

4-H Forestry

Making a Tree Scale Stick



The first step in good forest management is the measurement of trees to establish a forest inventory. The most common tree measurements needed for inventory include DBH (diameter at breast height), merchantable height, and total height (Figure 1).

Many tools are available to take these measurements, but one of the simplest and easiest to use is the tree scale stick.

Although you can buy a tree scale, many people have enjoyed making personalized sticks. By following the directions in this project, you can construct a tree scale stick to measure trees accurately.

Under certain situations, your handmade tree scale stick will outperform a manufactured stick. Some 4-H members with shorter arms find it impossible to hold a manufactured stick the required 25-inch distance from their eyes. You can make your stick for your arm length; therefore, tree measurements are more accurate. Also, manufactured sticks are not designed to measure total tree height, even though it is an important measurement.

Total height is needed to help determine pulpwood volumes in trees. You can make your stick to measure total height as easily as measuring merchantable height.

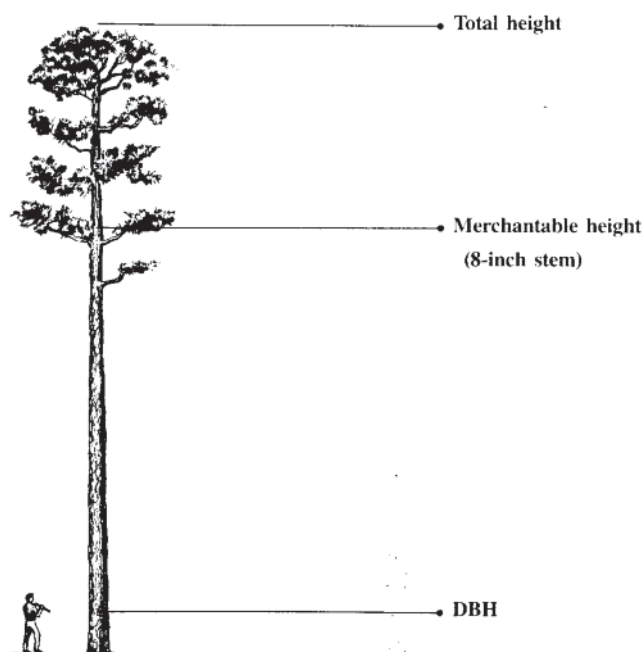


Figure 1. Three important tree measurements.

Project References

1. Extension Publication 2260 Are My Pine Trees Ready To Thin
2. Extension Publication 1473 4-H Forestry Project No. 7: Measuring Standing Sawtimber

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- by 14-inch 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

Sources of Help and Information

1. County Extension director or 4-H youth agent
2. 4-H volunteer leaders and parents
3. County forester, Mississippi Forestry Commission
4. District conservationist, Soil Conservation Service, U.S. Department of Agriculture
5. District ranger, Forest Service, U.S. Department of Agriculture
6. Foresters with local forest industries
7. Consulting foresters, self-employed
8. Park managers, Mississippi Department of Wildlife, Fisheries, and Parks



Instructions

1. Measure 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.

Let's measure arm reach for DBH first. Hold the yardstick sideways against a large tree, just as if DBH were being measured (P1473 4-H Forestry Project No. 7: Measuring Standing Sawtimber). 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, which you do not want to cover 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 (Figure 2). Hold the tape straight and tight and round off the measured distance to the nearest inch. This is your arm reach for DBH measurement. Record it below:

My arm reach for measuring DBH is _____ inches.

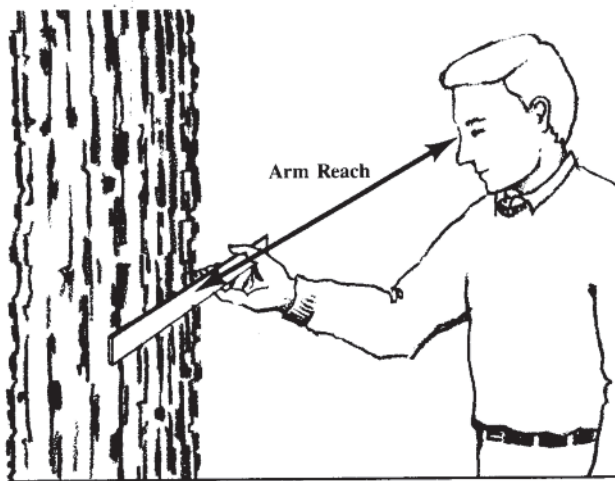


Figure 2. Determine your arm reach for DBH measurement.

2. 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 (P1473 4-H Forestry Project No. 7: Measuring Standing Sawtimber). 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. Record this measurement below:

My arm reach for measuring height is _____ inches.

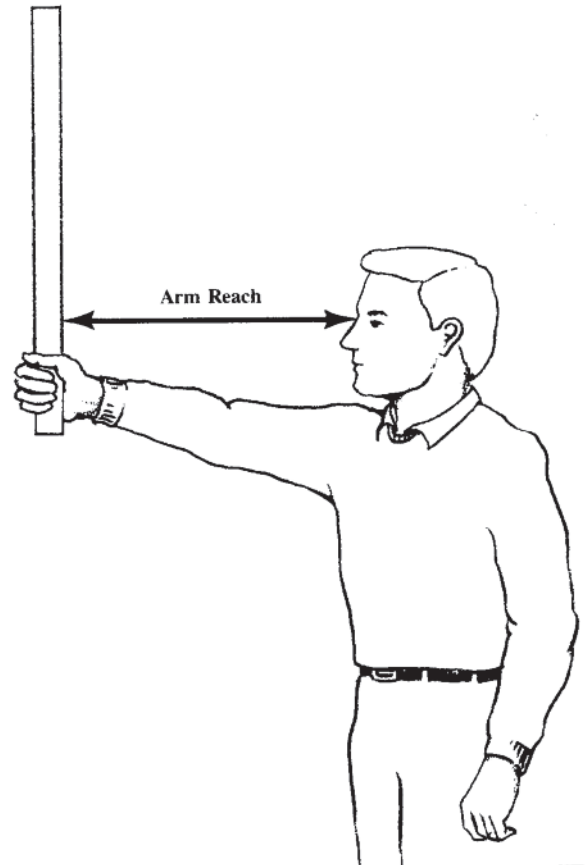


Figure 3. Determine your arm reach for height measurements.

3. Prepare your paper. Place three sheets of legal-size paper end to end on a table and allow them to overlap approximately $\frac{1}{4}$ 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. Mark your scale for DBH measurement. Look at Table 1. 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 distance 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 and include instructions for measuring DBH with your tree scale stick. For example, "Tree diameter (inches), hold _____ inches from eye." (Fill in the blank with your arm reach for DBH measurement.)

5. Mark your scale for measuring merchantable height. Look at Table 2. 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).

Include instructions for measuring merchantable height with your tree scale stick. For example, "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. Mark your scale for measuring total height. Look at Table 3. 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 distance 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).

Include instructions for measuring total height with your tree scale stick. For example, "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.

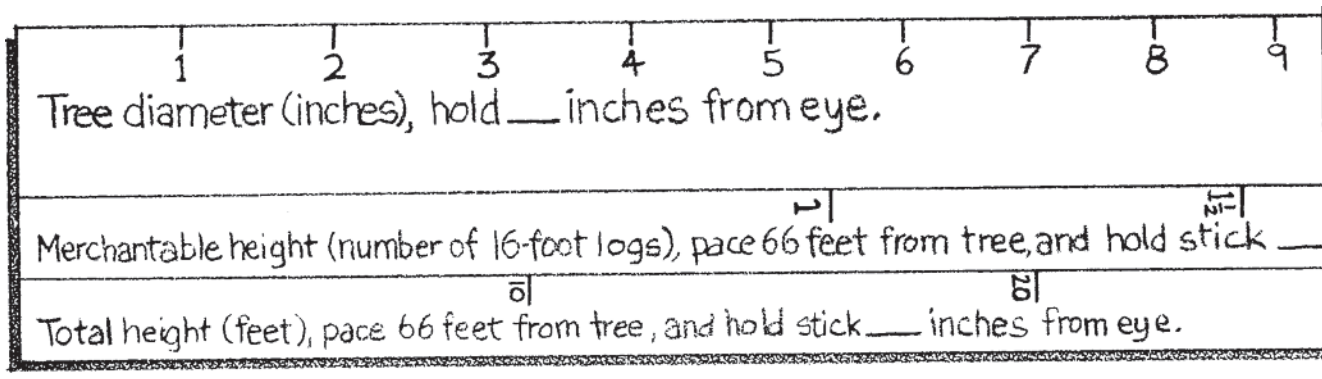


Figure 4. Scale lines for DBH, merchantable height, and total height.

7. Assemble your 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.

Using the tree scale stick to measure DBH and merchantable height is fully explained in P1473 4-H Forestry Project No. 7: Measuring Standing Sawtimber. Total tree height measurement may be something you are not familiar with. It is explained next.

8. Measure 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 (one 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 two 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 trees shorter than 30 feet, pace only two chains, or 33 feet, from the tree. Measure the height, and divide the reading on the scale stick by two to get the correct tree height. With these two tricks you should be able to measure the height of any tree.

Summary

- Collect project materials.
- Determine your arm reach for DBH and height measurements.
- Draw three lines, 36 inches in length, on paper. Use the first line for the DBH scale, the second for merchantable height, and the third for total height.
- Based on your arm length, locate the correct distances for scale lines in the tables.
- Mark off each scale, starting from the left edge as zero.
- Cut out the scale lines and assemble your scale stick.

Now get out there and have fun measuring trees!

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 (number 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

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