

Lesson Plan Template

Instructor: Kate Dean

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Course Title: Forestry

Specific Topic: Building a Customized Biltmore Stick

Reading Assignment: How to Make your own customized Biltmore Stick packet

<p>Performance Objectives:</p>	<p>After completion of the lesson, students will be able to:</p> <ol style="list-style-type: none"> 1. Annotate a set of directions and precisely follow these directions 2. Create a Biltmore stick customized to the arm length of the student
<p>Standards: CTE & CCSS</p>	<p>FOR 10.05.01 Identify and use appropriate forestry tools used in mensuration (biltmore, clinometers, increment borer, foresters tape, etc.)</p> <p>9-10.RST.3 Follow precisely a complex multistep procedure when carrying out experiments, taking measurements, or performing technical tasks, attending to special cases or exceptions defined in the text.</p> <p>9-10.SL.1 Initiate and participate effectively in a range of collaborative discussions (one-on-one, in groups, and teacher-led) with diverse partners on <i>grades 9–10 topics, texts, and issues</i>, building on others’ ideas and expressing their own clearly and persuasively.</p>
<p>Assessment:</p>	<p>Students will produce a summarized procedure – in their own words Students will ultimately produce a properly constructed Biltmore Stick</p>
<p>Materials:</p>	<p>How to make a Biltmore Stick instruction packet Highlighters Materials for building Biltmore stick (see instruction packet)</p>

Procedure:

Literacy Strategy used:

Image/term matching
Annotating Instructions

Introduction and Method of activating prior knowledge –

Entire Class:

- In the previous lesson students were introduced to the process of measuring forest products with emphasis on standing trees – they need to review this new material prior to delving into this lesson
- To this end, a list of important terms will be provided to each student – emphasizing that these terms were be used throughout this unit and will be referenced during our outdoor activities
- Images will be projected (most from the previous lesson’s slide show) – students will be asked to match the term from the list to the image
- These same images will be featured on both formative and summative assessments throughout the unit

- The “How to Build a Biltmore Stick” instruction packet will be distributed to each student

- Students will be shown a finished product – a Biltmore stick that was built customized to a particular person’s arm length – class will briefly discuss the use of this tool and the importance of tree measurement precision

- Students will be instructed to annotate the instructions for building the stick. They will circle important guiding verbs and use arrows to indicate what action each verb relates to. They will highlight any hints provided for each of the steps. Once they are done annotating the packet, they will rewrite the directions in bulleted format, in their own words. These rewritten directions will be their ticket to obtain materials needed to build their own Biltmore stick.

Group:

- Students will annotate their individual packets and generate their rewritten directions while working with a partner.

Application of Material:	Biltmore Sticks will be used throughout the entire unit for measuring various stands of trees both on campus and in local forests
Extension Questions:	
Accommodations needed:	

How to make your own customized Biltmore Stick

Project Materials:

1. A yardstick or similar-sized piece of wood.
2. A tape measure in inches.
3. A tape measure in centimeters.
4. Three sheets of plain, unlined 8½ x 14 inches, white paper.
5. A fine point, permanent-ink pen.
6. A long straightedge.
7. Scissors.
8. Glue.
9. Scotch tape.
10. Clear package tape, at least ½ inch wide.

Instructions:

1. Measuring Your Arm Reach:

Two arm-reach measurements are needed, one for measuring dbh and the other for measuring height, because you hold the tree scale stick differently to measure each. Correct measurement of your arm reach is critical. A mistake here will result in an inaccurate scale stick. Therefore, repeat arm-reach measurements at least twice to check for errors. Your arm reach will also change as you grow, so every year check your arm reach, and if it has changed, make a new tree scale stick.

Measure arm reach for dbh first. Hold the yardstick sideways against a large tree, just as if dbh were being measured. Grasp and hold the stick on its lower edge near where the stick touches the tree. The upper edge will have the dbh measurement scale, and you do not want to cover it with your hand. In addition, hold your arm straight and in a comfortable position, since this is how you always will measure dbh. Have a friend use the tape measure (inches) and determine the distance from the bone next to your eye to the yardstick. See Figure 2 for help. Hold the tape straight and tight and round off the measured distance to the nearest inch. This is your arm reach for dbh measurement; please record it below:

My arm reach for measuring dbh is _____ inches.

Now, determine arm reach for total and merchantable height measurements. Pace 66 feet (1 chain) from a tree, look back at the tree, and hold the yardstick vertical as if merchantable height were being measured. Again, make sure you hold your arm straight and comfortably since you must hold it this way for all future height measurements. As you did before for dbh, have your friend measure the distance from your eye bone to the yardstick and round off the distance to the nearest inch ([Figure 3](#)). This is your arm reach for height measurements. Please record below:

My arm reach for measuring height is _____ inches.

3. Paper Preparation

Place three sheets of legal-size paper end to end on a table and allow them to overlap approximately ¼ inch. Scotch-tape the sheets together on one side, then flip the sheets over. Take the pen and straight-edge and draw three parallel lines the length of the paper (36 inches long and 1 inch apart). The first line will be used to mark off the scale for dbh measurement, the second for merchantable height, and the third total height. Each scale will be specific for your particular arm reach.

4. Scale for DBH Measurement

Find [Table 1](#), Scale graduations for dbh measurements. The far left column is actual tree dbh, while remaining columns in the table show distances to mark off on the tree scale stick to measure dbh accurately. As you will notice, scale distances are in centimeters, not inches, making it easier for you to measure distances.

Look at the top of [Table 1](#) for the length of your arm reach for measuring dbh. Each number in that column below your arm reach is a distance on the scale stick that corresponds to a tree dbh on the same row.

Using a tape measure (centimeters) and pen, mark the distances for each dbh along the scale line you already drew. Remember always to measure from the far left-hand edge of the scale line, which is the zero point (dbh=0). Hold the paper sideways, and number each mark along the scale line with the tree dbh it corresponds with ([Figure 4](#)). Be sure to print neatly. Finally, place a title with the marked scale, which is tree diameter (inches), hold ___ inches from eye. Fill the blank in with your arm reach for dbh measurement.

5. Scale for Merchantable Height

Find [Table 2](#), Scale dimensions for merchantable height measurements. This table shows how to mark off distances on the tree scale stick to correspond to different merchantable heights. Use this table as you did Table 1.

Find your arm reach for measuring heights, and place a mark at the correct distances along the scale line for each log and half-log length. Turn the paper straight up and down to write the number of logs next to each mark on the scale. Numbers written this way will be easy to read when heights are measured ([Figure 4](#)).

Place a title with the marked scale, e.g., Merchantable height (number of 16-foot lots), pace 66 feet from tree, and hold stick ___ inches from eye. Fill in the blank with your arm reach for height measurements.

6. Scale for Total Height

Find [Table 3](#), Scale dimension for total height measurements. This table shows how to mark off distances on the tree scale stick to correspond to different total heights. Use this table as you did Tables 1 and 2. Find your arm reach for measuring heights, and place a mark at the correct distances along the scale line for height (feet). Again, turn the paper straight up and down to write the heights, in feet, next to each mark so they will be easy to read ([Figure 4](#)). Place a title with the marked scale, such as Total height (feet, pace 66 feet from tree, and hold stick ___ inches from eye. Fill in the blank with your arm reach for height measurements.

7. Assembly of Tree Scale Stick

Carefully cut out the three scale lines, dbh, merchantable height, and total height. The dbh scale can be 1 inch wide and the two height scales can each be $\frac{1}{2}$ inch wide. Lightly glue the dbh scale on the front of the yardstick and the two height scales on the back. When gluing, line up the zero point with the left-hand edge of the yardstick. In addition, line up the top edge of the dbh scale line as close to the upper edge of the yardstick as possible. Place one height scale near the upper edge and one near the lower.

After the glue has dried, place clear packaging tape over the tree scale lines to protect them from water and dirt. Your tree scale stick is now ready to use!

Use of the tree scale stick to measure dbh and merchantable height is fully explained in 4-H Project No. 7, Measuring Standing Sawtimber. Total tree height measurement may be something you are not familiar with. It is explained next.

8. Measuring Total Height

Total height is measured by holding the scale stick vertically one arm reach from your eye while standing at a distance of 66 feet (1 chain) from the tree. With one eye, line up the bottom of the scale stick with the point where the tree stem touches the ground.

Now, without moving your head, sight on the very uppermost reach of the main stem and find the adjacent total height value on the scale stick.

You can measure most trees accurately if you stand 66 feet from them. Exceptions are very large trees (greater than 80 feet in height) and very small trees (less than 30 feet). If a tree is more than 80 feet in height, pace away from the tree an additional 66 feet, making the total distance 2 chains or 132 feet. Measure total height normally, and whatever height you see on the scale, multiply it by 2 to get the correct height of the tree.

For short trees, under 30 feet in height, pace only 2 chains, or 33 feet, from the tree. Measure the height, and divide the reading on the scale stick by 2 to get the correct tree height. With these two tricks you should be able to measure the height of any tree.

Figure 2. Determining your arm reach for dbh measurement.

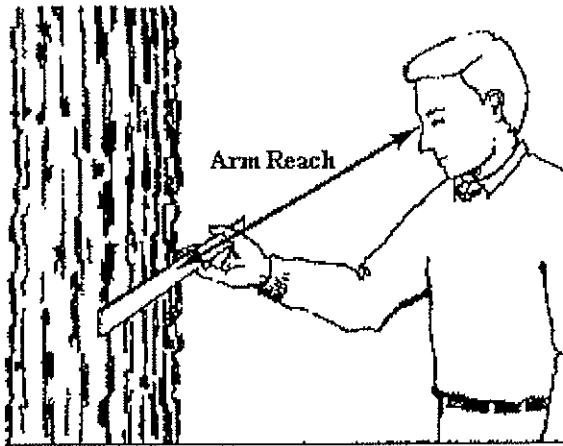


Figure 3. Determining your arm reach for height measurement.

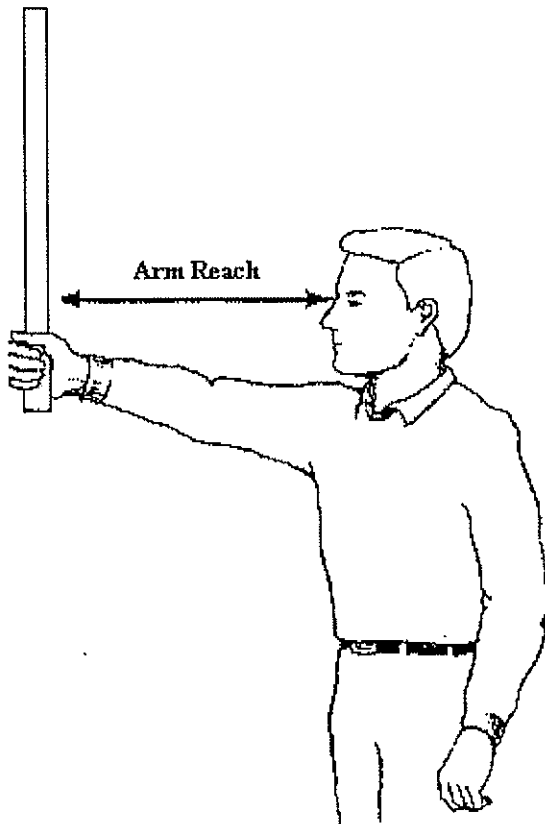


Table 1. Scale graduations for dbh (diameter at breast height). Mark off distances on the scale line, starting at the left-hand edge (zero point).

DBH (inches)	Arm Reach (inches)										
	20	21	22	23	24	25	26	27	28	29	30
	-Distance in centimeters-										
1	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5
2	4.8	4.9	4.9	4.9	4.9	4.9	4.9	4.9	4.9	4.9	4.9
3	7.1	7.1	7.1	7.2	7.2	7.2	7.2	7.2	7.2	7.3	7.3
4	9.3	9.3	9.3	9.4	9.4	9.4	9.5	9.5	9.5	9.5	9.5
5	11.4	11.4	11.5	11.5	11.6	11.6	11.6	11.7	11.7	11.7	11.8
6	13.4	13.4	13.5	13.6	13.6	13.7	13.7	13.8	13.8	13.9	13.9
7	15.3	15.4	15.5	15.6	15.6	15.7	15.8	15.8	15.9	16.0	16.0
8	17.2	17.3	17.4	17.5	17.6	17.7	17.8	17.8	17.9	18.0	18.1
9	19.0	19.1	19.3	19.4	19.5	19.6	19.7	19.8	19.9	20.0	20.0
10	20.7	20.9	21.1	21.2	21.3	21.5	21.6	21.7	21.8	21.9	22.0
11	22.4	22.6	22.8	23.0	23.1	23.3	23.4	23.6	23.7	23.8	23.9
12	24.1	24.3	24.5	24.7	24.9	25.1	25.2	25.4	25.5	25.6	25.8
13	25.7	26.0	26.2	26.4	26.6	26.8	27.0	27.1	27.3	27.4	27.6
14	27.3	27.6	27.8	28.0	28.3	28.5	28.7	28.9	29.0	29.2	29.4
15	28.8	29.1	29.4	29.6	29.9	30.1	30.3	30.5	30.7	30.9	31.1
16	30.2	30.6	30.9	31.2	31.5	31.7	32.0	32.2	32.4	32.6	32.8
17	31.7	32.1	32.4	32.7	33.0	33.3	33.6	33.8	34.1	34.3	34.5
18	33.2	33.5	33.9	34.2	34.6	34.9	35.1	35.4	35.7	35.9	36.1
19	34.6	35.0	35.4	35.7	36.1	36.4	36.7	37.0	37.2	37.5	37.8
20	35.9	36.4	36.8	37.2	37.5	37.9	38.2	38.5	38.8	39.1	39.3
21	37.3	37.7	38.2	38.6	39.0	39.3	39.7	40.0	40.3	40.6	40.9
22	38.6	39.1	39.5	39.9	40.4	40.8	41.1	41.5	41.8	42.1	42.4
23	39.8	40.4	40.8	41.3	41.7	42.2	42.6	42.9	43.3	43.6	44.0
24	41.1	41.6	42.2	42.6	43.1	43.5	44.0	44.4	44.7	45.1	45.4
25	42.3	42.9	43.4	44.0	44.4	44.9	45.3	45.8	46.2	46.5	46.9
26	43.5	44.1	44.7	45.2	45.8	46.2	46.7	47.1	47.6	48.0	48.3
27	44.7	45.4	46.0	46.5	47.0	47.6	48.0	48.5	48.9	49.4	49.8
28	45.9	46.6	47.2	47.8	48.3	48.8	49.3	49.8	50.3	50.7	51.1

29	47.1	47.7	48.4	49.0	49.6	50.1	50.6	51.1	51.6	52.1	52.5
30	48.2	48.9	49.6	50.2	50.8	51.4	51.9	52.4	52.9	53.4	53.9
31	49.3	50.0	50.7	51.4	52.0	52.6	53.2	53.7	54.2	54.7	55.2
32	50.4	51.2	51.9	52.6	53.2	53.8	54.4	55.0	55.5	56.0	56.5
33	51.5	52.3	53.0	53.7	54.4	55.0	55.6	56.2	56.8	57.3	57.8
34	52.6	53.4	54.1	54.9	55.6	56.2	56.8	57.4	58.0	58.6	59.1
35	53.6	54.4	55.2	56.0	56.7	57.4	58.0	58.7	59.3	59.8	60.4
36	54.6	55.5	56.3	57.1	57.8	58.5	59.2	59.9	60.5	61.1	61.6
37	55.7	56.5	57.4	58.2	58.9	59.7	60.4	61.0	61.7	62.3	62.9
38	56.7	57.6	58.4	59.3	60.1	60.8	61.5	62.2	62.9	63.5	64.1
39	57.7	58.6	59.5	60.3	61.1	61.9	62.7	63.4	64.0	64.7	65.3
40	58.7	59.6	60.5	61.4	62.2	63.0	63.8	64.5	65.2	65.9	66.5
41	59.6	60.6	61.5	62.4	63.3	64.1	64.9	65.6	66.3	67.0	67.7
42	60.6	61.6	62.5	63.5	64.3	65.2	66.0	66.7	67.5	68.2	68.9
43	61.5	62.6	63.5	64.5	65.4	66.2	67.0	67.8	68.6	69.3	70.0
44	62.5	63.5	64.5	65.5	66.4	67.3	68.1	68.9	69.7	70.4	71.2
45	63.4	64.5	65.5	66.5	67.4	68.3	69.2	70.0	70.8	71.6	72.3
46	64.3	65.4	66.5	67.5	68.4	69.3	70.2	71.1	71.9	72.7	73.4
47	65.2	66.3	67.4	68.4	69.4	70.3	71.2	72.1	72.9	73.7	74.5
48	66.1	67.3	68.3	69.4	70.4	71.3	72.3	73.2	74.0	74.8	75.6
49	67.0	68.2	69.3	70.3	71.4	72.3	73.3	74.2	75.1	75.9	76.7
50	67.9	69.1	70.2	71.3	72.3	73.3	74.3	75.2	76.1	76.9	77.8
51	68.8	70.0	71.1	72.2	73.3	74.3	75.3	76.2	77.1	78.0	78.8
52	69.6	70.8	72.0	73.1	74.2	75.3	76.3	77.2	78.1	79.0	79.9
53	70.5	71.7	72.9	74.1	75.2	76.2	77.2	78.2	79.1	80.1	80.9
54	71.3	72.6	73.8	75.0	76.1	77.2	78.2	79.2	80.1	81.1	82.0
55	72.1	73.4	74.7	75.9	77.0	78.1	79.1	80.2	81.1	82.1	83.0
56	73.0	74.3	75.5	76.7	77.9	79.0	80.1	81.1	82.1	83.1	84.0
57	73.8	75.1	76.4	77.6	78.8	79.9	81.0	82.1	83.1	84.1	85.0
58	74.6	76.0	77.2	78.5	79.9	80.9	82.0	83.0	84.1	85.1	86.0
59	75.4	76.8	78.1	79.4	80.6	81.8	82.9	84.0	85.0	86.0	87.0
60	76.2	77.6	78.9	80.2	81.5	82.7	83.8	84.9	86.0	87.0	88.0

Table 2. Scale graduations for merchantable height. Mark off distances on the scale line, starting at the left-hand edge (zero point).

Height No. of 16-foot logs	Arm Reach (inches)										
	20	21	22	23	24	25	26	27	28	29	30
	-Distance in centimeters-										
1	12.3	12.9	13.5	14.2	14.8	15.4	16.0	16.6	17.2	17.9	18.5
1.5	18.5	19.4	20.3	21.2	22.2	23.1	24.0	24.9	25.9	26.8	27.7
2	24.6	25.9	27.1	28.3	29.6	30.8	32.0	33.3	34.5	35.7	36.9
2.5	30.8	32.3	33.9	35.4	36.9	38.5	40.0	41.6	43.1	44.6	46.2
3	36.9	38.8	40.6	42.5	44.3	46.2	48.0	49.9	51.7	53.6	55.4
3.5	43.1	45.3	47.4	49.6	51.7	53.9	56.0	58.2	60.3	62.5	64.6
4	49.3	51.7	54.2	56.6	59.1	61.6	64.0	66.5	69.0	71.4	73.9
4.5	55.4	58.2	61.0	63.7	66.5	69.3	72.0	74.8	77.6	80.4	83.1
5	61.6	64.7	67.7	70.8	73.9	77.0	80.0	83.1	86.2	89.3	92.4

Table 3. Scale graduations for total height. Mark off distances on the scale line starting at the left-hand edge (zero point).

Total Height (feet)	Arm Reach (inches)										
	20	21	22	23	24	25	26	27	28	29	30
	-Distance in centimeters-										
10	7.7	8.1	8.5	8.9	9.2	9.6	10.0	10.4	10.8	11.2	11.5
20	15.4	16.2	16.9	17.7	18.5	19.2	20.0	20.8	21.6	22.3	23.1
30	23.1	24.2	25.4	26.6	27.7	28.9	30.0	31.2	32.3	33.5	34.6
40	30.8	32.3	33.9	35.4	36.9	38.5	40.0	41.6	43.1	44.6	46.2
50	38.5	40.4	42.3	44.3	46.2	48.1	50.0	52.0	53.9	55.8	57.7
60	46.2	48.5	50.8	53.1	55.4	57.7	60.0	62.3	64.7	67.0	69.3
70	53.9	56.6	59.3	62.0	64.7	67.3	70.0	72.7	75.4	78.1	80.8
80	61.6	64.7	67.7	70.8	73.9	77.0	80.0	83.1	86.2	89.3	92.4

Important Terms from Land and Forest Products Measurement Presentation

Chain

Mensuration

Board foot

Angle gauge

Basal Area

DBH

Biltmore Stick

D-tape

Total height

Merchantable height

Clinometers

Scaling

Timber cruising

37.2 ft





