being installed below ground
  - c. Enhances only plaza areas
  - d. High maintenance
4. Lighting that is placed behind plants outlining the plants is which type of night lighting?
  - a. Down
  - b. Shadow
  - c. Silhouette
  - d. Up
5. Which of the following is a soft paving material?
  - a. Concrete
  - b. Gravel
  - c. Stone
  - d. Tile

**Complete the following short answer questions.**

6. What are three tangible, natural enrichments?
  - a.
  - b.
  - c.

7. What are three intangible, natural enrichments?

a.

b.

c.

## Lesson 2: Landscape Enrichments

## Work Sheet 2.1: Landscape Enrichments

Walk the school campus, or another assigned site, and list the different types of enrichments that are found.

## MANUFACTURED ENRICHMENTS

Outdoor Furniture

- 1.
- 2.
- 3.

Outdoor Art

- 1.
- 2.
- 3.

Pools and Fountains

- 1.
- 2.
- 3.

Night Lighting

- 1.
- 2.
- 3.

## NATURAL ENRICHMENTS

Tangible

- 1.
- 2.
- 3.
- 4.

Intangible

- 1.
- 2.
- 3.
- 4.

Surfacing MaterialsPavingHard

- 1.
- 2.
- 3.

Soft

- 1.
- 2.
- 3.

Turf

- 1.
- 2.
- 3.

Ground Covers

- 1.
- 2.
- 3.

Flowers

- 1.
- 2.
- 3.

## UNIT XI - LANDSCAPE DESIGNING

### Lesson 3: Principles of Design

Objective: The student will be able to identify the five principles of design.

#### Study Questions

1. Why is it important to consider mature sizes of plants when planning the landscape?
2. What are the two types of balance and how do they differ?
3. What is rhythm in relation to landscape design?
4. How is simplicity achieved in a landscape design?
5. How can a focal point be established?

#### References

1. Landscaping and Turf Management (Student Reference). University of Missouri-Columbia: Instructional Materials Laboratory, 1990.
2. Work Sheet
  - a) WS 3.1: Balance



## UNIT XI - LANDSCAPE DESIGNING

### Lesson 3: Principles of Design

#### TEACHING PROCEDURES

##### A. Review

Review the previous lesson.

##### B. Motivation

A landscape design that uses design principles along with the elements of design will be appealing.

##### C. Assignment

##### D. Supervised study

##### E. Discussion

1. Ask students to discuss how humans and animals physically change from infants to adults. Apply this principle to plants.

**Why is it important to consider the mature sizes of plants when planning the landscape?**

Landscape plans are designed with mature plant sizes in mind so that the plants will not grow too large to keep the plan in balance, and become out-of-proportion to other items in the design.

2. Divide the room in half and move students from one side to the other to demonstrate balance.

**What are the two types of balance and how do they differ?**

- a) Symmetrical balance - One side is equal to the other side.
- b) Asymmetrical balance - One side looks like it has more than the other side, but is equal in balance.

3. Have students listen to different kinds of music (country, rock, classical) to hear the repetition in the music.

**What is rhythm in relation to landscape design?**

Rhythm is the sequence or repetition of the design elements and gives a sense of movement.

4. Show students different pictures (can be from magazines or books) of houses that appear cluttered with plants. Ask students what is wrong with the pictures.

**How is simplicity achieved in a landscape design?**

- a) Make straight lines into curves.
- b) Avoid complicated forms that conflict with building shapes or area shapes.
- c) Use group plantings.
- d) Do not emphasize just one design element.

5. Ask students what they think the main attractions are in the classroom, in a living room, and in a kitchen.

**How can a focal point be established?**

Focal point is established using a combination of the design elements to create a point of immediate, visual attraction.

**F. Other activity**

Have students use construction paper to cut out pieces of paper to paste onto other pieces of paper in order to create the following:

- a) Balance - symmetrical and asymmetrical
- b) Rhythm
- c) Focal points

**G. Conclusion**

A creative and harmonious landscape design is achieved by using the principles of design. These design principles are proportion, balance, rhythm, simplicity, and focal point.

**H. Competency**

Identify the five principles of design.

**I. Answers to Evaluation**

- 1) d
- 2) b
- 3) d
- 4) a
- 5) c
- 6) b

**J. Answers to Work Sheet**

Up to teacher's discretion

**UNIT XI - LANDSCAPE DESIGNING**

Name \_\_\_\_\_

**Lesson 3: Principles of Design**

Date \_\_\_\_\_

**EVALUATION**

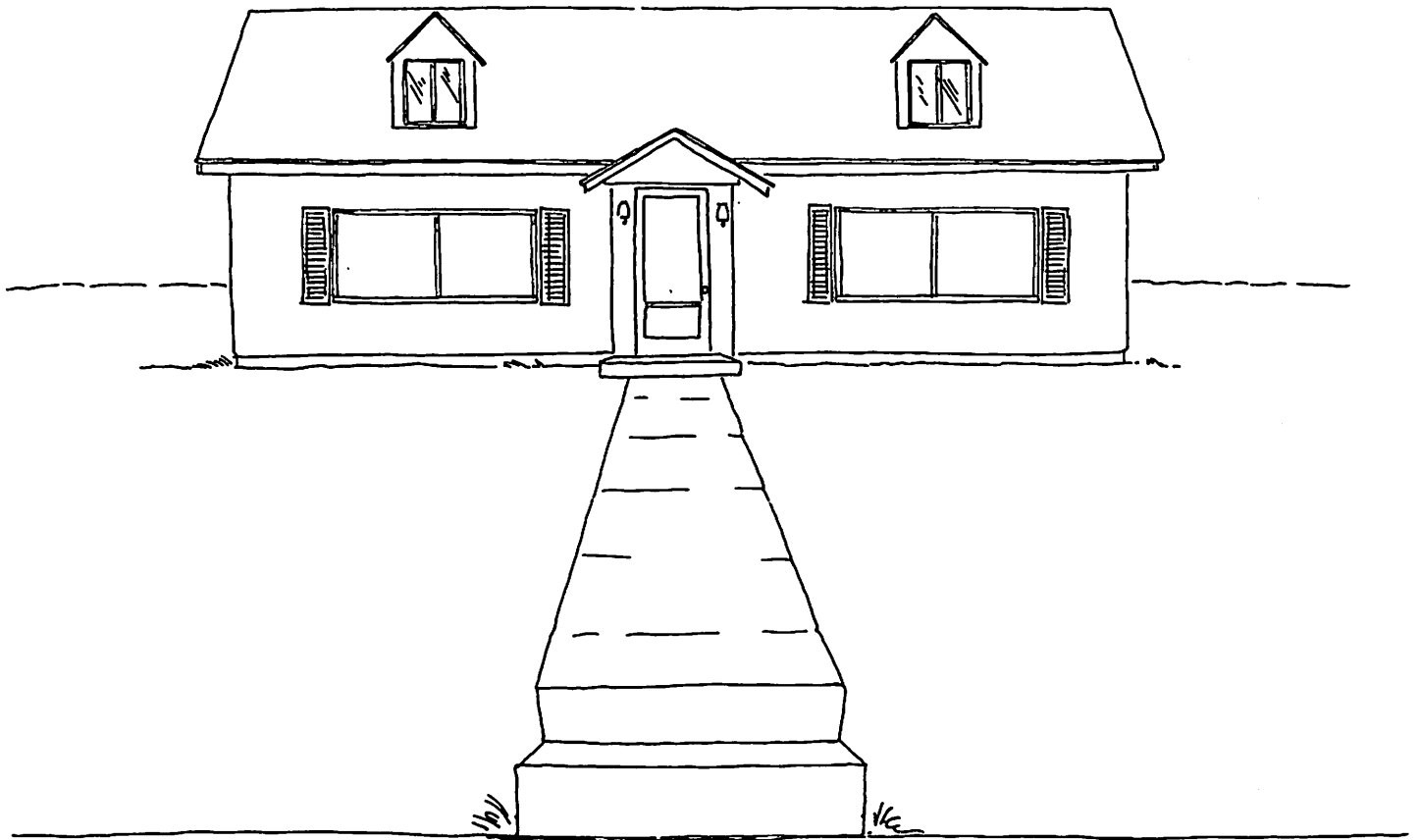
**Circle the letter that corresponds to the best answer.**

1. Which is not a principle of design?
  - a. Focal point
  - b. Proportion
  - c. Rhythm
  - d. Texture
2. What is the overall size of a landscape plan?
  - a. Focal point
  - b. Proportion
  - c. Scale
  - d. Simplicity
3. What is a mirror image balance called?
  - a. Asymmetrical
  - b. Linear
  - c. Off-balance
  - d. Symmetrical
4. What is the type of balance most frequently found in nature?
  - a. Asymmetrical
  - b. Linear
  - c. Off-balance
  - d. Symmetrical
5. What does too much repetition in rhythm causes?
  - a. Chaos
  - b. Harmony
  - c. Monotony
  - d. Simplicity
6. What is the use area with only one focal point?
  - a. Private use area
  - b. Public use area
  - c. Service/utility use area
  - d. None of the above

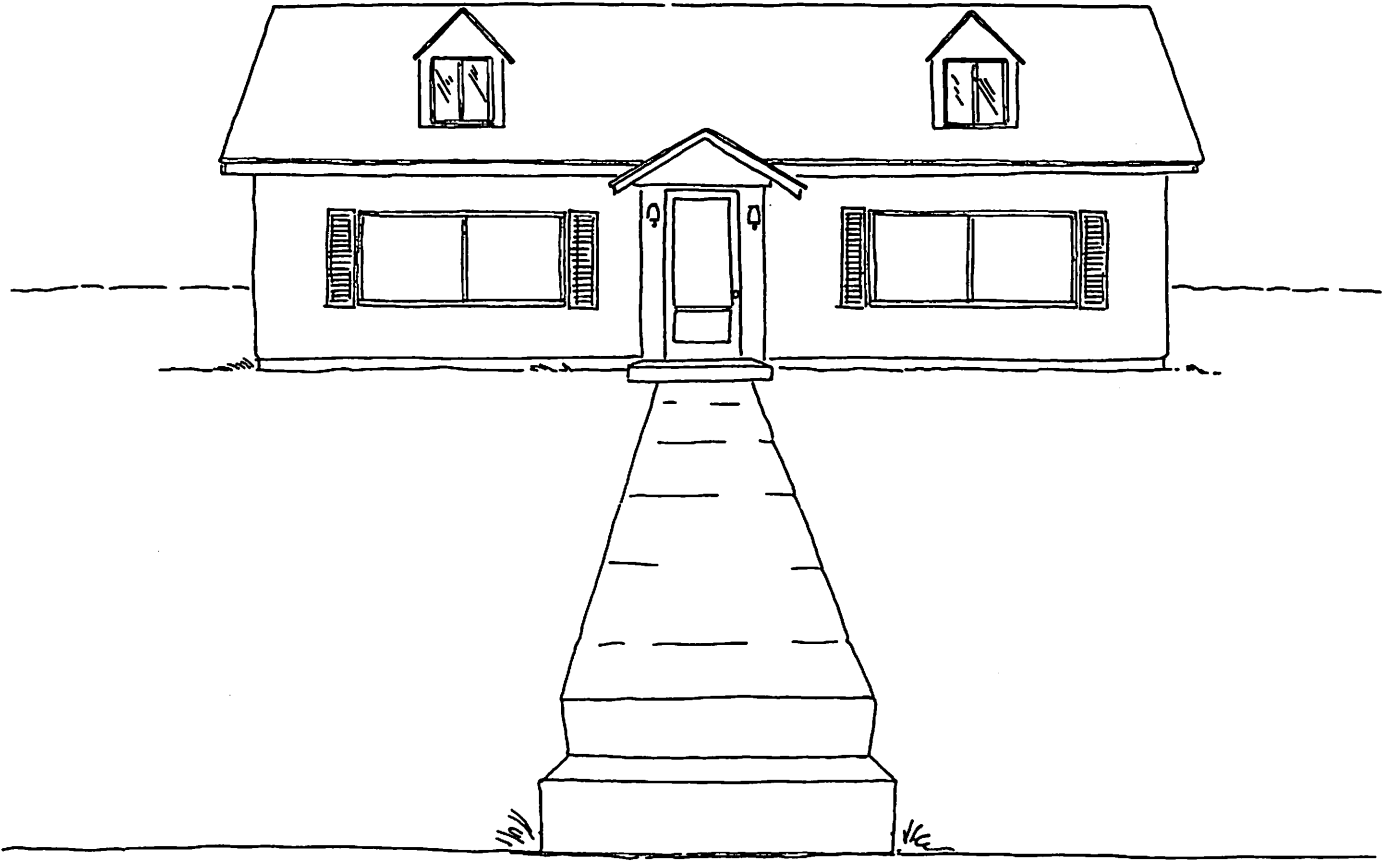
Lesson 3: Principles of Design

Work Sheet 3.1: Balance

1. Sketch a landscape with symmetrical balance.



2. Sketch a landscape with asymmetrical balance.



## UNIT XI - LANDSCAPE DESIGNING

### Lesson 4: Applying Design Elements and Principles

**Objective:** The student will be able to combine design elements and principles to create a landscape plan.

#### Study Questions

- 1. How can plants in an area support the focal point?**
- 2. What are the three basic ways of arranging trees and shrubs?**
- 3. How can an entrance in a public area be designed?**
- 4. How can private and service/utility areas be designed?**

#### References

1. Landscaping and Turf Management (Student Reference). University of Missouri-Columbia: Instructional Materials Laboratory, 1990.
2. Work Sheets
  - a) WS 4.1: Designing a Corner Planting
  - b) WS 4.2: Designing a Line Planting
  - c) WS 4.3: Designing the Public Area
  - d) WS 4.4: Designing the Public Area
  - e) WS 4.5: Designing the Private/Service Area

## UNIT XI - LANDSCAPE DESIGNING

### Lesson 4: Applying Design Elements and Principles

#### TEACHING PROCEDURES

##### A. Review

Review Lessons 1, 2, and 3.

##### B. Motivation

Design elements and principles, when used effectively in a landscape design, will help sell the design to the client.

##### C. Assignment

##### D. Supervised study

##### E. Discussion

1. Ask students what the different ways are that a school might support its football, basketball, or baseball teams.

**How can plants in an area support the focal point?**

- a) Specimen plants
- b) Accent plants
- c) Mass plantings

2. Ask students to discuss the different ways that a classroom can be arranged.

**What are the three basic ways of arranging trees and shrubs?**

- a) Line plantings
- b) Corner plantings
- c) Foundation plantings

3. Ask students what the function of a public area is.

**How can an entrance in a public area be designed?**

- a) Funneling approach
- b) Use of enrichments
- c) Use of corner, line, or foundation plantings

4. Ask students what the function of the private and service/utilities are.

**How can private and service/utility areas be designed?**

- a) Private area
  - 1) Emphasize focal point.
  - 2) Complement focal point.

- 3) Design according to size, shape, and use.
- 4) Design formally or informally, according to client's desire.
- b) Service/utility area
  - 1) Design with or without focal point.
  - 2) Screen partially or totally.
    - (a) Use line or corner plantings.
    - (b) Use construction materials.

**F. Other activity**

Take students on field trip to see corner, line, and foundation plantings.

**G. Conclusion**

Each area in a landscape plan is designed separately while blended together harmoniously by applying the design elements and principles. Each area is landscaped with line, corner, or foundation plantings. Accent, mass, and specimen plants can be used in these plantings.

**H. Competency**

Apply both the principles and elements of design to create a landscape plan.

**I. Answers to Evaluation**

- 1. a
- 2. b
- 3. d
- 4. b
- 5. b
- 6. c
- 7. a
- 8. d

**J. Answers to Work Sheets**

At teacher's discretion



EVALUATION

Circle the letter that corresponds to the correct answer.

1. What type of plant has a strong, visual feature but is most effective when planted in groupings?
  - a. Accent plant
  - b. Group plant
  - c. Mass plant
  - d. Specimen plant
2. What kind of plant is a yew?
  - a. Accent plant
  - b. Mass plant
  - c. Single plant
  - d. Specimen plant
3. Why is a line planting used?
  - a. To block a view
  - b. To provide total privacy
  - c. To give no privacy
  - d. All the above
4. What is the in-curve of a corner planting?
  - a. Where the shortest plant is placed
  - b. Where the tallest plant is placed
  - c. Not part of the corner planting
  - d. The furthest point from the center of the corner planting
5. Which is not true of foundation planting?
  - a. It was used many years ago.
  - b. It is not necessary today.
  - c. It unites the house to the yard.
  - d. It is not necessary to cover entire foundation area of the house.
6. Line, corner, and foundation plantings are most effective when plants are placed in groups of how many?
  - a. Four
  - b. Six
  - c. Seven
  - d. Eight

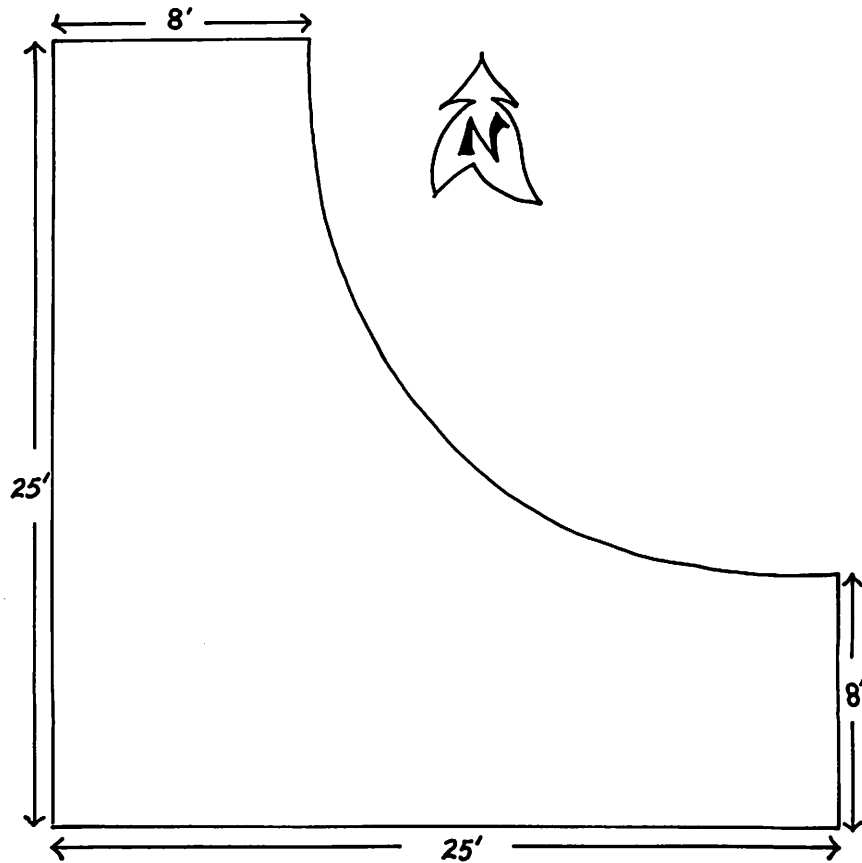
7. How can the front doorway of the public area be enhanced?
- a. By using the funnel approach
  - b. By covering the doorway with plantings
  - c. By placing three specimen plants together at the doorway
  - d. By leading people to the private area
8. Which is not true about the private area?
- a. It is a place of relaxation.
  - b. It is the continuation of the house to the outdoors.
  - c. It requires an open space for activities.
  - d. It should only be informally landscaped.

## Lesson 4: Applying Design Elements and Principles

## Work Sheet 4.1: Designing a Corner Planting

Using the measurements given, complete the following steps in designing a corner planting.

1. Draw the corner planting to scale, using a 1" = 4' scale, on graph paper.
2. Design with the idea that the client's view will be directed at the in-curve.
3. Make a plant list of all plant materials used.
4. Make a title block.

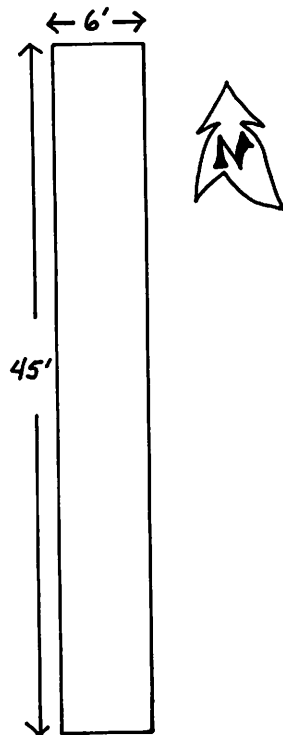


## Lesson 4: Applying Design Elements and Principles

## Work Sheet 4.2: Designing a Line Planting

Using the measurements given, complete the following steps in designing a line planting.

1. Draw a line planting to scale, using a 1" = 4', on graph paper.
2. Design with the idea that the client's view will be from the southeast. The line planting will be used as a partial screen. Keep in mind using only a few species of plants to maintain simplicity, and use mass groupings.
3. Make a plant list of all plant materials used.
4. Make a title block.

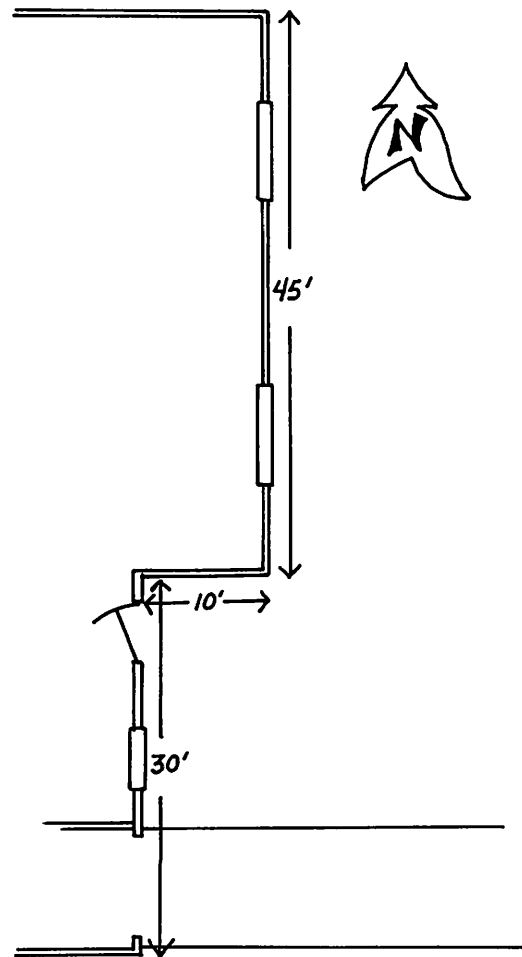


## Lesson 4: Applying Design Elements and Principles

## Work Sheet 4.3: Designing the Public Area

Using the measurements given, complete the following steps in designing the public area.

1. Draw this section of house on graph paper using a scale of 1" = 4'.
2. Design the public area using the front door as the focal point. Use corner and foundation plantings with mass groupings, accent, or specimen plants.
3. Make a list of all plant materials used. Design with plants that will grow well in this sunlight. Remember not to cover the windows with plants.
4. Make a title block for this design.



Lesson 4: Applying Design Elements and Principles

Work Sheet 4.4: Designing the Public Area

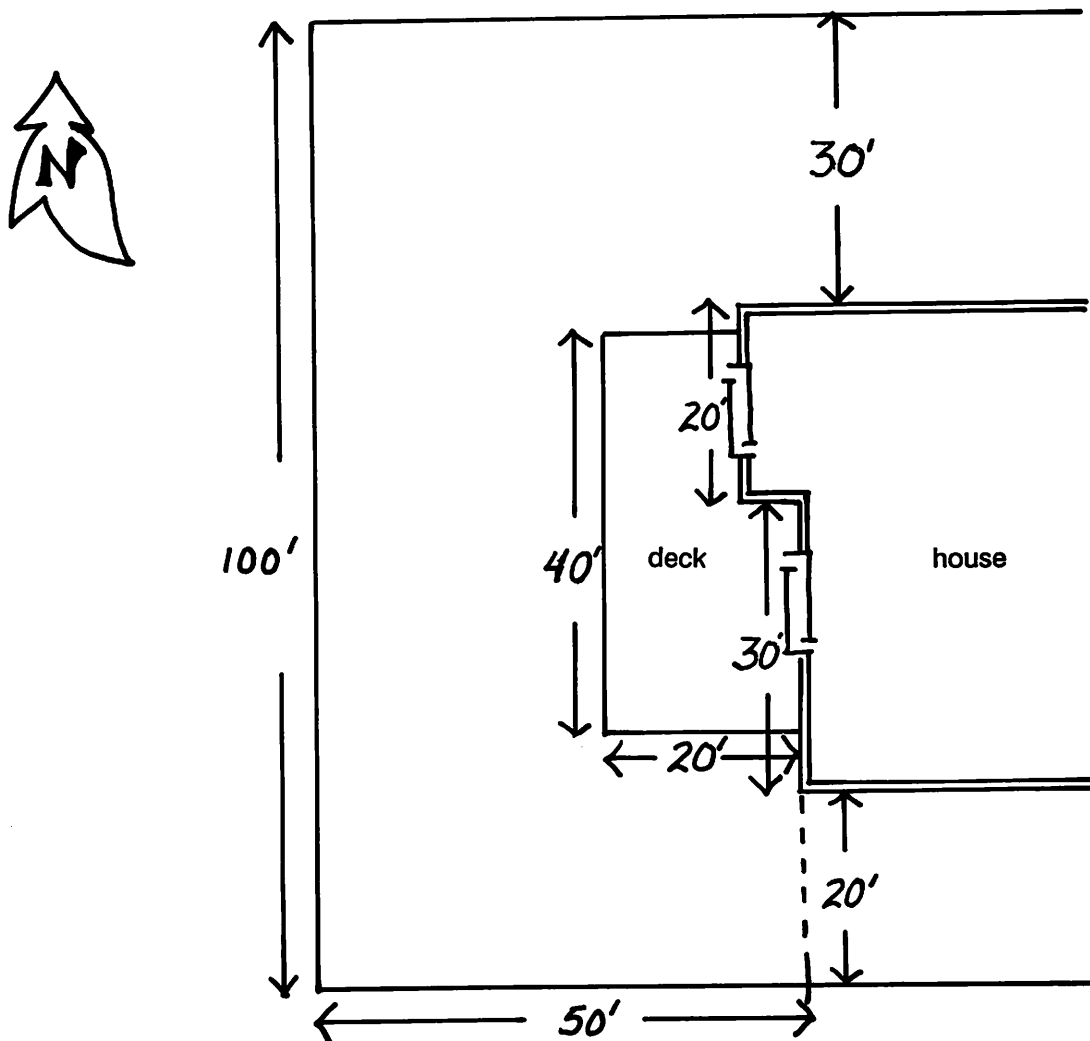
1. Design the public area of a house from the front view using background, corner plantings, and foundation plantings.

## Lesson 4: Applying Design Elements and Principles

## Work Sheet 4.5: Designing the Private and Service Areas

Using the measurements given, complete the following steps in designing the private and service areas.

1. Draw the private and service areas to scale using a 1" = .4'.
2. Design the area with line and corner plantings. Create a focal point in the Southwest corner to shade the patio from afternoon sun. Design a partial screen for privacy from the western neighbor. Add color to the design.
3. Make a list of all plant materials used.
4. Make a title block.



## UNIT XI - LANDSCAPE DESIGNING

### Lesson 5: Developing a Landscape Plan

**Objective:** The student will be able to develop a complete landscape plan.

#### Study Questions

- 1. What are the basic steps in developing a landscape plan?**
- 2. What planning should be done before beginning the actual drawing?**
- 3. How is the plan implemented according to the seasons?**
- 4. What characteristics make a plan more saleable?**

#### References

1. Landscaping and Turf Management. (Student Reference). University of Missouri-Columbia: Instructional Materials Laboratory, 1990.
2. Work Sheets
  - a) WS 5.1: Developing a Landscape Plan
  - b) WS 5.2: Developing a Landscape Plan



## UNIT XI - LANDSCAPE DESIGNING

### Lesson 5: Developing a Landscape Plan

#### TEACHING PROCEDURES

##### A. Review

Review Units 9-11.

##### B. Motivation

Before a client will buy a landscape design and have it installed, the design must be saleable. If a landscape designer follows the basic steps in developing a plan, the design will have the characteristics necessary to make it saleable.

##### C. Assignment

##### D. Supervised study

##### E. Discussion

1. Ask students to figure a math problem such as  $2 \times 3 + 1 = 7$ . Explain that just as a math problem has steps that must be followed to find the correct answer, there are steps to developing a landscape plan. Have students complete WS 5.1 and 5.2.

**What are the basic steps in developing a landscape plan?**

- a) Analysis of home needs
  - b) Site analysis
  - c) Design concept
  - d) Design solution stage
2. Ask students to explain what planning must be done before the FFA can put on their annual banquet. Just as we plan for activities, such as the annual banquet, we also have to plan before we start to design a landscape.

**What planning should be done before beginning the actual drawing?**

- a) Analysis of home needs
  - b) Site analysis
  - c) Base map
3. Ask students what seasons of the year are popular for poinsettias, Easter lilies, chrysanthemums, and tulips.

**How can the plan be implemented according to the seasons?**

- a) Turf
  - 1) Warm-season, late spring or early summer
  - 2) Cool-season, early spring or early fall
- b) Bulbs, spring and fall
- c) Vegetable garden

- 1) Cool-season crops, early spring and early fall
  - 2) Warm-season crops, late spring and early summer
  - d) Trees, dependent on individual specie
  - e) Shrubs, dependent on individual specie
4. Ask students how an employer might select among many applications to fill an opening in his business.

**What characteristics make a plan more saleable?**

- a) Designer
  - 1) Friendliness and courteousness
  - 2) Good verbal communication skills
  - 3) Flexibility to change
- b) Design
  - 1) Accuracy
  - 2) Neatness
  - 3) Legibility
  - 4) Communication of designer's ideas and concepts
  - 5) Creativity
  - 6) Adaptability to client's needs
  - 7) Adaptability to client's budget

**F. Other activity**

Students will complete a landscape plan by using the four basic steps for developing one.

**G. Conclusion**

Developing a landscape plan is a problem-solving activity that consists of four basic steps. A designer must use analysis of home needs, site analysis, development of the design concept and the design solution. The designer should have knowledge of seasonal considerations in implementing the plan. Both designer and design should have characteristics which enhance the saleability of the plan.

**H. Competency**

Develop a complete landscape plan.

**I. Answers to Evaluation**

- 1. c
- 2. d
- 3. b
- 4. a
- 5. d

- 6. The answer should include four of the following: accuracy, neatness, legibility, effective communication of designer's ideas, creativity, adapts to client's needs, or adapts to client's budget.

**J.    Answers to Work Sheets**

**WS 5.1 - at teacher's discretion**

**WS 5.2 - at teacher's discretion**

EVALUATION

**Circle the letter that corresponds to the best answer.**

1. Which is the first step in developing a landscape plan?
  - a. Design concept
  - b. Design solution stage
  - c. Home needs analysis
  - d. Site analysis
2. Which of the following is not a part of the planning needed to design a landscape?
  - a. Drawing a base map
  - b. Installation of design
  - c. Home needs analysis
  - d. Site analysis
3. When should turf be planted?
  - a. Fall or winter
  - b. Spring or fall
  - c. Summer or fall
  - d. Summer or spring
4. When are cool-season vegetable crops planted?
  - a. Early spring and early fall
  - b. Late spring and early summer
  - c. Spring and late summer
  - d. Summer and early fall
5. Which is not a characteristic of an effective landscape designer?
  - a. Flexibility to change
  - b. Friendliness and courteousness
  - c. Good communication skills
  - d. Tries to change the client's mind

**Complete the following short answer question.**

6. What are four characteristics of a saleable landscape plan?
  - a.
  - b.
  - c.
  - d.

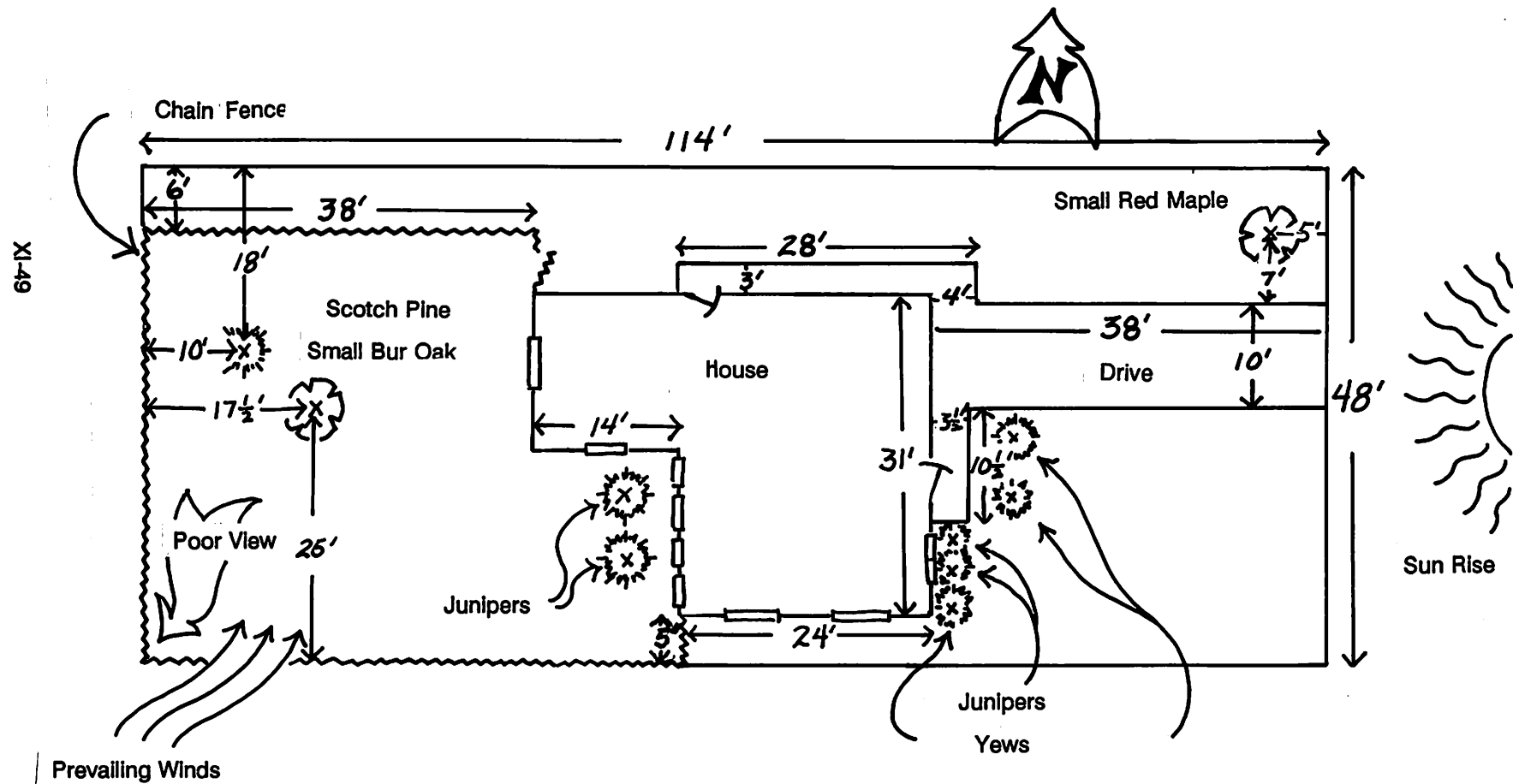
# UNIT XI - LANDSCAPE DESIGNING

WS 5.1

## Lesson 5: Developing a Landscape Plan

### Work Sheet 5.1: Developing a Landscape Plan

With the analysis of family needs and the site analysis provided, design a complete landscape plan for the existing home site below.



## ANALYSIS OF FAMILY NEEDS

Location 000 Pinewood Ave. Lot No.      Date       
Client Name Mr. & Mrs. Sam Somebody Telephone No. 555-6983  
Number of Children - Pre-school      Elementary 3 High School     

## Activities

## Needs

Entertaining: Paved area - capacity (people) \_\_\_\_\_ size \_\_\_\_\_  
color \_\_\_\_\_ material \_\_\_\_\_ plotted \_\_\_\_\_  
Shade - canopy \_\_\_\_\_ trellis \_\_\_\_\_  
umbrella \_\_\_\_\_ tree \_\_\_\_\_ plotted \_\_\_\_\_  
Seating - benches \_\_\_\_\_ capacity \_\_\_\_\_  
no. \_\_\_\_\_ style \_\_\_\_\_ plotted \_\_\_\_\_  
chairs \_\_\_\_\_ no. \_\_\_\_\_ style \_\_\_\_\_ plotted \_\_\_\_\_  
chairs - folding \_\_\_\_\_ no. \_\_\_\_\_ style \_\_\_\_\_  
storage \_\_\_\_\_  
tables \_\_\_\_\_ no. \_\_\_\_\_ style \_\_\_\_\_ plotted \_\_\_\_\_  
table - dining \_\_\_\_\_ capacity \_\_\_\_\_ style \_\_\_\_\_  
plotted \_\_\_\_\_  
Garden lighting \_\_\_\_\_ kind \_\_\_\_\_ style \_\_\_\_\_ no. \_\_\_\_\_ plotted \_\_\_\_\_  
\_\_\_\_\_ \_\_\_\_\_  
\_\_\_\_\_ \_\_\_\_\_

Cooking: Grill - permanent \_\_\_\_\_ size \_\_\_\_\_ style \_\_\_\_\_ plotted \_\_\_\_\_  
portable \_\_\_\_\_ size \_\_\_\_\_ style \_\_\_\_\_ storage \_\_\_\_\_ plotted \_\_\_\_\_  
Table - work \_\_\_\_\_ dimensions \_\_\_\_\_ style \_\_\_\_\_ plotted \_\_\_\_\_  
Storage for cooking \_\_\_\_\_ dimensions \_\_\_\_\_ plotted \_\_\_\_\_  
Electrical outlets \_\_\_\_\_ no. \_\_\_\_\_ plotted \_\_\_\_\_

Games: Croquet \_\_\_\_\_ dimensions \_\_\_\_\_ 30' x 60' \_\_\_\_\_ plotted \_\_\_\_\_  
Badminton \_\_\_\_\_ dimensions \_\_\_\_\_ 24' x 54' \_\_\_\_\_ plotted \_\_\_\_\_  
Bowling on the green \_\_\_\_\_ dimensions \_\_\_\_\_ 10' x 50' or 20' x 100' \_\_\_\_\_ plotted \_\_\_\_\_  
Volleyball \_\_\_\_\_ dimensions \_\_\_\_\_ 40' x 70' \_\_\_\_\_ plotted \_\_\_\_\_  
Basketball hoop \_\_\_\_\_ dimensions \_\_\_\_\_ 40' x 40' \_\_\_\_\_ plotted \_\_\_\_\_  
Tetherball \_\_\_\_\_ dimensions \_\_\_\_\_ 20' dia. circle \_\_\_\_\_ plotted \_\_\_\_\_  
Horseshoes \_\_\_\_\_ dimensions \_\_\_\_\_ 20' x 40' \_\_\_\_\_ plotted \_\_\_\_\_  
Archery \_\_\_\_\_ dimensions \_\_\_\_\_ 20' x 100' min. \_\_\_\_\_ plotted \_\_\_\_\_  
Putting green \_\_\_\_\_ dimensions \_\_\_\_\_ 30' dia. circle min. \_\_\_\_\_ plotted \_\_\_\_\_  
Shuffleboard \_\_\_\_\_ dimensions \_\_\_\_\_ 6' x 45' \_\_\_\_\_ plotted \_\_\_\_\_  
Other \_\_\_\_\_ dimensions \_\_\_\_\_ plotted \_\_\_\_\_  
Game storage \_\_\_\_\_ length \_\_\_\_\_ width \_\_\_\_\_ height \_\_\_\_\_  
plotted \_\_\_\_\_

Playing: Sandbox \_\_\_\_\_ dimensions \_\_\_\_\_ plotted \_\_\_\_\_  
Swings \_\_\_\_\_ dimensions \_\_\_\_\_ plotted \_\_\_\_\_  
Slide \_\_\_\_\_ dimensions \_\_\_\_\_ plotted \_\_\_\_\_  
Playhouse \_\_\_\_\_ dimensions \_\_\_\_\_ plotted \_\_\_\_\_  
Monkeybars \_\_\_\_\_ dimensions \_\_\_\_\_ plotted \_\_\_\_\_  
Wading pool \_\_\_\_\_ dimensions \_\_\_\_\_ plotted \_\_\_\_\_  
Blackboard \_\_\_\_\_ dimensions \_\_\_\_\_ plotted \_\_\_\_\_  
Other (specify) \_\_\_\_\_ dimensions \_\_\_\_\_ plotted \_\_\_\_\_  
Storage, wheel toys, etc. \_\_\_\_\_ dimensions \_\_\_\_\_ plotted \_\_\_\_\_

## Needs

Pets: Doghouse \_\_\_\_\_ dimensions \_\_\_\_\_  
run dimensions \_\_\_\_\_ plotted \_\_\_\_\_  
Other \_\_\_\_\_ dimensions \_\_\_\_\_  
run dimensions \_\_\_\_\_ plotted \_\_\_\_\_





## SITE ANALYSIS

Location 000 Pinewood Ave. Lot No.      Date       
 Client Name Mr. & Mrs. Sam Somebody Telephone No. 555-6983

On Site Factors

Lot: Dimensions - length 114' width 48' plotted       
 Rights-of-way      plotted       
 Easements      kind      plotted       
 Legal restrictions - setback 5' plotted       
                                     lot lines      plotted       
                                     corner obstruction      plotted       
                                     fence, setback      height 4'  
   length      type Chain Link  
                                     outbuilding       
                                     trees not permitted -  
   boxelder (female) ☒ poplar       
   willow      other     

Sidewalk: Installed concrete location plotted       
 Not installed      future location plotted       
                     done by owner      city       
 Never to be installed      Contours plotted       
 Drainage - adequate      inadequate       
                     install tile lines      plotted       
 Soil type - clay      loam      sand      muck       
 Soil sample taken       
 Soil test results - pH      N      P      Ca      other       
 Rock outcropping      plotted     

Water : Spring      brook      pond      marsh      other      plotted     

Existing vegetation: Trees ☒ species Bur Oak height 6' width 3' plotted       
                                     Red Maple 8' 3'       
                    
 Shrubs ☒ species Densaiformis height 3' width 3' plotted       
                                     Yucca 3' 3'       
                                     Pfitzer juniper 4' 5'       
                    
 Turf areas      plotted       
                     satisfactory      renovate      replace       
 Bare soil      plotted

Structures: House \_\_\_\_\_ length \_\_\_\_\_ width \_\_\_\_\_ plotted \_\_\_\_\_  
Front faces north \_\_\_\_\_ east ☒ south \_\_\_\_\_ west \_\_\_\_\_  
other \_\_\_\_\_  
Style rough color(s) \_\_\_\_\_  
Material - brick ☒ frame \_\_\_\_\_ stone \_\_\_\_\_ other \_\_\_\_\_

Outer Buildings - length \_\_\_\_\_ width \_\_\_\_\_ plotted \_\_\_\_\_  
Materials \_\_\_\_\_ plotted \_\_\_\_\_  
Driveway ☒ width 10' length 38' material concrete plotted \_\_\_\_\_  
Walks ☒ width 3' length 28' material concrete plotted \_\_\_\_\_  
Terraces \_\_\_\_\_ width \_\_\_\_\_ length \_\_\_\_\_ material \_\_\_\_\_ plotted \_\_\_\_\_

Climate: Hardiness zone 5 on plan \_\_\_\_\_ prevailing wind direction SW  
on plan \_\_\_\_\_  
Orientation - north indicated on plan \_\_\_\_\_ shade areas plotted \_\_\_\_\_  
sunlight control area plotted \_\_\_\_\_  
wind control area plotted \_\_\_\_\_  
snowdrift control area plotted \_\_\_\_\_

Utilities: Overhead poles plotted \_\_\_\_\_ wires plotted \_\_\_\_\_  
Underground water line \_\_\_\_\_ plotted \_\_\_\_\_  
water valve \_\_\_\_\_ plotted \_\_\_\_\_  
electric lines \_\_\_\_\_ plotted \_\_\_\_\_  
electric meter \_\_\_\_\_ plotted \_\_\_\_\_  
drainage lines \_\_\_\_\_ plotted \_\_\_\_\_  
septic tank \_\_\_\_\_ drainage field \_\_\_\_\_ plotted \_\_\_\_\_  
dry wells \_\_\_\_\_ plotted \_\_\_\_\_  
gas line \_\_\_\_\_ plotted \_\_\_\_\_  
gas valve \_\_\_\_\_ plotted \_\_\_\_\_  
gas meter \_\_\_\_\_ plotted \_\_\_\_\_

#### Off Site Factors

##### Favorable views -

Kind	height	width	season	plotted
_____	_____	_____	_____	_____
_____	_____	_____	_____	_____
_____	_____	_____	_____	_____

##### Unfavorable views -

Kind	height	width	season	plotted
<u>neighbor to SW</u>	_____	_____	_____	_____
_____	_____	_____	_____	_____
_____	_____	_____	_____	_____

Pedestrian traffic: Control needed \_\_\_\_\_ not needed ☒ pattern plotted \_\_\_\_\_

Noise: Control needed \_\_\_\_\_ area plotted \_\_\_\_\_

Dust: Control needed \_\_\_\_\_ area plotted \_\_\_\_\_

Bright lights: Car \_\_\_\_\_ parking \_\_\_\_\_ neighbor \_\_\_\_\_ other \_\_\_\_\_  
area plotted \_\_\_\_\_

Lesson 5: Developing a Landscape Plan

Work Sheet 5.2: Developing a Landscape Plan

**Design a landscape plan using a site chosen by one's teacher or oneself. Develop the landscape plan by using the four basic steps of:**

- 1) Complete analysis of family needs.**
- 2) Complete site analysis**
- 3) Sketch design concept**
- 4) Draw the design solution**

## ANALYSIS OF FAMILY NEEDS

Location \_\_\_\_\_ Lot No. \_\_\_\_\_ Date \_\_\_\_\_  
 Client Name \_\_\_\_\_ Telephone No. \_\_\_\_\_  
 Number of Children - Pre-school \_\_\_\_\_ Elementary \_\_\_\_\_ High School \_\_\_\_\_

## Activities

## Needs

Entertaining:	Paved area - capacity (people) _____ size _____	plotted _____
	color _____ material _____	
	Shade - canopy _____ trellis _____	
	umbrella _____ tree _____	plotted _____
	Seating - benches _____ capacity _____	
	no. _____ style _____	plotted _____
	chairs _____ no. _____ style _____	plotted _____
	chairs - folding _____ no. _____ style _____	
	storage _____	
	tables _____ no. _____ style _____	plotted _____
	table - dining _____ capacity _____ style _____	
		plotted _____
	Garden lighting _____ kind _____ style _____ no. _____	plotted _____
	_____	_____
	_____	_____
Cooking:	Grill - permanent _____ size _____ style _____	plotted _____
	portable _____ size _____ style _____ storage _____	plotted _____
	Table - work _____ dimensions _____ style _____	plotted _____
	Storage for cooking _____ dimensions _____	plotted _____
	Electrical outlets _____ no. _____	plotted _____
Games:	Croquet _____ dimensions _____ 30' x 60'	plotted _____
	Badminton _____ dimensions _____ 24' x 54'	plotted _____
	Bowling on the green _____ dimensions 10' x 50' or 20' x 100'	plotted _____
	Volleyball _____ dimensions _____ 40' x 70'	plotted _____
	Basketball hoop _____ dimensions _____ 40' x 40'	plotted _____
	Tetherball _____ dimensions _____ 20' dia. circle	plotted _____
	Horseshoes _____ dimensions _____ 20' x 40'	plotted _____
	Archery _____ dimensions _____ 20' x 100' min.	plotted _____
	Putting green _____ dimensions _____ 30' dia. circle min.	plotted _____
	Shuffleboard _____ dimensions _____ 6' x 45'	plotted _____
	Other _____ dimensions _____	plotted _____
	Game storage _____ length _____ width _____ height _____	plotted _____
Playing:	Sandbox _____ dimensions _____	plotted _____
	Swings _____ dimensions _____	plotted _____
	Slide _____ dimensions _____	plotted _____
	Playhouse _____ dimensions _____	plotted _____
	Monkeybars _____ dimensions _____	plotted _____
	Wading pool _____ dimensions _____	plotted _____
	Blackboard _____ dimensions _____	plotted _____
	Other (specify) _____ dimensions _____	plotted _____
	Storage, wheel toys, etc. _____ dimensions _____	plotted _____

## Activities

## Needs

Swimming:	Pool _____ dimensions _____ shape _____	
	material _____	plotted _____
	Diving board _____ dimensions _____	plotted _____
	Paved area _____ dimensions _____	
	material _____	plotted _____
	Enclosure _____	plotted _____
	Equipment storage _____	plotted _____

Gardening:	Minimum maintenance _____		
	Automatic watering system _____	plotted _____	
	Flower beds _____ annuals _____ perennials _____		
	roses _____ mixed _____	plotted _____	
	Planter boxes _____ kind _____	plotted _____	
	Water garden _____ water lilies _____ fountain _____		
	dimensions _____	plotted _____	
	Cutting garden _____ dimensions _____	plotted _____	
	Vegetable garden _____ dimensions _____	plotted _____	
	Harb garden _____ dimensions _____	plotted _____	
	Dwarf fruit trees _____ kind _____ no. _____	plotted _____	
	_____		
	_____		
	Bush fruits _____ kind _____ no. _____	plotted _____	
	_____		
	_____		
	Vine fruits _____ kind _____ no. _____	plotted _____	
	Favorite plants _____ kind _____		
	_____		
	_____		
	_____		
	Ornaments _____ statuary _____ other _____	plotted _____	
	Coldframes _____ dimensions _____	plotted _____	
	Greenhouse _____ dimensions _____	plotted _____	
	Compost bin _____ dimensions _____	plotted _____	
	Garden storage: equipment - mower _____ sweeper _____		
	fertilizer spreader _____		
	hose _____ sprinkler _____		
	duster _____ sprayer _____		
	other _____	plotted _____	
	tools - spade _____ rake _____		
	hoe _____ hand tools _____		
	other _____	plotted _____	
	supplies - fertilizer _____ pest _____		
	control _____ other _____	plotted _____	

Bird watching:

Bird feeder	_____	plotted	_____
Bird bath	_____	plotted	_____
Bird houses	_____	plotted	_____
Bird attracting shrubs	_____	plotted	_____

Pets: Doghouse \_\_\_\_\_ dimensions \_\_\_\_\_ plotted \_\_\_\_\_  
run dimensions \_\_\_\_\_  
Other \_\_\_\_\_ dimensions \_\_\_\_\_ plotted \_\_\_\_\_  
run dimensions \_\_\_\_\_



## SITE ANALYSIS

Location \_\_\_\_\_ Lot No. \_\_\_\_\_ Date \_\_\_\_\_  
 Client Name \_\_\_\_\_ Telephone No. \_\_\_\_\_

On Site Factors

Lot: Dimensions - length \_\_\_\_\_ width \_\_\_\_\_ plotted \_\_\_\_\_  
 Rights-of-way \_\_\_\_\_ plotted \_\_\_\_\_  
 Easements \_\_\_\_\_ kind \_\_\_\_\_ plotted \_\_\_\_\_  
 Legal restrictions - setback \_\_\_\_\_ plotted \_\_\_\_\_  
                                     lot lines \_\_\_\_\_ plotted \_\_\_\_\_  
                                     corner obstruction \_\_\_\_\_ plotted \_\_\_\_\_  
                                     fence, setback \_\_\_\_\_ height \_\_\_\_\_  
   length \_\_\_\_\_ type \_\_\_\_\_  
                                     outbuilding \_\_\_\_\_  
                                     trees not permitted -  
   boxelder (female) \_\_\_\_\_ poplar \_\_\_\_\_  
   willow \_\_\_\_\_ other \_\_\_\_\_

Sidewalk: Installed \_\_\_\_\_ location plotted \_\_\_\_\_  
 Not installed \_\_\_\_\_ future location plotted \_\_\_\_\_  
                     done by owner \_\_\_\_\_ city \_\_\_\_\_  
 Never to be installed \_\_\_\_\_ Contours plotted \_\_\_\_\_  
 Drainage - adequate \_\_\_\_\_ inadequate \_\_\_\_\_  
                     install tile lines \_\_\_\_\_ plotted \_\_\_\_\_  
 Soil type - clay \_\_\_\_\_ loam \_\_\_\_\_ sand \_\_\_\_\_ muck \_\_\_\_\_  
 Soil sample taken \_\_\_\_\_  
 Soil test results - pH \_\_\_\_\_ N \_\_\_\_\_ P \_\_\_\_\_ Ca \_\_\_\_\_ other \_\_\_\_\_  
 Rock outcropping \_\_\_\_\_ plotted \_\_\_\_\_

Water : Spring \_\_\_\_\_ brook \_\_\_\_\_ pond \_\_\_\_\_ marsh \_\_\_\_\_ other \_\_\_\_\_ plotted \_\_\_\_\_

Existing  
 vegetation: Trees \_\_\_\_\_ species \_\_\_\_\_ height \_\_\_\_\_ width \_\_\_\_\_ plotted \_\_\_\_\_  
                                     \_\_\_\_\_  
                                     \_\_\_\_\_  
                                     \_\_\_\_\_  
 Shrubs \_\_\_\_\_ species \_\_\_\_\_ height \_\_\_\_\_ width \_\_\_\_\_ plotted \_\_\_\_\_  
                                     \_\_\_\_\_  
                                     \_\_\_\_\_  
                                     \_\_\_\_\_  
 Turf areas \_\_\_\_\_ plotted \_\_\_\_\_  
                     satisfactory \_\_\_\_\_ renovate \_\_\_\_\_ replace \_\_\_\_\_  
 Bare soil \_\_\_\_\_ plotted \_\_\_\_\_

Structures: House \_\_\_\_\_ length \_\_\_\_\_ width \_\_\_\_\_ plotted \_\_\_\_\_  
 Front faces north \_\_\_\_\_ east \_\_\_\_\_ south \_\_\_\_\_ west \_\_\_\_\_  
 other \_\_\_\_\_  
 Style \_\_\_\_\_ color(s) \_\_\_\_\_  
 Material - brick \_\_\_\_\_ frame \_\_\_\_\_ stone \_\_\_\_\_ other \_\_\_\_\_

Outer Buildings - length \_\_\_\_\_ width \_\_\_\_\_ plotted \_\_\_\_\_  
 Materials \_\_\_\_\_ plotted \_\_\_\_\_  
 Driveway \_\_\_\_\_ width \_\_\_\_\_ length \_\_\_\_\_ material \_\_\_\_\_ plotted \_\_\_\_\_

Walks \_\_\_\_\_ width \_\_\_\_\_ length \_\_\_\_\_ material \_\_\_\_\_ plotted \_\_\_\_\_  
 Terraces \_\_\_\_\_ width \_\_\_\_\_ length \_\_\_\_\_ material \_\_\_\_\_ plotted \_\_\_\_\_

Climate: Hardiness zone \_\_\_\_\_ on plan \_\_\_\_\_ prevailing wind direction \_\_\_\_\_  
 on plan \_\_\_\_\_  
 Orientation - north indicated on plan \_\_\_\_\_ shade areas plotted \_\_\_\_\_  
 sunlight control area plotted \_\_\_\_\_  
 wind control area plotted \_\_\_\_\_  
 snowdrift control area plotted \_\_\_\_\_

Utilities: Overhead poles plotted \_\_\_\_\_ wires plotted \_\_\_\_\_  
 Underground water line \_\_\_\_\_ plotted \_\_\_\_\_  
 water valve \_\_\_\_\_ plotted \_\_\_\_\_  
 electric lines \_\_\_\_\_ plotted \_\_\_\_\_  
 electric meter \_\_\_\_\_ plotted \_\_\_\_\_  
 drainage lines \_\_\_\_\_ plotted \_\_\_\_\_  
 septic tank \_\_\_\_\_ drainage field \_\_\_\_\_ plotted \_\_\_\_\_  
 dry wells \_\_\_\_\_ plotted \_\_\_\_\_  
 gas line \_\_\_\_\_ plotted \_\_\_\_\_  
 gas valve \_\_\_\_\_ plotted \_\_\_\_\_  
 gas meter \_\_\_\_\_ plotted \_\_\_\_\_

#### Off Site Factors

##### Favorable views -

Kind	height	width	season	plotted
_____	_____	_____	_____	_____
_____	_____	_____	_____	_____
_____	_____	_____	_____	_____

##### Unfavorable views -

Kind	height	width	season	plotted
_____	_____	_____	_____	_____
_____	_____	_____	_____	_____
_____	_____	_____	_____	_____

Pedestrian traffic: Control needed \_\_\_\_\_ not needed \_\_\_\_\_ pattern plotted \_\_\_\_\_

Noise: Control needed \_\_\_\_\_ area plotted \_\_\_\_\_

Dust: Control needed \_\_\_\_\_ area plotted \_\_\_\_\_

Bright lights: Car \_\_\_\_\_ parking \_\_\_\_\_ neighbor \_\_\_\_\_ other \_\_\_\_\_  
 area plotted \_\_\_\_\_

Credit: Pennsylvania State University. Landscape Design (A Student Handbook). University Park, PA:  
 College of Agriculture, Agricultural Experiment Station, Department of Agricultural Education, 1968.



## UNIT XII - DEVELOPING COST ESTIMATES

### Lesson 1: Pricing the Design

Objective: The student will be able to figure a cost analysis.

#### Study Questions

1. What is the difference between a cost estimate and a bid?
2. What is included in the price of a landscape design?
3. What are landscape specifications?
4. What are the features of a cost estimate?
5. How is a cost estimate prepared?
6. Who benefits from a cost estimate?
7. How is the quantity of materials determined for a landscape design?

#### References

1. Landscaping and Turf Management (Student Reference). University of Missouri-Columbia: Instructional Materials Laboratory, 1990.
2. Transparency Master
  - a) TM 1.1: Cost Estimate Sheet
3. Work Sheets
  - a) WS 1.1: Figuring Volume
  - b) WS 1.2: Cost Estimate Sheet

## UNIT XII - DEVELOPING COST ESTIMATES

### Lesson 1: Pricing the Design

#### TEACHING PROCEDURES

##### A. Introduction

Landscape designers must know how to price designs in order to have a successful business. Knowing how to prepare bids or cost estimates for clients is essential in this process.

##### B. Motivation

Calculating the price of landscape designs will satisfy clients because they will know what they are spending for the materials and services received. It will satisfy the designers because they will know their profits.

##### C. Assignment

##### D. Supervised study

##### E. Discussion

1. Ask students if they know the difference between an estimate and a bid in the construction industry.

**What is the difference between a cost estimate and a bid?**

- a) Cost estimate - an approximation of the final cost
- b) Bid - a firm price set by the company that includes all cost involved

2. Tell students to imagine that they own their own business. Ask them what would be important factors in setting the price of their product.

**What is included in the price of a landscape design?**

- a) The total of
  - 1) Material costs
  - 2) Labor costs
  - 3) Equipment costs
  - 4) Subcontracted work

3. Ask students how they know the quality of an item before purchasing it.

**What are landscape specifications?**

Specifications are an exact list of quality standards to be used for each material and procedure in the landscape design.

4. Ask students what some basic steps are in following a recipe.

**What are the features of a cost estimate?**

- a) Cost of materials
- b) Labor costs
- c) Equipment rental
- d) Subcontracted work

5. Ask students what some steps are in preparing a budget. Use TM 1.1, Cost Estimate Sheet.

**How is a cost estimate prepared?**

- a) Fill out name, address, and other information about client and job site. Also, estimate starting and finishing dates.
- b) Materials
  - 1) Materials used - description
  - 2) Quantities of each - number of units required
  - 3) Cost of each - cost/unit
  - 4) Total - total cost
- c) Labor
  - 1) Number of employees - description
  - 2) Estimated number of hours - number of units required
  - 3) Cost per worker per hour
  - 4) Frequently a standard percentage of the materials cost is charged.
- d) Equipment
  - 1) List equipment owned or rented - description
  - 2) Number of hours or days - number of units required
  - 3) The rate per hour or day - cost/unit
  - 4) Totals - total cost
- e) Subcontracted work
  - 1) Subcontractor - description
  - 2) Hours or days worked - number of units required
  - 3) Rate paid for work - cost/unit
  - 4) Totals - total cost
- f) Subtotal - add everything but labor
- g) Tax - according to local rate
- h) Total of the entire estimate

6. Ask students who benefits when an item is purchased.

**Who benefits from a cost estimate?**

- a) The client knows total cost of the design.
- b) The business knows all costs are covered.

7. Ask students how to figure amounts of food needed for a dinner in order to serve six people.

**How is the quantity of materials determined for a landscape design?**

- a) Figure area-length x width.
- b) Figure volume or quantity-length x width x depth.
  - 1) Convert to all the same units of measure.
  - 2) Convert to the units (cubic feet or yards) in which material is sold.

**F. Other Activity**

Ask a representative from a landscape firm to come in and talk about pricing a design.

G. Conclusion

The price of a landscape design can be written as a cost estimate or a bid. All specifications must be written in the cost analysis. Other information found on a cost analysis sheet are: subcontracted work, materials used, labor, and equipment. Figuring quantities needed is important in determining total cost. Both the client and the landscape firm benefit from a cost analysis.

H. Competency

Calculate the price of a landscape design.

I. Answers to Evaluation

1. a
2. b
3. b
4. c
5. a

J. Answers to Work Sheet

WS 1.1

1. Drive  $45' \times 15' \times .333' = 224.78$  cu. ft.  
Walk  $25' \times 5' \times .333' = 41.63$  cu. ft.  
 $224.78 + 41.63 = 266.41$   
 $266.41$  cu. ft.  $\times \frac{1 \text{ cu. yd.}}{27 \text{ cu. ft.}} = 9.87$  cu. yd.
2. Take the rectangular shape of the back yard and subtract the area of the house (the part in the back yard), deck, and raised bed.  
  
entire area of back yard =  $85' \times 60' = 5,100$  sq. ft.  
portion of house in back yard =  $20' \times 20' = 400$  sq. ft.  
deck area = 1.  $20' \times 20' = 400$  sq. ft.  
2.  $20' \times 5' = 100$  sq. ft.  
3.  $\frac{3.14 \times (7 \text{ ft.})^2}{4} = 38.5$  sq. ft.  
raised bed =  $40' \times 5' = 200$  sq. ft.  
  
 $5,100 - (400 + 400 + 100 + 38.5 + 200) = 5,100 - 1,138.5 = 3,961.5$  sq. ft.
3. L  $\times$  W  $\times$  Depth =  $40' \times 5' \times 1.5' = 300$  cu. ft.  
 $300$  cu. ft.  $\times \frac{1 \text{ cu. yd.}}{27 \text{ cu. ft.}} = 11.11$  cu. yd.
4. Area =  $\pi r^2$   
 $3.14 \times (1.5')^2 = 3.14 \times 2.25$  sq. ft. =  $7$  sq. ft.  
 $7$  sq. ft.  $\times .17$  ft. =  $1.19$  cu. ft.
5.  $11.5" \times 20' / 1" = 230.0$  ft.

WS 1.2 - A sample answer is provided on the following page.

LANDSCAPE COST ESTIMATE SHEET					
<b>CUSTOMER INFORMATION:</b> NAME: <u>Kelly Anybody</u> HOME PHONE: <u>314-555-1798</u> ADDRESS <u>10 High St.</u> WORK PHONE: <u>314-555-2990</u> CITY: <u>Anytown</u> STATE: <u>MO</u> ZIP: <u>65203</u>					
NAME OF ESTIMATOR: <u>Student's Name</u> TODAY'S DATE: <u>  /  /  </u> ESTIMATED STARTING DATE: <u>  /  /  </u> ESTIMATED FINISH DATE: <u>  /  /  </u>					
UNITS	DESCRIPTION	COST/UNIT	TOTAL COST		
<b>MATERIALS:</b>					
1.	15lbs Lime	07	1	05	
2.	15lbs Fertilizer	45	6	75	
3.	10yds <sup>3</sup> Mulch	3 10	31	00	
4.	5 Zebra Plants	6 99	34	95	
5.	1 White Dogwood	38 50	38	50	
6.	13 Emerald Gold Euonymus	11 75	152	75	
7.	4 Kousiformis Yew	22 00	88	00	
8.	Materials Subtotal		353	00	
9.					
10.					
11.					
12.					
<b>LABOR:</b>					
13.					
14.	2hrs Flower Bed Preparation	12 00	24	00	
15.	Planting Labor		141	20	
16.	(40% of Material Costs)				
17.					
<b>EQUIPMENT:</b>					
18.	2hrs Rototiller Rental	8 00	16	00	
19.					
<b>SUBCONTRACTED WORK:</b>					
20.	None				
21.					
22.					
<b>SUBTOTAL</b>			534	20	
<b>TAX</b>			@ ( <u>6.5</u> % )	34	72
<b>TOTAL COST ESTIMATE (WITHIN 15%):</b>			568	92	

UNIT XII - DEVELOPING COST ESTIMATES

Name \_\_\_\_\_

Lesson 1: Pricing the Design

Date \_\_\_\_\_

EVALUATION

Circle the letter that corresponds to the best answer.

1. What is a binding agreement between client and landscape company called?

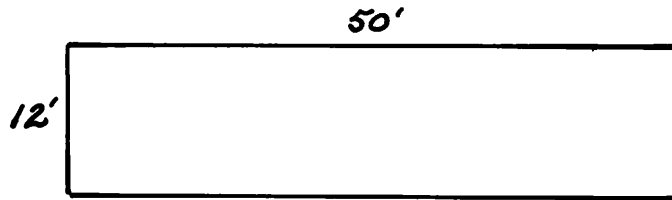
- a) Bid
- b) Cost estimate
- c) Legal statement
- d) Price

2. Which is not a feature of a cost estimate?

- a) Plant materials
- b) Kind of truck used
- c) Subcontracted work
- d) Labor costs

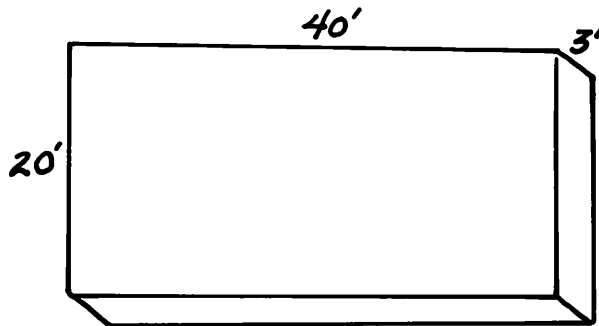
3. What is the area of the design below?

- a) 600 ft.
- b) 600 sq. ft.
- c) 600 cu. ft.
- d) 600 cu. yds.



4. What is the volume of the area below?

- a) 240 ft.
- b) 240 sq. ft.
- c) 2,400 cu. ft.
- d) 2,400 cu. yds.



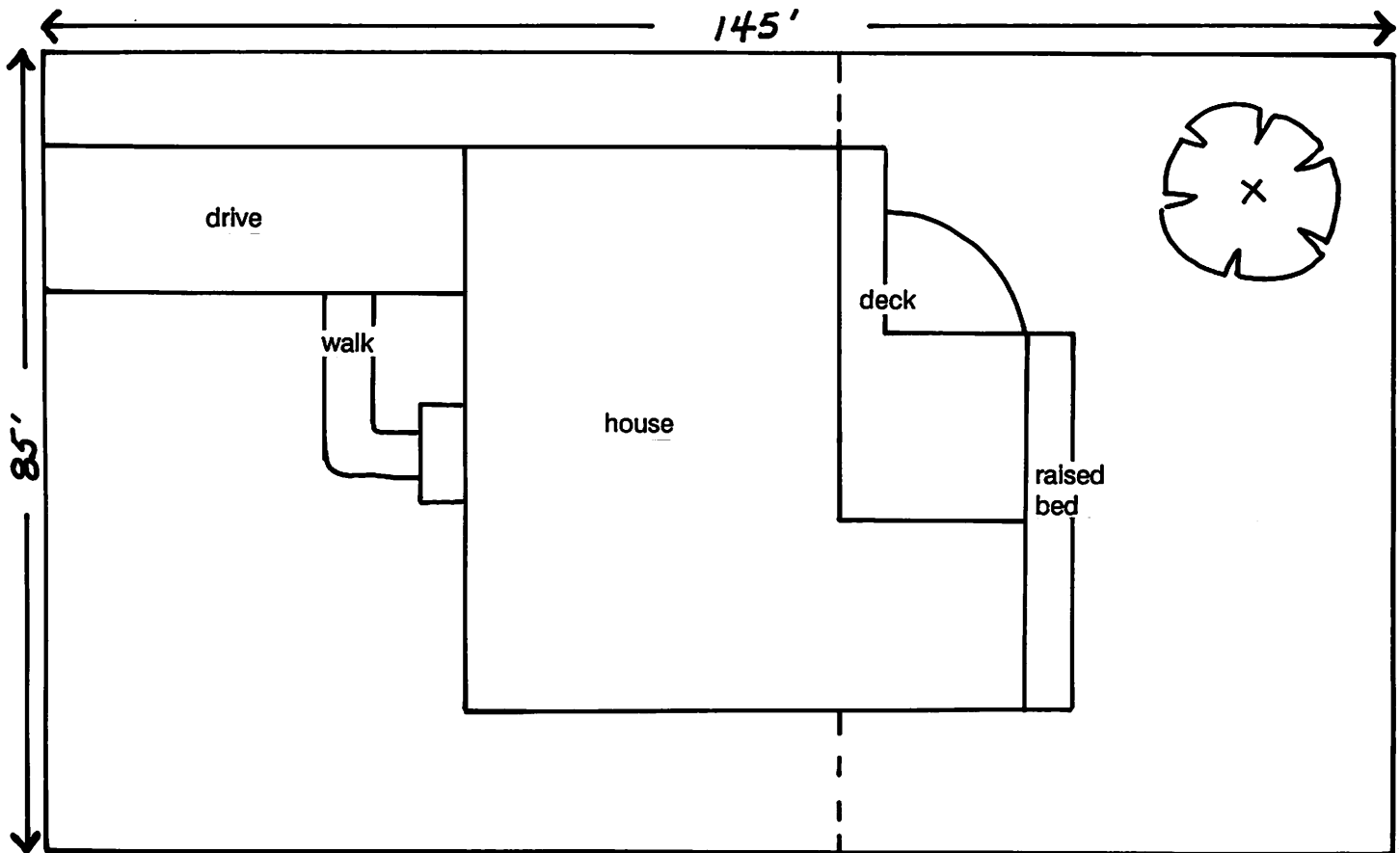
5. Which of the following is not an overhead cost?

- a) Plant materials
- b) Rent
- c) Salaries
- d) Utilities

## Lesson 1: Pricing Design

## Work Sheet 1.1: Landscaping-Area/Volume Exercise

Using the landscape plan provided, answer the questions below. Scale is 1" = 20'. (Show your work.)



1. How many cubic yards of concrete are needed to pour the driveway and sidewalk 4" deep? Do not include landing.
2. You want to plant grass seed in the back lawn, but you need to know what the area is in order to buy the grass seed. You plan to plant seed under the tree. How many square feet are in the back lawn?

3. How many yards of soil would be needed to fill the raised bed, by the deck, with 18" of topsoil?
  
  
  
  
  
  
  
  
  
  
4. How many cubic feet of bark mulch will be needed to put a 3' diameter ring 2" deep around the tree in the backyard?
  
  
  
  
  
  
  
  
  
  
5. How many linear feet of privacy fencing would be required to enclose the back lawn?



## UNIT XII - DEVELOPING COST ESTIMATES

WS 1.2

### Lesson 1: Pricing the Design

#### Work Sheet 1.2: Cost Estimate Sheet

**Place the information correctly onto the cost estimate sheet located on the back of this page and calculate the total estimate.**

Customer is Joseph M. Gardener at 1667 Meadow Lane, Mhome, Missouri, 66523. Work Phone is 555-9934 and Home Phone is 555-4321.

Estimated starting date will be 10 days from today and it should be completed in one day.

1. Sales Tax 6.5%
2. Labor for 2 hours of flower bed preparation at \$12.00/hour
3. Labor for general plantings will equal 40% of the total material bill before taxes
4. Lime 15 pounds at 7 cents a pound
5. White dogwood - potted at \$38.50 each
6. 13 Emerald Gold Euonymus at \$11.75 each
7. 10 cubic yard bags of mulch at \$3.10/bag
8. No subcontracted work
9. Fertilizer at \$.45/pound, for 15 pounds
10. 5 Zebra plants at \$6.99 each
11. 4 densiformis yews at \$22.00 each
12. 2 hours of rototiller rental at \$8.00/hour

Remember to total the estimate.

LANDSCAPE COST ESTIMATE SHEET					
<b>CUSTOMER INFORMATION:</b>					
NAME: _____		HOME PHONE: _____			
ADDRESS _____		WORK PHONE: _____			
CITY: _____		STATE: _____		ZIP: _____	
NAME OF ESTIMATOR: _____			TODAY'S DATE: _____		
ESTIMATED STARTING DATE: _____			ESTIMATED FINISH DATE: _____		
UNITS		DESCRIPTION	COST/UNIT	TOTAL COST	
<b>MATERIALS:</b>					
1.					
2.					
3.					
4.					
5.					
6.					
7.					
8.					
9.					
10.					
11.					
12.					
<b>LABOR:</b>					
13.					
14.					
15.					
16.					
17.					
<b>EQUIPMENT:</b>					
18.					
19.					
<b>SUBCONTRACTED WORK:</b>					
20.					
21.					
22.					
<b>SUBTOTAL</b>					
<b>TAX</b>				@ ( _____ %)	
<b>TOTAL COST ESTIMATE (WITHIN 15%):</b>					

## UNIT XII - DEVELOPING COST ESTIMATES

### Lesson 2: Pricing Landscape Maintenance

**Objective:** The student will be able to price the various components of landscape maintenance.

#### Study Questions

- 1. Why is a cost analysis needed in landscape maintenance?**
- 2. What tasks are involved in landscape maintenance?**
- 3. What are the seven features of the landscape maintenance cost analysis?**
- 4. How are labor costs determined?**

#### References

1. Landscaping and Turf Management (Student Reference). University of Missouri-Columbia: Instructional Materials Laboratory, 1990.
2. Work Sheet
  - a) WS 2.1: Labor Costs

## UNIT XII - DEVELOPING COST ESTIMATES

### Lesson 2: Pricing Landscape Maintenance

#### TEACHING PROCEDURES

##### A. Review

Review the previous lesson.

##### B. Motivation

Understanding the factors involved in preparing a cost analysis for landscape maintenance will help ensure that a profit will be made.

##### C. Assignment

##### D. Supervised study

##### E. Discussion

1. Ask students why it would be important to establish a cost for services before performing them?

#### **Why is a cost analysis needed in landscape maintenance?**

- a) Permits a fair price to be charged to the customer
- b) Can compare the efficiency of different crews in performing the same task
- c) Ensures that all costs to the firm are covered
- d) Allows comparison of the profitability of different tasks

2. Ask students what types of tasks are involved in maintaining their own yards.

#### **What tasks are involved in landscape maintenance?**

- a) Mow lawn.
- b) Prune trees and shrubs.
- c) Apply fertilizer to lawn and plantings.
- d) Control weeds in lawn and plantings.
- e) Spray and/or dust to control insects and diseases.
- f) Plant and care for flower beds and borders.
- g) Replace dead plants.
- h) Paint or stain outdoor furnishings.
- i) Repair walls and paved surfaces.
- j) Clean fountains and pool basins.
- k) Irrigate lawn.
- l) Cultivate soil around trees and shrubs.
- m) Replace mulches.
- n) Remove lawn thatch.
- o) Roll and reseed lawn.
- p) Rake leaves in fall.
- q) Winterize trees and shrubs.
- r) Remove snow.

s) Perform preventative maintenance on equipment.

3. Ask students what cost analysis is.

**What are the seven features of the landscape maintenance cost analysis?**

- a) A listing of all tasks to be performed
- b) The total square footage area involved for each service
- c) The number of times each service is performed during the year
- d) The time required to complete each task once
- e) The time required to complete each task annually
- f) The cost of all materials required for each task
- g) The cost of all labor required for each task

4. Ask students students how hourly wages are calculated.

**How are labor costs determined?**

- a) Divide hour into ten parts, e.g. 0.1 = six minutes
- b) Determine hours worked, e.g., 45 minutes worked  
 $45 \text{ min.} + 60 \text{ min./hr.} = .75 \text{ hours worked}$   
 $.75 \times \text{hourly rate } (\$5.50)$   
 $.75 \times \$5.50 = \$4.13 \text{ labor cost}$

F. Other Activity

Have someone from a landscape maintenance firm discuss cost analysis.

G. Conclusion

Cost analysis can also be used with landscape maintenance. It benefits the client as well as the landscape firm. Many tasks, from mowing the lawn to snow removal, are included in a cost analysis. Wages are also calculated and added to the cost analysis.

H. Competency

Price various components of landscape maintenance.

I. Answers to evaluation

- 1. c
- 2. a
- 3. a
- 4. b

J. Answers to Work Sheet

- |            |             |
|------------|-------------|
| 1. \$7.50  | 6. \$38.14  |
| 2. \$15.75 | 7. \$49.00  |
| 3. \$40.80 | 8. \$10.30  |
| 4. \$26.68 | 9. \$2.50   |
| 5. \$27.00 | 10. \$37.70 |

UNIT XII - DEVELOPING COST ESTIMATES

Name \_\_\_\_\_

Lesson 2: Pricing Landscape Maintenance

Date \_\_\_\_\_

EVALUATION

Circle the letter that corresponds to the best answer.

1. Which is not a task in regular landscape maintenance?
  - a. Mow lawn.
  - b. Prune trees and shrubs.
  - c. Sow seed.
  - d. Spray and/or dust to control insects.
2. Which is not a feature of a maintenance cost analysis?
  - a. List of all tasks to be completed
  - b. Cost of all materials
  - c. Cost of repairing mistakes made by workers
  - d. Time required to complete each task
3. What is the total salary if wages are \$4.85 per hour and the employee has worked 5 1/2 hours?
  - a. \$26.68
  - b. \$28.46
  - c. \$31.25
  - d. \$32.89
4. What is not a benefit of using cost analysis in landscape maintenance?
  - a. Customer will be charged fair price.
  - b. The landscape design can easily be changed.
  - c. Landscape firm costs are acknowledged.
  - d. Efficiency crew performances can be measured.

## UNIT XII - DEVELOPING COST ESTIMATES

WS 2.1

### Lesson 2: Pricing Landscape Maintenance

#### Work Sheet 2.1: Labor Costs

1 hour = 10 units

1/10 hour = .1 or 6 minutes

Example:

wage: \$5.50 per hour, worked 45 min.

45 min. x  $\frac{1 \text{ hr.}}{60 \text{ min.}}$  = .75 hrs.

.75 hrs. x \$5.50 = \$4.13

Calculate the total salary for the following.

- |     |              |                           |                     |
|-----|--------------|---------------------------|---------------------|
| 1.  | Wage: \$5.00 | hours worked: 1 1/2 hours | Total Salary: _____ |
| 2.  | Wage: \$5.25 | hours worked: 3 hours     | Total Salary: _____ |
| 3.  | Wage: \$5.10 | hours worked: 8 hours     | Total Salary: _____ |
| 4.  | Wage: \$4.85 | hours worked: 5 1/2 hours | Total Salary: _____ |
| 5.  | Wage: \$6.00 | hours worked: 4 1/4 hours | Total Salary: _____ |
| 6.  | Wage: \$5.65 | hours worked: 6 3/4 hours | Total Salary: _____ |
| 7.  | Wage: \$4.90 | hours worked: 10 hours    | Total Salary: _____ |
| 8.  | Wage: \$5.15 | hours worked: 2 hours     | Total Salary: _____ |
| 9.  | Wage: \$5.00 | hours worked: 1/2 hours   | Total Salary: _____ |
| 10. | Wage: \$5.20 | hours worked: 7 1/4 hours | Total Salary: _____ |