Lesson A2–4

Understanding Leaf Anatomy and Morphology

Unit A. Horticultural Science

Problem Area 2. Plant Anatomy and Physiology

Lesson 4. Understanding Leaf Anatomy and Morphology

New Mexico Content Standard:

Pathway Strand: Plant Systems

Standard: **II:** Address taxonomic or other classifications to explain basic plant anatomy and physiology.

Benchmark: **II-A:** Examine unique plant properties to identify/describe functional difference in plant structures including roots, stems, flowers, leaves and fruit.

Performance Standard: **1.** Identify plant structures (e.g., seeds). **2.** Describe physiological functions of plants. **3.** Describe germination process and conditions. **4.** Explain the processes of photosynthesis and respiration.

Student Learning Objectives. Instruction in this lesson should result in students achieving the following objectives:

1. Describe the main parts of a leaf.
2. Describe some major types of leaves.
3. Discuss common vein patterns found in leaves.
4. Explain how a leaf is organized.

List of Resources. The following resources may be useful in teaching this lesson:

Recommended Resources. One of the following resources should be selected to accompany the lesson:

Biondo, Ronald J. and Jasper S. Lee. *Introduction to Plant and Soil Science and Technology,* Second Edition. Danville, Illinois: Interstate Publishers, Inc., 2003.

Schroeder, Charles B., et al. *Introduction to Horticulture*, Third Edition. Danville, Illinois: Interstate Publishers, Inc., 2000.

List of Equipment, Tools, Supplies, and Facilities

Writing surface

Overhead projector

Transparencies from attached masters

Copies of student lab sheet

Pressed leaves from a leaf collection and/or the following greenhouse plants: any Dracaena or Spider Plant, any Begonia, Peperomia or Pilea, and any Peace Lily, Dieffenbachia, or Chinese Evergreen

Pictures of leaves from a book

Microscopes and prepared slides of leaf cross-sections

Terms. The following terms are presented in this lesson (shown in bold italics):

Compound leaf

Cuticle

Dichotomous venation

Epidermis

Guard cells

Leaf blade

Midrib

Netted veins

Palisade mesophyll

Parallel veins

Petiole

Pinnately netted

Simple leaf

Spongy mesophyll

Stomata

Interest Approach. Use an interest approach that will prepare the students for the lesson. Teachers often develop approaches for their unique class and student situations. A possible approach is included here.

Bring several different leaves or plants with different leaves into class. Ask students to compare and contrast them. Use student responses to form a list of how the leaves are the same and how they are different. Begin to build on their list. Do the similarities on the list have something to do with photosynthesis? (Similarities may be that leaves are green or have a large flat surface.) What are the words that we use to describe the differences. Can we choose better terms?

Summary of Content and Teaching Strategies

Objective 1: Describe the main parts of a leaf.

Anticipated Problem: What are the main parts of a leaf?

I. Leaves are the primary food producing organs of the plant. They are designed to efficiently collect light and use that light energy to produce food. These are some of the parts of a leaf which help to encourage that efficiency.

   A. The main sun collecting structure on the leaf is a large broad flat surface called the ***leaf blade***. The blade has many layers, which help the plant move and store photosynthesis materials and by-products. The blade is held away from the stem and supported by a leaf stem called the ***petiole***. The petiole is not exactly like a stem, but it does have xylem and phloem so it can transport water and sugar.

   B. The blade is, in turn, supported by a system of veins, which also contain both xylem and phloem. These veins prevent the blade from collapsing under its own weight. Many leaves are organized with one main vein running down the middle of the blade. This vein is called the ***midrib***. All of the veins and the petiole and midrib help position the blade in a way that it is facing the light source.

Use the recommended resources to strengthen student understanding of the concepts taught. TM: A2–4A can be used as a visual aid.

Objective 2: Describe some major types of leaves.

Anticipated Problem: What are some of the major types of leaves?

II. There are many different types of leaves. Some leaves are adapted to hot, dry climates by storing water or being smaller. Some leaves have very large blades to collect the maximum light in a shady location. In some leaves, the blade is broken up into several sections.

   A. A leaf which has only one blade on its petiole is called a ***simple leaf***. Most plants have simple leaves.

B. In some leaves, the blade is divided into three or more sections. A leaf with multiple blades is called a ***compound leaf***. There are many different kinds of compound leaves.

Show students examples of compound and simple leaves. Ask students to distinguish between the petioles and stems. Use TM: A2–4B to provide a visual aid.

Objective 3: Discuss common vein patterns found in leaves.

Anticipated Problem: What are some vein patterns found in leaves?

III. Veins of flowering plants are found in several patterns. Most of these patterns can be categorized into two groups.

A. Monocots have leaves which have ***parallel veins***. While the veins may not be parallel in a strict mathematical sense, none of the veins on the whole leaf will cross each other. It may look like they fuse together at the top or bottom of the blade.

B. Dicots have veins which connect and branch from each other. Veins in a branching pattern are called ***netted veins***. Some leaves with netted veins have several smaller veins branching out of a dominant midrib, a condition known as ***pinnately netted***. Other leaves have several dominant veins branching out from the petiole. This condition is known as palmately netted. A few plants have a spreading vein pattern called ***dichotomous venation***. A gingko leaf has this type of veins.

Ask students to predict whether a plant is a monocot or a dicot based on what pattern of veins they have. Pictures or actual plants can be used. If no plants are available, collect some from a nearby lawn.

Objective 4: Explain how a leaf is organized.

Anticipated Problem: How is a leaf organized?

IV. A leaf is organized to collect sunlight and turn it, through photosynthesis, into food. The leaf blade has many layers of tissue to allow this to happen.

A. On top of the leaf is a waxy non-cellular layer called the ***cuticle***. The cuticle is on the leaf to prevent water from escaping. Generally speaking, plants which live in bright arid conditions have very thick cuticle layers.

B. The next layer on the leaf is also there for protection. The ***epidermis*** is the skin-like layer of cells found on both the top and the bottom surface of the leaf. The epidermis may be one or many layers thick.

C. Directly beneath the upper epidermis is a layer of cells which are standing on end and packed very tightly. These standing cells are responsible for most of the photosynthesis in the leaf and are called the ***palisade mesophyll***.

D. Under the palisade mesophyll are loosely packed cells called the spongy mesophyll. The ***spongy mesophyll*** forms air spaces which hold raw materials used and products of photosynthesis.

E. The lower epidermis has holes in it for gas exchange. The holes are called ***stomata*** and they can open and close. The opening and closing is controlled by the ***guard cells,*** which surround each stomata.

Use LS: A2–4A and TM: A2–4C to help teach the concept. Ask students to explain purposes for each leaf structure.

Review/Summary. Use the student learning objectives to summarize the lesson. Repeated practice using actual plants, pictures of plants, and drawing plants are very helpful. Student responses can be used to determine which objectives should be reviewed.

Application. LS: A2–4A can be used to apply objectives to an actual leaf cross-section.

Evaluation. Evaluation should be based on student comprehension of the learning objectives. This can be determined using the attached sample written test.

Answers to Sample Test:

Part One: Matching

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

Part Two: Completion

stomata
spongy, palisade
guard
cuticle
parallel, netted

Part Three: Short Answer

1. Compound leaves have more than one blade. Simple leaves have only one blade on each petiole.

Sample Test Name _____

Test

Lesson A2–4: Understanding Leaf Anatomy and Morphology

Part One: Matching

Instructions. Match the term with the correct response. Write the letter of the term by the definition.

a. Epidermis
b. Leaf base
c. Midrib
d. Petiole

_____ 1. The single dominant vein in the middle of the blade.

_____ 2. The layer of cells that make up the top and bottom surface of the leaf.

_____ 3. The leaf stem.

_____ 4. The large flat surface of the leaf.

Part Two: Completion

Instructions. Provide the word or words to complete the following statements.

1. The part of the leaf which allows gas to escape is the _____.
2. There are two types of mesophyll. The _____ mesophyll is loosely packed with many air spaces and the _____ mesophyll is tightly packed and stand on end.
3. _____ cells control the opening and closing of the stomata.
4. The waxy upper layer of the leaf is called the _____.
5. Monocots have _____veins while dicots have _____ veins.

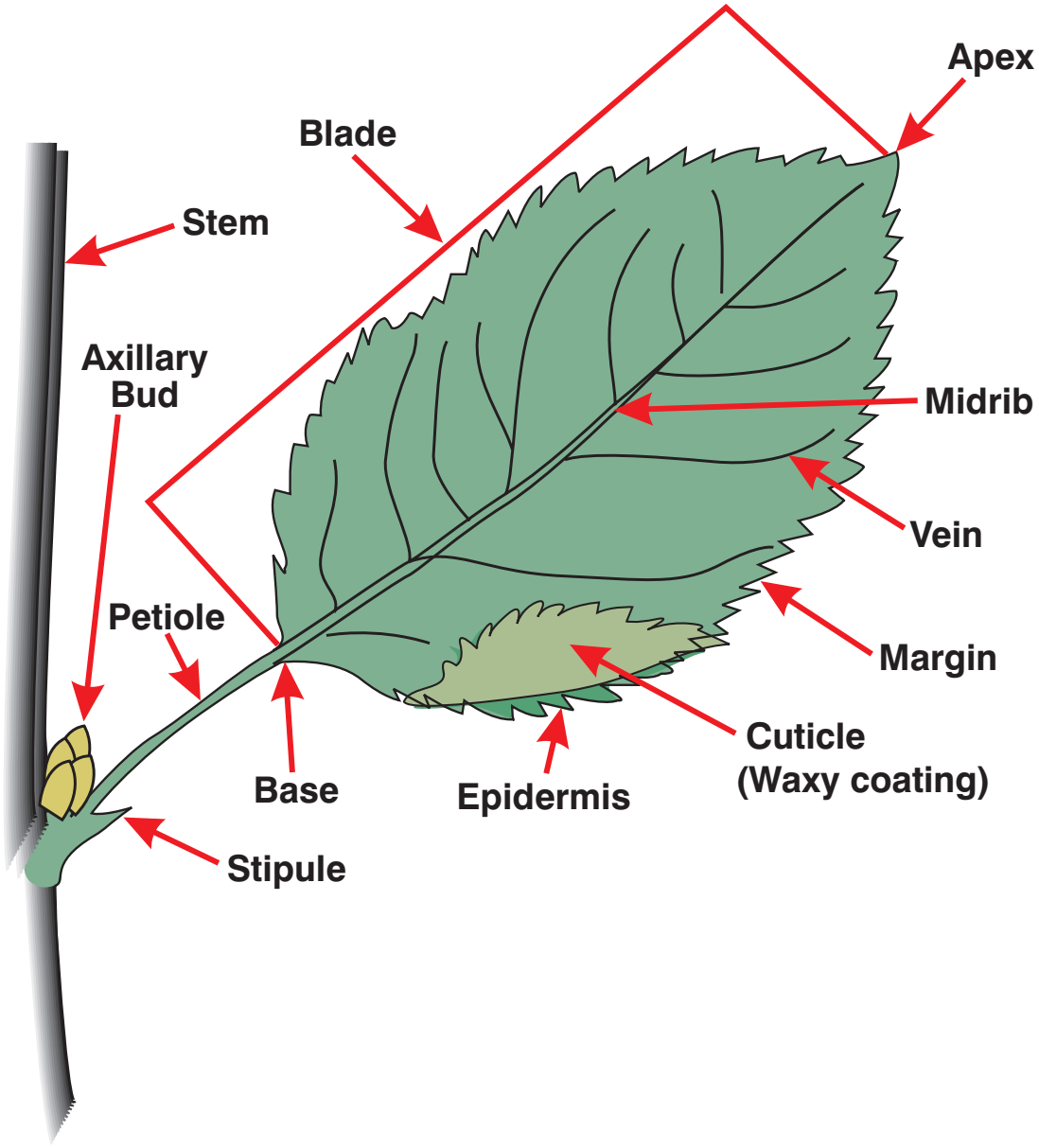
Part Three: Short Answer

Instructions. Provide information to answer the following question.

Name the difference between compound and simple leaves.

TM: A2–4A

PARTS OF A SIMPLE DICOT LEAF

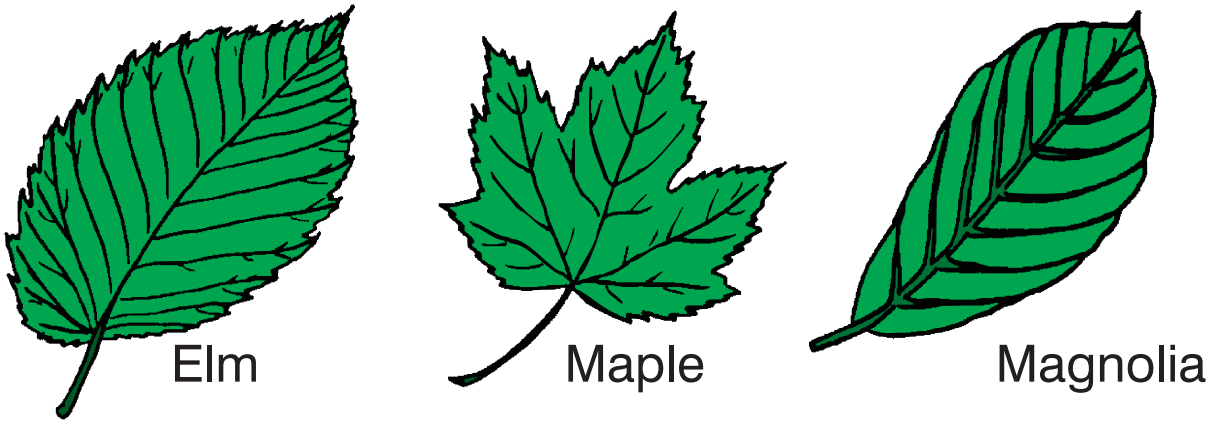


(Courtesy, Interstate Publishers, Inc.)

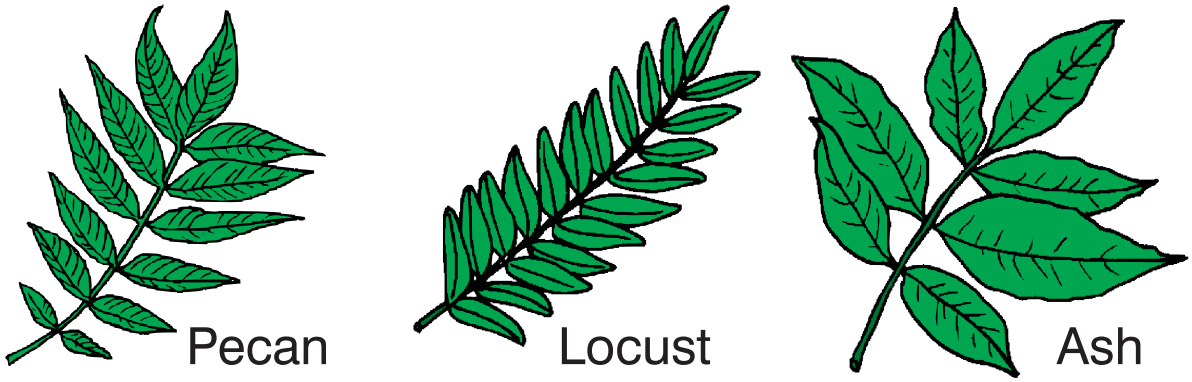
TM: A2–4B

SOME SIMPLE AND COMPOUND LEAVES

SIMPLE

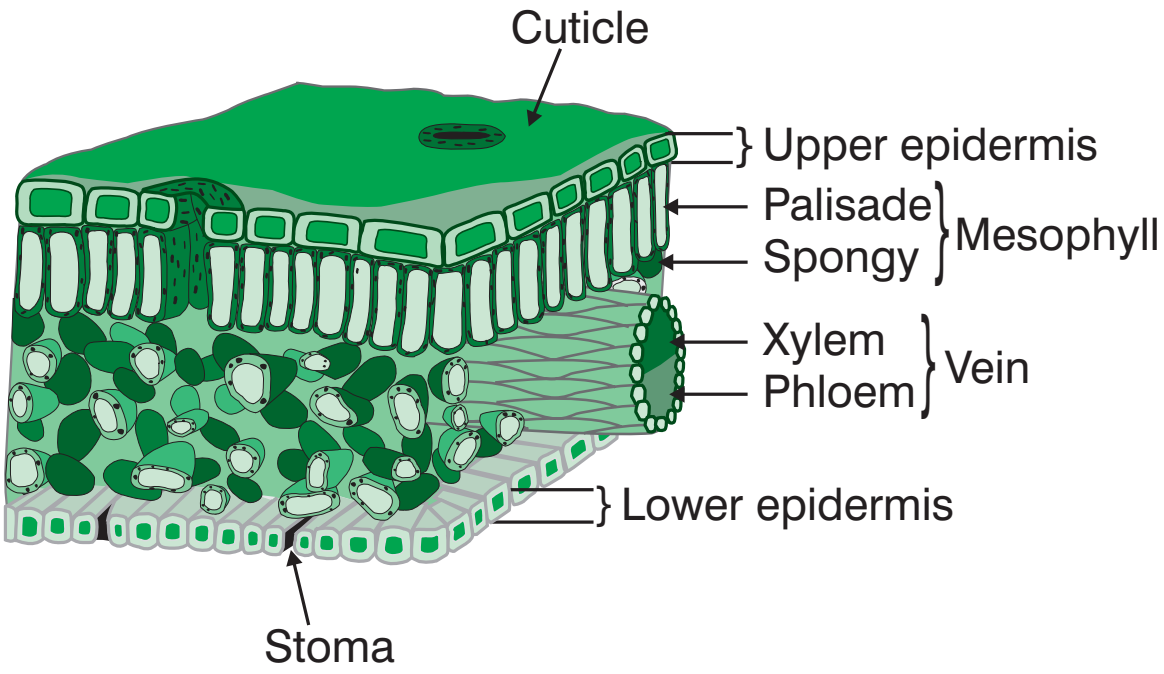


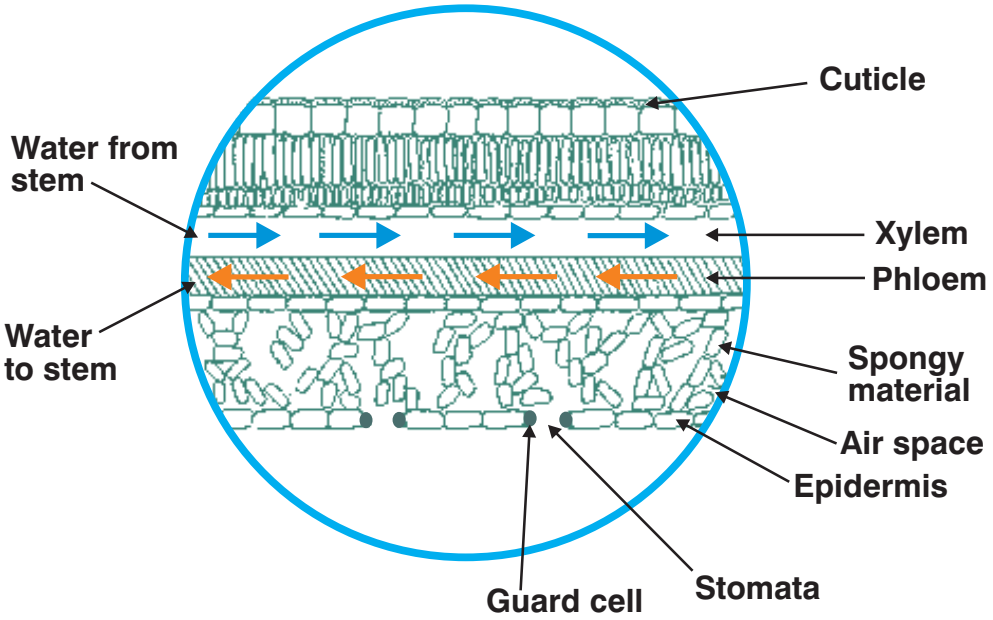
COMPOUND



(Courtesy, Interstate Publishers, Inc.)

THE CROSS SECTION OF A LEAF BLADE





(Courtesy, Interstate Publishers, Inc.)

Name _____

Lab Sheet

1. Use the microscope to look at a prepared leaf cross-section. In the space provided below, draw a picture of a narrow section of leaf and label all of the following parts:

   cuticle
   epidermis
   guard cells
   palisade mesophyll
   spongy mesophyll
   stomata

2. If the leaf were a greenhouse, what object or area of the greenhouse would do the job of each of these structures? For example, whitewash on the glass of a greenhouse might be comparable to the cuticle of a leaf.