



# The Amazing Race in the Forest!

## Middle School Food and Agricultural Literacy Curriculum

### Precepts

- F. Continuous Improvement
  - F1. Implement a leadership and personal growth plan.

### National Standards

- NL-ENG.K-12.4 – Communication Skills
- NL-ENG.K-12.12 – Applying Language Skills
- NM-NUM.6-8.3 – Compute Fluently and Make Reasonable Estimates

### Student Learning Objectives

- As a result of this **unit** the students will...
- Explain the basic concepts of the forestry industry.
- As a result of this **lesson** the students will...
- Apply math concepts utilized by the forestry industry.

### Content Outline

**Objective 1.** Apply math concepts utilized by the forestry industry.

- I. **Calculating the number of acres in a tract of forest land**
- II. **Calculating the Diameter Breast Height or DBH:** the diameter of the tree at four and one half feet above the ground. It is measured with a device called a dendrometer; also can be measured with a Diameter Tape or a Biltmore Stick. When calculating DBH the measurement is always rounded to the nearest inch measurement. If the tree was 5 1/2" it would be rounded up to 6". If the tree measured 8 1/4" it would be rounded down to 8".

### Time

Instruction time for this lesson: 45 minutes.

### Resources

American Forest Foundation. (2006). Project learning tree pre K-8 Environmental education activity guide Activity 67 How big is your tree. Washington, D.C. — Middle School Curriculum Unit 13 Forestry and natural resources Lesson 8 Measuring the forest. Retrieved August 10, 2009. From Georgia Ag Ed Curriculum Web site. — <http://www.gp.com/education/innature/fromforest/download.html> — National FFA Organization. (2003). LifeKnowledge Precepts and Signs of Success

### Tools, Equipment, and Supplies

Overhead projector/transparencies  
1/2 sheet poster board – for teacher destination clue card  
Duct tape line on floor (at least 2 feet long) – one per group  
MS.NR.5.3.AS.A (math calculation worksheet) – one per student  
Pencil – one per student  
One piece of lumber for board feet measurement  
MS.NR.5.3.AS.B (information for destination clue) – one per teacher  
MS.NR.5.3.AS.C (labels for each station placed on the walls around the room) – one per station  
MS.NR.5.3.AS.D (explanation of problems for each station) – one section per station  
MS.NR.5.3.TM.A – answers to student math worksheet – one per teacher  
MS.NR.5.3.ASSESS.A – one per student

### Key Terms

The following terms are presented in this lesson and appear in ***bold italics***:

***Diameter Breast Height or DBH.***

***Board foot***

***Sawlogs***

### III. Calculating Board Feet

- A. Board foot: The standard unit of measurement for most lumber. It is a measurement equal to a piece of wood one inch thick, one foot wide, and one foot long.

### IV. Calculating the Number of Sawlogs: 16-foot logs that are free of large knots and at least eight to ten inches in diameter.

### V. Using the Board Foot Table to calculate the number of board feet in each tree measured.



Lesson Number: MS.NR.5.3

## Middle School Food and Agricultural Literacy Curriculum

### The Amazing Race in the Forest!

#### Interest Approach

This class uses the concept of the TV show The Amazing Race to involve students in the math concepts used by the forestry industry. Before class you will have to pre-assign groups and make students aware of their groups before giving the directions below. It will be very helpful if you have at least one student with strong math skills in each group. Also, before class, you will have to mark a line on the floor for each group to measure. (Duct tape works well to make the line.) Make the lines the same length; however separate them, if possible, and turn them in different directions so it gives the illusion that they might be different lengths. In addition, before class take a ½ piece of poster board and fold it hamburger style. Decorate it with the title "Destination Clue" on the side facing the class. On the other side tape **MS.NR.5.3.AS.B**. Also, cut apart **MS.NR.5.3.AS.C** and post each label around the room in a location conducive to the students completing the calculations. In addition, cut apart **MS.NR.5.3.AS.D** and post a different part at each of the stations.

Welcome to class today. This is going to be an exciting day because today we will be participating in a segment of the TV show, The Amazing Race! Groups will compete and complete an activity to be able to receive the clue needed to tell where to go in order to finish this segment of the race. When I say MOVE, your previously assigned groups will take only a pencil with them and the group will proceed to one of the duct taped areas on the floor. What questions do you have? MOVE!

Allow groups to go to the different areas marked with duct tape.

Here is your challenge. When I say GO, groups have 15 seconds to work together and measure the line designated by the duct tape. Use anything you already have on you to determine the measurement. Each group will then share the measurement they determined. What questions are there? GO!

Allow groups 15 to 45 seconds to measure their line. Students will probably decide to use their pencil, hand, foot, or even a belt as a measurement instrument and correlate the length of the line to what they believe is the length of the body part/ item they used to measure with.

All right, there was certainly some creative measuring going on! Now, let's see what the groups came up with. A volunteer spokesperson from each group will tell what the length of their line was and how the group determined that measurement.

Call on each group to give their measurement and method of measuring.

Thank you for those responses. We sure are glad that we don't have to measure like that when we really need an accurate measurement! Class, please share how we do get accurate measurements.

Allow students to volunteer answers. Guide them to using standard measures such as rulers, yardsticks, measuring tapes, etc.

Great answers! We will need to keep that in mind as we open the destination clue and find out where we will be racing today!

## Summary of Content and Teaching Strategies

**Objective 1.** Apply math concepts utilized by the forestry industry.

Yesterday we discovered the thousands of products that the forest provides and how trees contribute to a better life for all of us. To be able to effectively harvest and utilize those trees we must be able to determine their potential harvested value. Today we will learn how to apply math concepts used by foresters. Let's stay focused and have the desire to participate as we start our amazing race into the forest.

Bring out the prepared poster board titled "Destination Clue" with **MS.NR.5.3.AS.B** glued to the teacher's side of it with great flourish and read it to the class.

(On card: Hello racers, and welcome to the amazing race into the forest. You will be using your group's math skills to solve some problems that are common in the forestry industry. You may work together; however, all members of the group must have the answers filled in on their own worksheet for your group to be successful. Good luck in the race!)



Lesson Number: MS.NR.5.3

## Middle School Food and Agricultural Literacy Curriculum

### The Amazing Race in the Forest!

All students in the group will be responsible for having the calculations on their own worksheet. Students will pick up the worksheet (**MS.NR.5.3.AS.A**) at their first station and use it to record answers for problems at all stations. There will be five stations with different types of calculations for the students to complete.

Directions for the problems will come from sections cut from **MS.NR.5.3.AS.D** and posted at each station. Groups will be given five minutes at each station and will all rotate through all of the stations.

Read from destination clue card:

Hello racers, and welcome to the amazing race into the forest. Use your group's math skills to solve some problems that are common in the forestry industry. Five minutes will be given at each station to read the instructions and complete the calculations. Work together; however, all members of the group must have the answers filled in on their own worksheet. Good luck in the race!

Put card down.

- I. **Calculating the number of acres in a tract of forest land**
- II. **Calculating the Diameter Breast Height or DBH:** the diameter of the tree at four and one half feet above the ground. It is measured with a device called a dendrometer. When calculating DBH the measurement is always rounded to the nearest two inch measurement. If the tree was 5 1/2" it would be rounded up to 6". If the tree measured 8 1/4" it would be rounded down to 8".
- III. **Calculating Board Feet**
  - A. Board foot: The standard unit of measurement for most lumber. It is a measurement equal to a piece of wood one inch thick, one foot wide, and one foot long.
- IV. **Calculating the Number of Sawlogs:** 16 foot logs that are free of large knots and at least eight to ten inches in diameter.
- V. **Using the Board Foot Table to calculate the number of board feet in each tree measured.**

All right, time to start our amazing race! When I say GO, each group will move to one of the stations designated around the room by the labels on the wall (**MS.NR.5.3.AS.C**). Each person in the group will pick up their own Forestry Math Calculations Work Sheet at the first station and put their name on this sheet.

The groups will have five minutes to follow the directions at each station **MS.NR.5.3.AS.D** and complete the calculations to solve the different types of problems.

When time is called, groups will move in a clockwise direction to the next station until they are back at their original station. Hold up one finger if you have questions, two fingers if you understand, or three fingers if you could teach the directions to a classmate. GO!

You should monitor groups and if all groups finish more quickly, go ahead and call time so that they will rotate to the next station. When they are back at the original station, they will take their worksheets and move back to their seat.

Way to go! Now when I say MOVE, groups will move quickly and quietly back to their seats and wait with their worksheet and pencil ready to check their answers. MOVE!

Go over the procedure and answers for each problem using the transparency or writing the correct answers on the board so that every student can be sure to have the correct computations.

After computation review is complete, the *Eyewitness News Moment®* will be used as a review allowing the students to report live from the amazing race to apply math concepts used by the forestry industry. This e-Moment allows the students to use the information they have gathered as part of the lesson today and review it in a fun manner. One student takes on the role of the newscaster and the other student is the person being interviewed about a newsworthy event: our amazing race.

### Review/Summary

Excellent work! We have definitely run a good race to learn how to solve some useful forestry problems today. Now let's consider for a moment that just as foresters must commit to make long-term plans to manage trees so that we will always have this valuable natural resource, we must also commit to setting, planning, and managing our own long-term goals for our future success.



Lesson Number: MS.NR.5.3

## Middle School Food and Agricultural Literacy Curriculum

### The Amazing Race in the Forest!

What would happen if foresters did not have a plan for how they desired a section of timber to be planted, cared for, and harvested?

Allow volunteers to answer. Guide them to possibilities such as; growth of unwanted and economically unprofitable species would make the land less productive.

Excellent answers! What could happen if you don't set and follow through on your own long-term goals?

Allow volunteers to answer. Guide them to understand that long-term goals help them to set a course for success allowing them to have a plan to follow and a result to aim for instead of just allowing circumstances to dictate their path.

Commitment to setting and following through with our long-term goals will give us a plan to follow to achieve our goals. Just as the foresters we have been learning about must make a plan to achieve the goals they have set for an area of trees, we should be proactive and make our own plan to set and manage our long-term goals to help us win that very important race to success in our own lives!

Now, when I say ACTION take four minutes to partner with the person on your right to create an Eyewitness News report. This report will be live from the amazing race and will remind us about how to apply math concepts used by the forestry industry! One partner will take on the part of the newscaster and the other partner will take on the role of the interviewee. You will be presenting these newscasts to the class, so make them brief but packed with information. What questions are there? ACTION!

Allow students time to create their newscasts. As time allows, let volunteers present their newscasts to the class.

Awesome newscasts! We did it. We actually worked some computations utilized in the forestry industry. Give yourself a hand for building your math skills as you successfully completed our amazing race!

## Application

### Extended classroom activity:

Calculate the height of several trees on the school campus.

### FFA activity:

Have a forester or professional arborist come to a meeting and present the process they use for timber stand/forest management.

### SAE activity:

Calculate the value of the trees in your wildlife management or forestry products SAEs if you were to harvest them.

## Evaluation

MS.NR.5.3.ASSESS.A

## Answers to Evaluation

1. Area =  $1320 \times 132 = 174,240$   
Acres =  $174,240 / 43,560 = 4$  acres
2. Diameter =  $60 / 3.14 = 19.1$
3. 31'4" would be recorded as a height of 31'  
42'8" would be recorded as a height of 43'
4. 1.3 board feet
5. Tree height/16 = # of sawlogs (round to the nearest .05)  $32 / 16 = 2$
6. 69



Name \_\_\_\_\_

Directions: Read each problem and calculate the correct answer. Be sure to show your work.

- 1. **Area = Length x Width                      1 Acre = 43,560 square feet**  
**How many acres in a tract of forest land that measures 1,320' long and 132' wide?**
- 2. **Find the DBH or diameter of the tree at four and one half feet above the ground using a measurement of circumference of 60 inches.**

To find the diameter take the circumference and divide by pi 3.14. Foresters always round to the nearest inch measurement. If the tree was 5 1/2" it would be rounded up to 6". Diameter = circumference/3.14 (Do not round up)

- 3. **The total height of the tree is considered to be the distance between the base of the tree trunk and the topmost twig. You can determine this measurement using a partner and a ruler. After you determine the measurement, you must round to the nearest foot and record your answer as the height. What would a forester record the tree height as for a tree that measured 31'4"? What would a forester record the tree height as for a tree that measured 42'8"?**
- 4. **A board foot is the standard unit of volume and is defined as a piece of wood 12 inches long, 12 inches wide, and one inch thick. A board foot equals 144 cubic inches. (Multiply 1x12x12=144; 144/144=1 board foot) How many board feet does a board that measures 2x4x24 represent?**
- 5. **Foresters calculate the number of sawlogs by taking the measurement of the height of the tree and dividing by 16, then they round to the nearest 0.5. If you have a tree with a height measurement of 32', how many sawlogs will that tree produce?**
- 6. **What is the number of board feet in a tree with a DBH of 10 and measures 2.5 sawlogs?**

|         | 1<br>16' Log | 1.5<br>16' Log | 2<br>16' Logs | 2.5<br>16' Logs | 3<br>16' Logs | 3.5<br>16' Logs | 4<br>16' Logs |
|---------|--------------|----------------|---------------|-----------------|---------------|-----------------|---------------|
| 8" dbh  | 20           | 27             | 33            | 38              |               |                 |               |
| 10" dbh | 38           | 50             | 61            | 69              | 77            |                 |               |
| 12" dbh | 58           | 77             | 96            | 110             | 124           | 132             | 141           |
| 14" dbh | 82           | 110            | 138           | 160             | 182           | 196             | 211           |



## Forestry Math Worksheet

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Calculating the number of acres in a tract of forest land

Station #1 \_\_\_\_\_

Calculating the DBH or Diameter Breast Height

Station # 2 \_\_\_\_\_

Calculating Tree Height

Station # 3    30'4" \_\_\_\_\_ 40'8" \_\_\_\_\_

Calculating Board Feet

Station # 4 length \_\_\_\_\_ width \_\_\_\_\_ thickness \_\_\_\_\_

Board feet = \_\_\_\_\_

Calculating the number of sawlogs

Station # 5 \_\_\_\_\_ sawlogs

Using the Board Foot Table to calculate the number of board feet in each tree measured.

Station # 6 \_\_\_\_\_

\_\_\_\_\_  
\_\_\_\_\_





**Hello racers, and welcome to the amazing race into the forest. You will be using your group's math skills to solve some problems that are common in the forestry industry. You will have five minutes at each station to read the instructions and complete the calculations. You may work together; however, all members of the group must have the answers filled in on their own worksheet. Good luck in the race!**



Labels for each  
station

## **Station #1**

Calculating the number of  
acres in a tract of forest land

## **Station # 2**

Calculating the DBH or  
Diameter Breast Height

## **Station # 3**

Calculating Tree Height

## **Station # 4**

Calculating Board Feet





## **Station # 5**

Calculating the Number of  
Sawlogs

## **Station # 6**

Using the Board Foot Table to  
calculate the number of board  
feet in each tree measured



### Station #1 — Calculating the number of acres in a tract of forest land

Foresters must be able to calculate the number of acres they are working with. They do this by using the following formulas:

Area = Length x Width

Acres = Area/43,560 (area in square feet of 1 acre)

Your task is to determine how many acres in a tract of forest land that measures 1,320' long and 132' wide. Record your answer on your worksheet in the blank next to Station # 1.

### Station # 2 — Calculating the DBH or Diameter Breast Height

The DBH is the diameter of the tree at four and one half feet above the ground. It is measured with a device called a dendrometer. Since we are practicing the math that foresters use, we will imagine that we have determined that the circumference at four and one half feet above the ground is 55 inches. We could also use a flexible tape measure to find the circumference at four and one half feet above the ground if a dendrometer is not available.

To find the diameter take the circumference and divide by  $\pi$  or 3.14. Foresters always round to the nearest two inch measurement. If the tree was 5 1/2" it would be rounded up to 6". If the tree measured 8 1/4" it would be rounded down to 8".

Diameter = circumference/3.14

Record your answers next to the blank for Station # 2 on your worksheet

### Station # 3 — Calculating Tree Height

The total height of the tree is considered to be the distance between the base of the tree trunk and the topmost twig. The measuring tools foresters use are the Abney hand level, clinometer, or transit. If you needed to measure the tree height and these tools were not available, you could measure the tree's height with a yard stick or ruler. Have a partner stand at the base of the tree. Carefully back away from the tree, holding your ruler in front of you in a vertical position. Be sure to keep your arm straight. Stop when the tree and the ruler appear to be the same size. (Close one eye to help you line it up.) Now, turn your wrist so that the ruler looks level to the ground and is in a horizontal position. Be sure to keep your arm straight. Now have your partner walk to the spot that you see as the top of the ruler. Be sure the base of the ruler is kept at the base of the tree. Measure how many feet he or she walked. That is the tree's height. Round to the nearest foot and record your answer as the height.

What would a forester record the tree height as for a tree that measured 30'4"?

What would a forester record the tree height as for a tree that measured 40' 8'?

Record your answers on the blanks next to Station # 3 Tree Height on your handout.



#### Station # 4 — Calculating Board Feet

A forester needs to know the amount of lumber in a tree before it is harvested. This can be determined by knowing the height and diameter of a tree. By calculating the number of sawlogs (16' logs that are free of large knots and at least 8-10 inches in diameter), a forester can approximate the amount of board feet in a tree. A board foot is the standard unit of volume and is defined as a piece of wood 12 inches long, 12 inches wide, and one inch thick.

Take the board on the table and measure the board with the ruler provided. Record the length, width, and thickness on your answer sheet.

How many board feet does this board represent?

Record your answers for Station # 4 Calculating Board Feet on your handout.

#### Station # 5 — Calculating the Number of Sawlogs

Foresters calculate the number of sawlogs by taking the measurement of the height of the tree and dividing by 16, then they round to the nearest 0.5.

If you have a tree with a height measurement of 48', how many sawlogs will that tree produce?

Record your answers to Station # 5 Calculating the Number of Sawlogs on your worksheet.

#### Station # 6 — Using the Board Foot Table to calculate the number of board feet in each tree measured.

Foresters use the Board Foot Table to determine the number of board feet in trees that they have measured and know the DBH or Diameter Breast Height (diameter of the tree at 4 1/2 feet above the ground. In this table the DBH of the tree is represented on the left column of the table.



Foresters must also know the height and have calculated the number of sawlogs in the tree. In this table the number of sawlogs is represented by the columns across the top of the table. Use the table below to answer the questions.

**What is the number of board feet in a tree that has a DBH of 8 and measures 2.5 sawlogs?** \_\_\_\_\_

**What is the number of board feet in a tree that has a DBH of 12 and measures 3.5 sawlogs?** \_\_\_\_\_

**What is the number of board feet in a tree that has a DBH of 14 and measures 4 sawlogs?** \_\_\_\_\_

|         | 1<br>16' Log | 1.5<br>16' Log | 2<br>16' Logs | 2.5<br>16' Logs | 3<br>16' Logs | 3.5<br>16' Logs | 4<br>16' Logs |
|---------|--------------|----------------|---------------|-----------------|---------------|-----------------|---------------|
| 8" dbh  | 20           | 27             | 33            | 38              |               |                 |               |
| 10" dbh | 38           | 50             | 61            | 69              | 77            |                 |               |
| 12" dbh | 58           | 77             | 96            | 110             | 124           | 132             | 141           |
| 14" dbh | 82           | 110            | 138           | 160             | 182           | 196             | 211           |

Record your answers to Station # 6 Using the Board Foot Table to calculate the number of board feet in each tree measured on your worksheet.

**What is the number of board feet in a tree that has a DBH of 8 and measures 2.5 sawlogs?** \_\_\_\_\_

**What is the number of board feet in a tree that has a DBH of 12 and measures 3.5 sawlogs?** \_\_\_\_\_

**What is the number of board feet in a tree that has a DBH of 14 and measures 4 sawlogs?** \_\_\_\_\_



### Station #1: Calculating the number of acres in a tract of forest land

Foresters must be able to calculate the number of acres they are working with. They do this by using the following formulas:

$$\text{Area} = \text{Length} \times \text{Width}$$

$$\text{Acres} = \text{Area} / 43,560 \text{ (area in square feet of 1 acre)}$$

Your task is to determine how many acres in a tract of forest land that measures 1,320' long and 132' wide.

Record your answer on your worksheet in the blank next to Station # 1.

#### Answers for Station # 1

$$\text{Area} = 1320 \times 132 = 174,240$$

$$\text{Acres} = 174,240 / 43,560 = 4 \text{ acres}$$

### Station # 2 Calculating the DBH or Diameter Breast Height

The DBH is the diameter of the tree at four and one half feet above the ground. It is measured with a device called a dendrometer. Since we are practicing the math that foresters use, we will imagine that we have determined that the circumference at four and one half feet above the ground is 55 inches. We could also use a flexible tape measure to find the circumference at four and one half feet above the ground if a dendrometer is not available.

To find the diameter take the circumference and divide by  $\pi$  or 3.14. Foresters always round to the nearest inch measurement. If the tree was 5 1/2", it would be rounded up to 6".

$$\text{Diameter} = \text{circumference} / 3.14$$

#### Answers for Station # 2

$$\text{Diameter} = 55 / 3.14 = 17.515 \text{ which should be rounded up to } 18"$$

### Station # 3 Calculating Tree Height

The total height of the tree is considered to be the distance between the base of the tree trunk and the topmost twig. The measuring tools foresters use are the Abney hand level, clinometer, or transit. If you needed to measure the tree height and these tools were not available, you could measure the tree's height with a yard stick or ruler. Have a partner stand at the base of the

tree. Carefully back away from the tree, holding your ruler in front of you in a vertical position. Be sure to keep your arm straight. Stop when the tree and the ruler appear to be the same size. (Close one eye to help you line it up.) Now, turn your wrist so that the ruler looks level to the ground and is in a horizontal position. Be sure to keep your arm straight. Now, have your partner walk to the spot that you see as the top of the ruler. Be sure the base of the ruler is kept at the base of the tree. Measure how many feet he or she walked. That is the tree's height. Round to the nearest foot and record your answer as the height.

What would a forester record the tree height as for a tree that measured 30' 4"?

What would a forester record the tree height as for a tree that measured 40' 8"?

#### Answers to Station # 3 Tree Height

30' 4" would be recorded as a height of 30'

40' 8" would be recorded as a height of 41'

### Station # 4 Calculating Board Feet

A forester needs to know the amount of lumber in a tree before it is harvested. This can be determined by knowing the height and diameter of a tree. By calculating the number of saw logs (16' logs that are free of large knots and at least 8-10 inches in diameter), a forester can approximate the amount of board feet in a tree. A board foot is the standard unit of volume and is defined as a piece of wood 12 inches long, 12 inches wide, and one inch thick.

Take the board on the table and measure the board with the ruler provided. Record the length, width, and thickness on your answer sheet.

How many board feet does this board represent?

#### Answers for Station # 4 Calculating Board Feet

12 inches long

12 inches wide

1 inch thick

One board foot



### Station # 5 Calculating the Number of Saw logs

Foresters calculate the number of sawlogs by taking the measurement of the height of the tree and dividing by 16, then they round to the nearest 0.5.

If you have a tree with a height measurement of 48', how many sawlogs will that tree produce?

#### Answers to Station # 5

##### Calculating the Number of Sawlogs

Tree height/16 = # of sawlogs (round to the nearest .05)  $48/16 = 3$

### Station # 6 Using the Board Foot Table to calculate the number of board feet in each tree measured

Foresters use the Board Foot Table to determine the number of board feet in trees that they have measured and know the DBH or Diameter Breast Height (diameter of the tree at 4 1/2 feet above the ground. In this table the DBH of the tree is represented on the left column of the table. Foresters must also know the height and have calculated the number of sawlogs in the tree. In this table the number of sawlogs is represented by the columns across the top of the table. Use the table below to answer the questions.

What is the number of board feet in a tree that has a DBH of 8 and measures 2.5 sawlogs?

What is the number of board feet in a tree that has a DBH of 12 and measures 3.5 sawlogs?

What is the number of board feet in a tree that has a DBH of 14 and measures 4 sawlogs?

#### Answers to Station # 6

##### Using the Board Foot Table to calculate the number of board feet in each tree measured.

What is the number of board feet in a tree that has a DBH of 8 and measures 2.5 sawlogs? 38

What is the number of board feet in a tree that has a DBH of 12 and measures 3.5 sawlogs? 132

What is the number of board feet in a tree that has a DBH of 14 and measures 4 sawlogs? 211

|         | 1<br>16' Log | 1.5<br>16' Log | 2<br>16' Logs | 2.5<br>16' Logs | 3<br>16' Logs | 3.5<br>16' Logs | 4<br>16' Logs |
|---------|--------------|----------------|---------------|-----------------|---------------|-----------------|---------------|
| 8" dbh  | 20           | 27             | 33            | 38              |               |                 |               |
| 10" dbh | 38           | 50             | 61            | 69              | 77            |                 |               |
| 12" dbh | 58           | 77             | 96            | 110             | 124           | 132             | 141           |
| 14" dbh | 82           | 110            | 138           | 160             | 182           | 196             | 211           |