Lesson B3–2

Measuring Trees

Unit B. Plant Wildlife Management

Problem Area 3. Forest Management

Lesson 2. Measuring Trees

New Mexico Content Standard:

Pathway Strand: Power, Structural and Technical Systems

Standard: **III:** Apply principles of service and repair to mechanical equipment, structures, biological systems, land treatment, power utilization, and technology.

Benchmark: **III-G:** Use tools in the workplace to demonstrate safe use and proper skills with construction/fabrication hand tools.

Performance Standard: **1.** Demonstrate proper use of measurement and layout tools. **2.** Apply proper use of measurement and layout tools in construction/fabrication of an actual project.

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

1. Describe the common units of measure used in forestry.
2. Explain how to determine the diameter of a standing tree.
3. Explain how to measure the height of standing trees.

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:

Rolfe, Gary L., John M. Edgington, I. Irving Holland, and Gayle C. Fortenberry. *Forests and Forestry* 6th Edition. Upper Saddle River, New Jersey: Prentice Hall Interstate, 2003. (Chapter 3)

Other Resources. The following resources will be useful to students and teachers:

List of Equipment, Tools, Supplies, and Facilities

Writing surface
Overhead projector
Transparencies from attached masters
Tree scale sticks
Diameter tapes
Tree volume tables

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

Basal area
Board foot
Breast height
Cord
Cubic foot
Cunit
dbh
Hypsometer
Linear foot
Merchantable height
Piece

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.

On the board write the words "Yield," "Plant Population," and "Variety." Ask students to define these terms. Ask students what these terms refer to. It is expected that they will respond with an answer such as "grain production." Tell the students just as grain production has its terms, forestry has terms it uses as well to measure production. Lead discussion to first lesson objective.

Summary of Content and Teaching Strategies

Objective 1: Describe the common units of measure used in forestry.

Anticipated Problem: What are the common units of measure used in forestry?

I. Tree measurements are necessary to determine the volume of wood in each tree. The total of individual tree measurements and volumes provides an inventory of the whole timber stand. Timber trees are measured with a variety of units of measure. Some of these units are unique to the wood industry and others are also used for generally measuring.

A. ***Board foot***—a unit of measurement represented by a piece of rough wood 1 foot square and 1 inch think. The board foot is generally used to measure sawtimber and veneer timber. In surfaced or finished lumber, width and thickness are based on measurements before surfacing or other finishing.

B. ***Cubic foot***—a unit of measurement equal to the volume of a cube of rough wood 1 foot in length on each of its six sides. A cubic foot contains 12 board feet. The unit is used to measure all kinds of timber products.

C. ***Cord***—a stack of wood, including air space between pieces, that measures 4 feet x 4 feet x 8 feet, or 128 cubic feet. The cord is used to measure pulpwood and fence posts.

D. ***Cubit***—a stack of wood containing 100 cubic feet of solid wood.

E. ***Piece***—a unit of measurement that refers to the number or quantity of timber products of a specified dimension.

F. ***Linear foot***—a unit of measurement used to express the length of a product in feet.

G. ***Basal area***—a unit of measurement applied to standing timber to indicate the level of stocking. It is the cross-sectional area of trees at ***breast height***, or 4 ½ feet above the average ground line. Basal area is expressed in square feet. It may apply to individual trees, or it may apply to all trees when it is expressed on an acre basis.

There are many techniques that can be used to assist students in mastering this material. Students need text material to aid in understanding the common units of measure used in forestry. Chapter 3 in Forests and Forestry is recommended. Use TM: B3–2A to aid in discussion on this topic.

Objective 2: Explain how to determine the diameter of a standing tree.

Anticipated Problem: How do I determine the diameter of a standing tree?

II. In the United States, the diameter of standing trees is most commonly measured at breast height. This is known as ***dbh***. Diameter measurements are taken outside the bark, with deductions made for bark thickness. Tree diameters are usually recorded in even 2-inch classes to facilitate volume determination. Typically diameter classes are 6-, 8-, 10-, 12-, and 14-inch diameters. A tree is placed according to diameter in the nearest 2-inch class.

A. A diameter tape is the most accurate tool for measuring a tree. It is calibrated so that each inch on the diameter side of the tape is actually 3.1416 inches in length. Because the tape is calibrated in this way, taking a measurement of the tree's circumference produces the tree's diameter.

B. A technique similar to the one described for using a diameter tape can be used for roughly measuring tree diameter with a Biltmore stick. This procedure is based on the geometric principle of similar triangles, with the scale on the stick graduated to read directly in inches.

There are many techniques that can be used to assist students in mastering this material. Students need text material to aid in understanding how to determine the diameter of a standing tree. Chapter 3 in Forests and Forestry is recommended. Use TM: B3–2B, TM: B3–2C, and TM: B3–2D to aid in discussion on this topic.

Objective 3: Explain how to measure the height of standing trees.

Anticipated Problem: How do I measure the height of standing trees?

IV. Tree height may be measured in terms of feet or number of logs or bolts. A tree is measured to either its total height or its merchantable height. ***Merchantable height*** refers to the usable length of the tree for a specific product and is measured from the stump height to the cut-off point near the top. This cut-off point is located where the stem diameter reaches a minimum size for the product for which the tree is to be harvested or where excess limbs or forks prevent closer utilization. Merchantable height for a sawtimber tree is determined by the number of 16-foot logs and half logs that can be cut from a tree. The cut-off point for sawtimber trees varies from 6 to 10 inches. Merchantable height for a pulpwood tree is usually tallied to the nearest pulpwood bolt of a given length. This will be 4 feet, 5 feet, or 5 feet 3 inches, depending on pulp mill specifications. The cut-off point for pulpwood is generally 4 inches.

A. One instrument that is used to measure tree height is a ***hypsometer***. Hypsometers (graduated in log length) are normally found on the edge tree scale sticks. Most tree scale sticks also have volume tables printed on one of the wide sides.

There are many techniques that can be used to assist students in mastering this material. Students need text material to aid in understanding how to measure the height of standing trees. Chapter 3 in Forests and Forestry is recommended. Use TM: B3-2E to aid in discussion on this topic.

Review/Summary. Use the student learning objectives to summarize the lesson. Have students explain the content associated with each objective. Student responses can be used in determining which objectives need to be reviewed or taught from a different angle. Questions at end of chapters in the textbook may also be used in the review/summary.

Application. Conduct a tree survey of the trees located on the school's campus or in a nearby wooded area. Contact your local forester for assist.

Evaluation. Use the following sample test to evaluate the students' comprehension of the material covered in this lesson.

Answers to Sample Test:

Part One: Matching

1 = h; 2 = f; 3 = e; 4 = b; 5 = d; 6 = a; 7 = g; 8 = c

Part Two: Completion

1. diameter tape
2. stem diameter; limbs; forks
3. breast height; dbh

Sample Test Name _____

Test

Lesson B3–2: Measuring Trees

Part One: Matching

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

a. Basal area	d. Merchantable height	g. Cubic foot
b. Cord	e. dbh	h. Linear foot
c. Hypsometer	f. Board foot	

_____ 1. A unit of measurement used to express the length of a product in feet.

_____ 2. A unit of measurement represented by a piece of rough wood 1 foot square and 1 inch thick.

_____ 3. Diameter at breast height.

_____ 4. A stack of wood, including air space between pieces, that measures 4 feet × 4 feet × 8 feet, or 128 cubic feet.

_____ 5. The usable length of the tree for a specific product and the measurement from the stump height to the cut-off point near the top.

_____ 6. A unit of measurement applied to standing timber to indicate the level of stocking.

_____ 7. A unit of measurement equal to the volume of a cube of rough wood 1 foot in length on each of its six sides.

_____ 8. Instrument that is used to measure tree height.

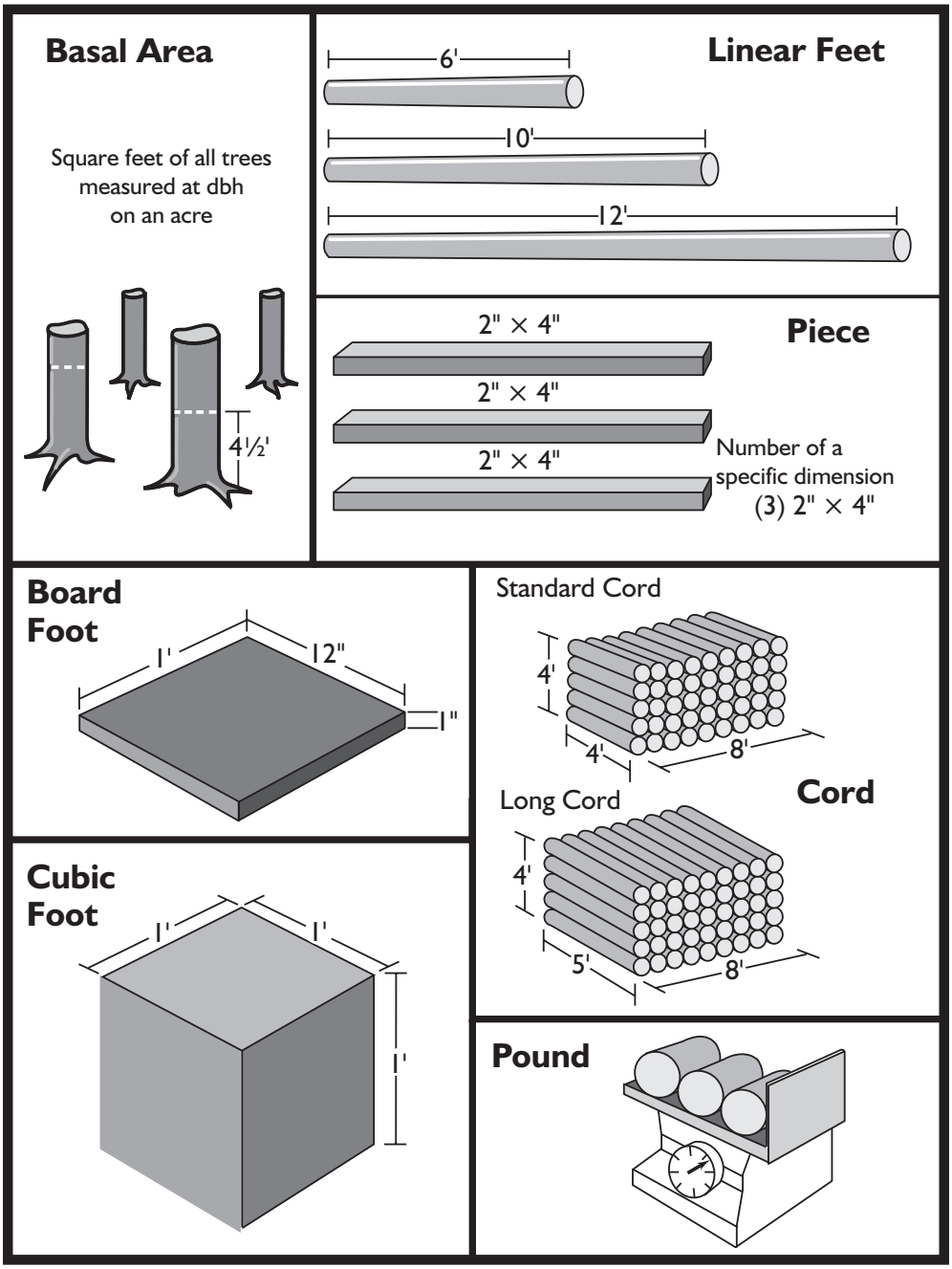
Part Two: Completion

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

1. A _____ _____ is the most accurate tool for measuring tree diameter.
2. The cut-off point of a tree is located where the _____ _____ reaches a minimum size for the product for which the tree is to be harvested or where excess _____ or _____ prevent closer utilization.
3. In the United States, the diameter of standing trees is most commonly measured at _____ _____, also known as _____.

TM: B3–2A

COMMON FORESTRY MEASUREMENT UNITS



(Courtesy, Interstate Publishers, Inc.)

TM: B3–2B

DIAMETER CLASSES

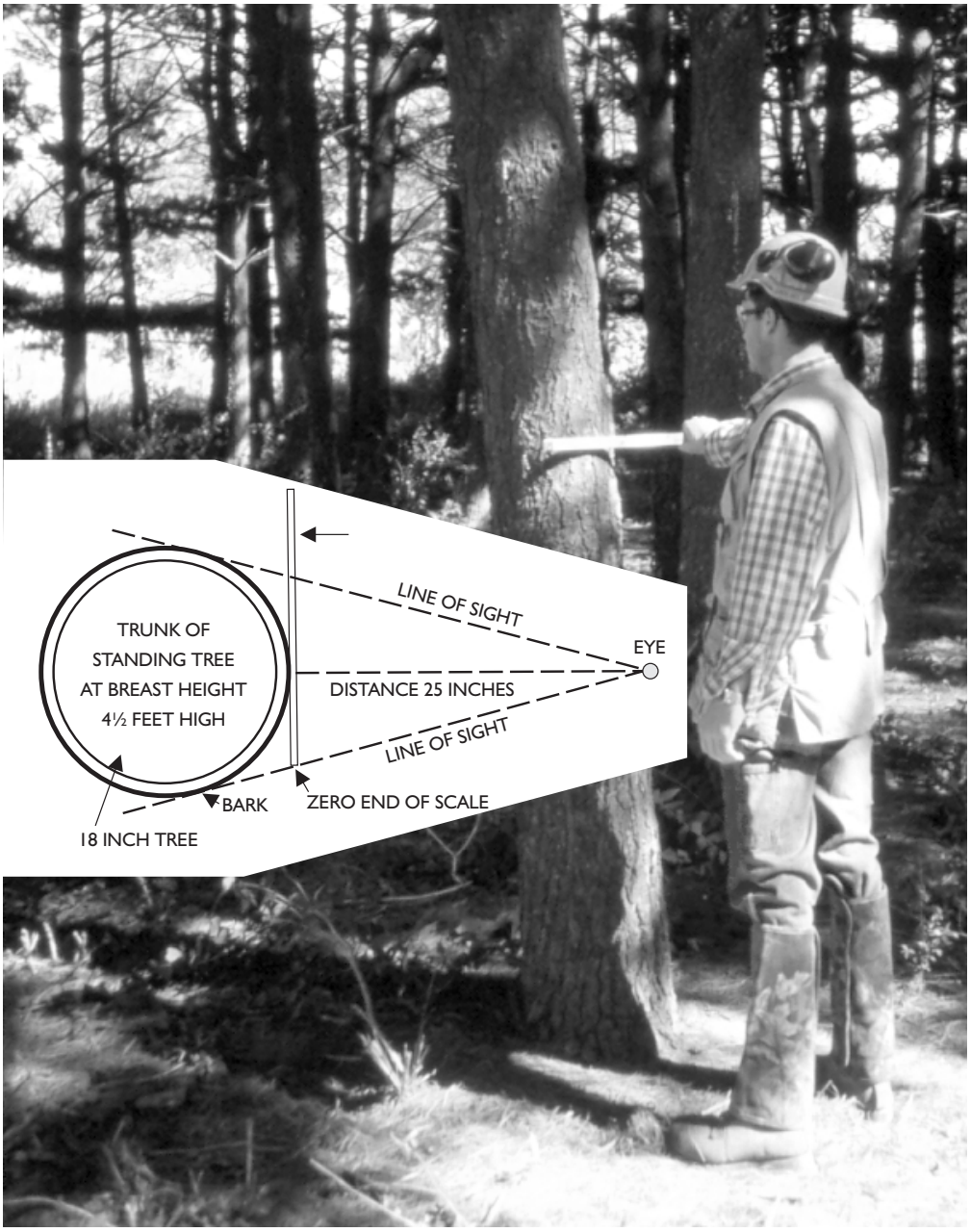
10-inch trees	9.1 to 11.0 inches
12-inch trees	11.1 to 13.0 inches
14-inch trees	13.1 to 15.0 inches
16-inch trees	15.1 to 17.0 inches
18-inch trees	17.1 to 19.0 inches
20-inch trees	19.1 to 21.0 inches

STEPS IN USING A BILTMORE STICK

1. Hold the stick horizontally, at arm's length (25 inches from the eye) and 4 ½ feet above the ground.
2. Place the Biltmore Stick against the tree, with the left end of the stick along one edge of the tree. Keep one eye closed.
3. Without moving your head, read the diameter where the right side of the tree intersects the stick.

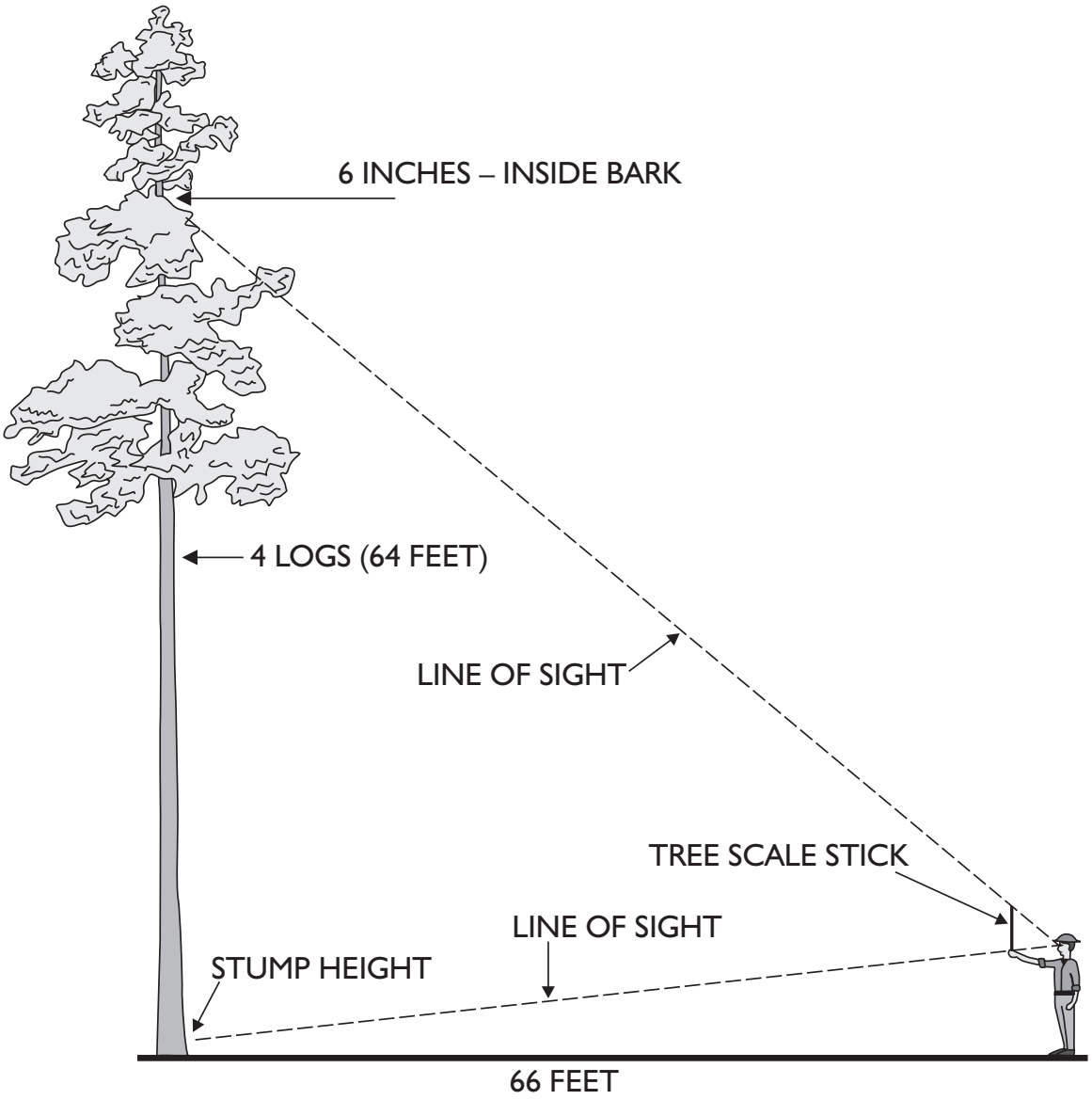
TM: B3–2D

DIAMETER MEASUREMENT USING A BILTMORE STICK



TM: B3–2E

EXAMPLE OF HYPSOMETER MEASUREMENT DIRECTIONS



(Courtesy, Interstate Publishers, Inc.)