

4-H Forestry Project No. 4

Making a Tree Scale Stick



The first step in good forest management is measuring 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 stick, 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 can even 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 a stick for your arm length, resulting in more accurate measurements. Additionally, manufactured sticks are not designed to measure total tree height, despite its importance.

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

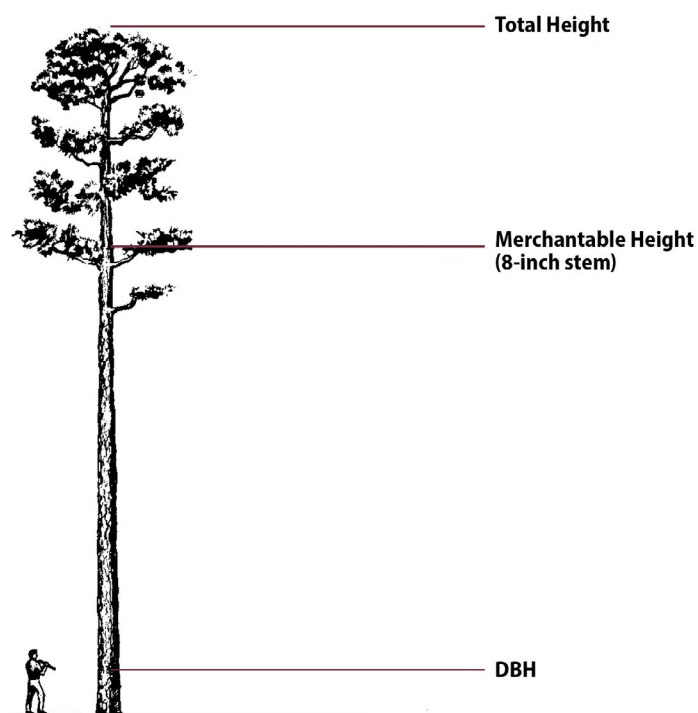


Figure 1. Three important tree measurements.

Project References

1. MSU Extension Publication 1991 4-H Forestry Competition Handbook
2. Extension Publication 2260 Are My Pine Trees Ready to Thin?
3. Extension Publication 1473 4-H Forestry Project No. 5: 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. Transparent tape
10. Clear package tape, at least ½-inch wide

Sources of Help and Information

1. MSU Extension agents, MSU Extension Service county offices
2. Area forester, Mississippi Forestry Commission, Find Your Forester - MFC
3. District conservationist, Natural Resources Conservation Service, U.S. Department of Agriculture, USDA Service Center Locator
4. Project forester or district ranger, Forest Service, U.S. Department of Agriculture, Mississippi's National Forests
5. Registered foresters, Mississippi Board of Registration for Foresters
6. Park managers, Mississippi Department of Wildlife, Fisheries, and Parks, Mississippi's State Parks
7. 4-H volunteer leaders and parents



Instructions

1. Measure your arm reach. Arm-reach measurements are needed for DBH and height. Correct measurement of your arm reach is critical. A mistake here will result in an inaccurate scale stick. Repeat arm-reach measurements at least twice to check for errors. Remeasure arm-reach yearly and adjust for changes as you grow.

Measure arm reach for DBH first. Hold the yardstick sideways against a large tree, just as if DBH were being measured (Figure 2). Grasp and hold the stick on its lower edge near where the stick touches the tree. Hold your arm straight and in a comfortable position.

Have a friend use tape measure (inches) to 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. Record your arm reach for DBH below.

My arm reach for measuring DBH is ____ inches.

2. Determine arm reach for total and merchantable height measurements. Measure 66 feet (1 chain) from a tree, look back at the tree, and hold the yardstick vertically as if merchantable height were being measured (Figure 3).

Again, make sure you hold your arm straight and comfortably.

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.

3. Prepare your paper (Figure 4). Place three sheets of legal-size paper end to end on a table and allow them to overlap approximately $\frac{1}{4}$ inch. Tape the sheets together on one side, then flip the sheets over. Take the pen and straightedge 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. Refer to Table 1. The far-left column is actual tree DBH, and the top column corresponds to your arm reach. The numbers under your arm-reach are the distances to mark off on the tree scale

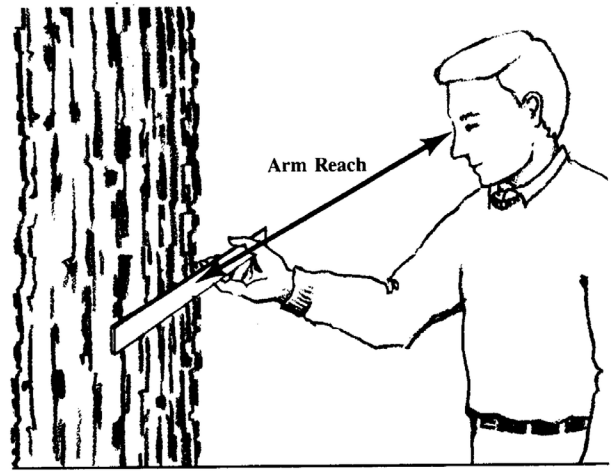


Figure 2. Determine your arm reach for DBH measurement.

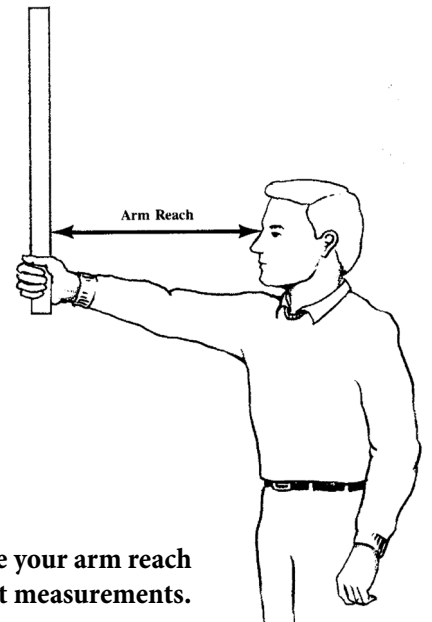


Figure 3. Determine your arm reach for height measurements.

stick. Take note that the scale distances are in centimeters, not inches, making it easier for you to measure distances.

Using a tape measure (centimeters) and pen, mark the distance for each DBH along the scale line you drew. Always 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. Refer to Table 2, which shows how to mark distances on the tree scale stick to correspond to different merchantable heights. Use this table as you did Table 1.

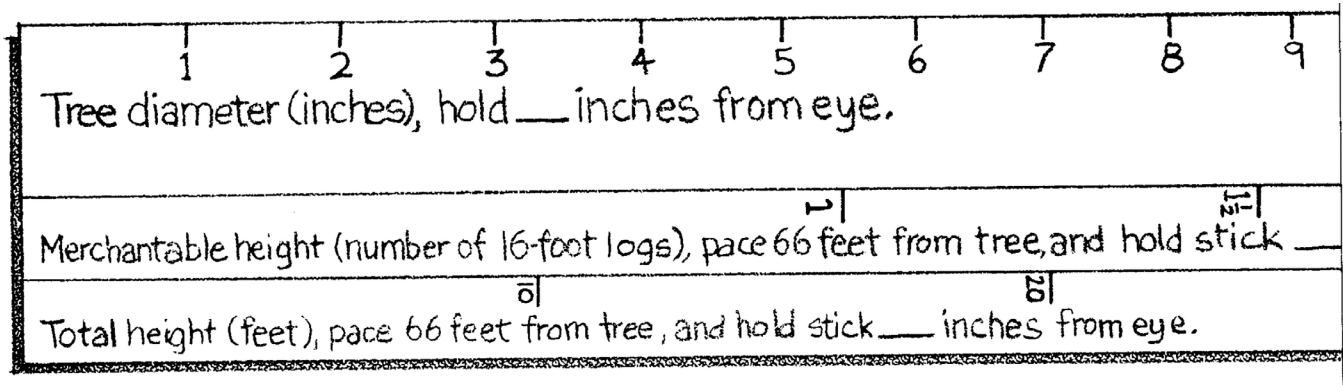


Figure 4. Sample tree scale stick.

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. Refer to Table 3, which 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.

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 can be 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 MSU Extension publication 1991 4-H Forestry Competition Handbook.

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 one-half chain, 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 (centimeters)										
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).

DBH (inches)	Arm Reach (inches)										
	20	21	22	23	24	25	26	27	28	29	30
	Distance (centimeters)										
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).

DBH (inches)	Arm Reach (inches)										
	20	21	22	23	24	25	26	27	28	29	30
	Distance (centimeters)										
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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