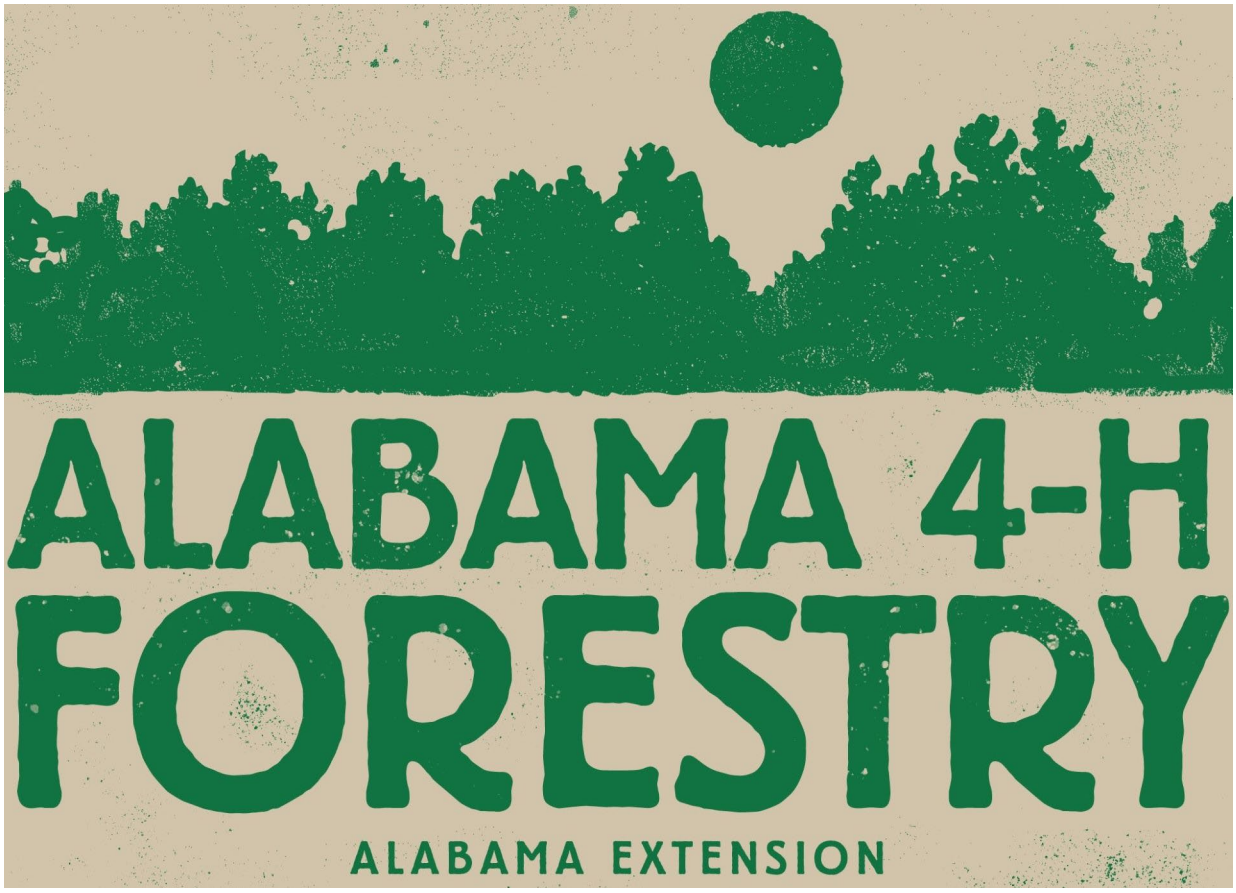
Alabama 4-H Forestry Program

2025-26 State Manual & Study Guide



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ALABAMA 4-H
Alabama Cooperative Extension System

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Introduction to Alabama 4-H Forestry

Objectives
The Alabama 4-H Forestry Program is designed to teach youth about native tree species, forest ecology, and how to manage forests. Youth ages 9 to 18 are eligible to participate in Alabama 4-H Forestry through independent study or as part of a club. In addition to learning natural resource management, youth benefit from developing life skills and meeting other people and professionals who have interests in natural resources.

The information in the manual is designed to teach concepts of forest habitat management and to prepare youth participants for the annual statewide Alabama Forestry Invitational competitive event. By learning how to identify species, read maps, traverse ground, and measure timber, we are building the foundation for problem solving and everyday decision making in the forest management field.

Before making recommendations about forest management, it is important to know all possible information about the landscape. On a designated site, we need to know how to navigate the area of land using a compass, how to interpret its features by looking at a map, how to estimate the volume of its trees by measuring its height and diameter, assess its health by identifying forest insects and/or diseases present, and evaluating its conditions by examining the soil, slope, damage, and types and ages of trees.

Forest managers must be able to inventory and evaluate the present condition of a habitat at a particular site and then be able to explain the condition to landowners and other interested individuals. Once the inventory is complete, a decision must be made as to how to manage the environment to improve the condition of the area. We define and detail relevant management practices in the manual that can be implemented to improve the habitat for certain forest management objectives. The forest evaluation activity (also known as senior site evaluation) provides experience with this decision-making process.

Youth who participate in Alabama 4-H Forestry are equipped with the knowledge and skills to pursue natural resources career pathways and engage in citizen science and act as stewards of the environment. Participants are divided into **two** age divisions- Senior (ages 14 to 18) and Junior (ages 9 to 13). Senior participants may be eligible to participate in 4-H Forestry at the national level.

Disclaimer: Contents of this guide are intended for internal audiences and are subject to change.

Learning the Material

The Alabama 4-H Forestry program and contest is organized into components that we refer to as activities: Tree Species Identification, Tree Measurement, Compass Traverse, Insect and Disease Species Identification (Senior division), Topographic Maps, Forest Evaluation (Senior division), and Forestry Knowledge Bowl (Senior division). In addition, senior division participants participate in a Forestry Quiz at the contest to test their overall knowledge of forest related content.
Learning the forestry material requires time, dedication, and practice. This learning should take place through independent study and/or local forestry club practices. Participants should first read about and understand the **Alabama Forestry Facts** section of the manual. This section is important because it provides background information and a bigger picture of why forestry is so important in our state.

Once the basic concepts of forest environments are understood, you can proceed to learn about the different tree species, how to take their measurements, the different insects and diseases that can damage them, and identifying land features from a map perspective and on the ground estimates. At the senior level of participation, youth should be able to evaluate a forest site and make management recommendations.

Learning the forestry material should be fun. Youth leaders of clubs, parents, and assisting subject matter experts may use research-based videos, field guides, and other teaching materials to further learning. State foresters, Extension specialists and agents, and private industry professionals make good resources for helping to teach background knowledge and skills to youth participants.

Outside resources often aid in learning, but the Alabama 4-H Forestry Invitational state contest content **will come from this state manual and study guide**. Please keep this in mind as you learn the material and prepare for the contest.

Alabama Forestry Contest Rules and Guidelines

Participants should review this manual and be prepared before coming to the state event. Questions will not be allowed during the contest except for those related to contest procedure.

Contestants and Eligibility

The Alabama 4-H Forestry Invitational State Contest is open to active members of Alabama 4-H who have been a member for a minimum of 90-days. Any youth in Alabama can sign up for 4-H for free in their county of residence (or an adjacent county) and may choose to participate in Alabama Forestry as an individual participant or through a chartered Alabama 4-H club that has experiential learning in regularly scheduled and planned meetings.

The Alabama 4-H club year begins on August 1 and ends on July 31. Age eligibility is based on the age of the youth prior to January 1 of the Alabama 4-H club year. To be eligible for 4-H, the youth must be 9 years old and not older than 19 years old prior to January 1 of the Alabama 4-H club year. The Alabama 4-H Age and Eligibility Chart will help families, volunteers, and staff to determine the divisions of 4-H membership. Please Note: An individual or team may win the Alabama 4-H Forestry Invitational State Contest only once during his/her 4-H and FFA career. For example, a team (or individual) may not compete as a 4-H team one year, then come back another year as an FFA team or individual.

Team Selection

Youth participants may participate in the state contest on their own as an individual representing their 4-H county, or as part of a team representing their 4-H county. The Tree Species Identification, Tree Measurement, Compass Traverse, Topographic Maps, and Insect and Disease Species Identification contest activities are all performed individually (not working together as a team), and therefore, youth participants are able to earn individual 1st through 5th place awards for each. The Forest Evaluation and Forestry Knowledge Bowl are the only contest activities performed together with team members.

An official team consists of 3 or 4 youth participants. A county may have as many individual participants or teams as they choose as long as teams within the same age division are coached by different coaches and at different times and locations.

Code of Conduct

All participants are required to follow the 4-H Code of Conduct.

General Contest Rules

Alabama 4-H Forestry Invitational State Contest rules vary from year to year and are specified at the time that the contest for that particular year is announced. Youth participants should know and understand all contest protocols and rules prior to participating in the state contest. The following are general contest rules and are subject to change:

1. All participants must provide their own pen or pencil, clipboard, and tree-scale stick.
2. No electronic devices of any kind are allowed at the contest site.
3. No talking by participants will be allowed during the contest, except when working on the designated team activity or as directed.
4. Anyone caught cheating may be disqualified at the discretion of the State 4-H Forestry Planning Committee.
5. All adults, except contest officials, are required to be off-site while the contest is in progress.

6. Participants will work independently on Tree Species Identification, Tree Measurement, Compass Traverse, Topographic Maps, and Insect and Disease Species Identification; the Forest Evaluation and Forestry Knowledge Bowl are team activities.
7. Participant contest scoresheets will be submitted to a contest official immediately after completion of each activity.
    a. Official committee members and helpers will grade the contest scoresheets and analyze the results. Their decision is final.
    b. The team score will be the sum of the scores in the individual activities, plus the team score for the Forest Evaluation and Forestry Knowledge Bowl.
    c. After the event, individual and team scores may be made available to team leaders.
8. Distribution of awards is determined by the Alabama 4-H Forestry Planning Committee. Junior and Senior Division participants will typically be recognized as follows:
    a. Team Awards: 1st, 2nd, and 3rd places by age division
    b. Individual Awards: 1st, 2nd, 3rd, 4th, and 5th places for each individual activity by age division, as well as 1st, 2nd, and 3rd places for overall high individuals by age division
    c. All participants will receive participation ribbons.

Alabama Forestry Facts

Forestry's Effects on Alabama's Economy

- Forestry is the most important rural manufacturing sector in Alabama.
- Alabama's annual manufactured forest products are valued at more than $12.5 billion.
- Forestry industry investments have totaled $6.7 billion over the last decade.
- There were over 1,500 forest industry businesses in 2024 providing over 120,000 total jobs. These include logging companies, paper mills, and sawmills.
- Without Alabama's forest industry, we would miss out on close to $500 million in taxes.
- Alabama has the third largest timberland base in the country, with 23.02 million acres.
- The Alabama forestry industry jobs are 2.59 times the national job concentration.
- Alabama is ranked 2nd nationally in pulp production.
- Alabama's forestry industry creates many products we rely on such as wood panels, plywood, pulp and paper, cabinets, furniture, and more.

Forests and the Environment

- One mature tree absorbs carbon dioxide at a rate of 48 pounds per year.
- Two mature trees provide enough oxygen for one person to breathe for a year.
- In one day, one large tree can absorb up to 100 gallons of water and release it into the air, cooling the surrounding area.
- Forests improve public health by keeping pollutants out of lungs by trapping and removing dust, ash, pollen, and smoke.

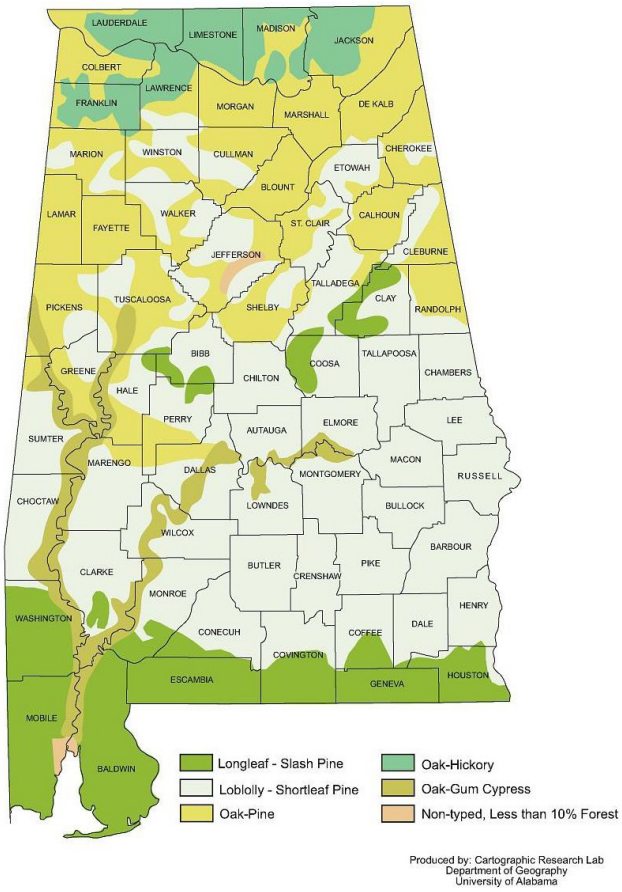

Figure 1. Alabama forest types. Source: Discovering Alabama, https://www.discoveringalabama.org/alabama-forests.html

- More than half of U.S. drinking water originates in forests.
- Forests help improve water quality by extracting pollutants through tree roots.
- Conservation buffers slow water runoff, trap sediment, and enhance infiltration within the buffer.
- Conservation buffers reduce odor. They are a source of food, nesting cover, and shelter for many wildlife species. Strategically placed buffer strips in the agricultural landscape can effectively mitigate the movement of sediment, nutrients, and pesticides within farm field and from farm fields.

Figure 2. Conservation buffer

- Riparian buffers can be established along streams, lakes, ponds, and wetlands to improve or maintain water quality and to protect or improve fish and wildlife habitat.
- Trees and shrubs create cover and nesting habitats for wildlife. As leaves and insects fall from trees, it provides a primary food source for aquatic ecosystems.

- **Other Forestry Facts**
  Alabama's state tree is the southern longleaf pine.
- Alabama's forests could cover all of Rhode Island, Delaware, Massachusetts, New Jersey, and Connecticut.
- Since 2013, the Alabama TREASURE Forest Association (ATFA) has dedicated its efforts to improving the forest land of Alabama. Forests are managed in a way to ensure the next generation will enjoy the same benefits people receive from them today.
- The Tongass National Forest in Alaska is the largest forest in the United States (17 million acres).
- Alabama is divided into five geographical regions--three in the Appalachian Highlands Region, one in the Inland Plains Region, and one in the Atlantic Plain Region.

- Alabama has four national forests that cover 673,109 acres-Bankhead, Conecuh, Talladega, and Tuskegee National Forests.
- Over 193,000 acres of Alabama National Forest land were restored in 2025 using prescribed burns.
- Alabama's four national forests are home to approximately 900 species of birds, mammals, reptiles, amphibians, and fishes. These species include endangered and threatened species such as the gopher tortoise, eastern indigo snake, and red-cockaded woodpecker.

Figure 3. Gopher tortoise

- The red-cockaded woodpecker, a species that has previously been on the endangered species list since 1970, has 399 active clusters in Alabama's National Forests. Thanks in large part to forest conservation efforts, the red-cockaded woodpecker was downlisted to "threatened" status in November 2024.
- Alabama's state bird is the northern flicker; the state butterfly is an eastern tiger swallowtail; the state mammal is a black bear; and the state fruit tree is the peach.
- Alabama has 4 state forests: Geneva State Forest, Saint Stephens State Forest, Little River Sate Forest, and Weogufka State Forest.
- Alabama has 21 State Parks. This includes Blue Springs State Park, Gulf State Park, and Lake Guntersville State Park.

Figure 4. Prescribed burn

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Tree Identification

Objectives

The objective of Tree Species Identification is to test participant ability to identify tree species within various forest ecosystems in Alabama. This is an individual contest activity. The species represented in this activity are found in Official Tree Species List.

Contest Rules

1. Participants are provided with a scoresheet containing the common names of each species on the official tree identification species list and are required to identify the tree species based on visual observations.
2. Participants are allotted a specific amount of time to identify each species and provide their answer by recording the number of the corresponding tree on their scoresheet. They are not required to write out the name.
3. Four points are awarded for recording the correct answer.

Figure 1. Eastern hemlock

Figure 2. Flowering dogwood

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Official Tree Species List

Common name	Scientific Name	Common Name	Scientific Name
American basswood	*Tilia americana*	mockernut hickory	*Carya tomentosea*
American beech	*Fagus grandifolia*	Northern red oak	*Quercus rubra*
American elm	*Ulmus americana*	overcup oak	*Quercus lyrata*
American holly	*Ilex opaca*	pecan	*Carya illinoensis*
American hornbeam/blue beech	*Carpinus caroliniana*	pignut hickory	*Carya glabra*
ash	*Fraxinus sp.*	post oak	*Quercus stellata*
Atlantic white cedar	*Chamaecyprais thyoides*	red maple	*Acer rubrum*
baldcypress	*Taxodium distichum*	red mulberry	*Morus rubra*
black cherry	*Prunus serotina*	redbud	*Cercis canadensis*
black locust	*Robinia pseudoacacia*	river birch	*Betula nigra*
black oak	*Quercus velutina*	sassafras	*Sassafras albidum*
black tupelo or blackgum	*Nyssa sylvatica*	scarlet oak	*Quercus coccinea*
black walnut	*Juglans nigra*	shagbark hickory	*Carya ovata*
black willow	*Salix nigra*	shortleaf pine	*Pinus echinata*
blackjack oak	*Quercus marilandica*	silver maple	*Acer saccharinum*
boxelder	*Acer negundo*	slash pine	*Pinus elliottii*
buckeye	*Aesculus sp.*	slippery elm	*Ulmus rubra*
cherrybark oak	*Quercus pagoda*	sourwood	*Oxydendrum arboretum*
chestnut oak	*Quercus montanta*	Southern catalpa	*Catalpa bignonioides*
common persimmon	*Diospyros virginiana*	Southern magnolia	*Magnolia grandiflora*
cucumbertree	*Magnolia acuminata*	Southern red oak	*Quercus falcata*
Eastern cottonwood	*Populus deltoides*	sugarberry	*Celtis occidentalis*
Eastern hewmlock	*Tsuga canadensis*	sugar maple	*Acer saccharum*
Eastern hopornbeam	*Ostrya virginiana*	sweetgum	*Liquidambar styraciflua*
Eastern redcedar	*Juniperus virginiana*	sycamore	*Platanus occidentalis*
Eastern white pine	*Pinus strobus*	Virginia pine	*Pinus virginiana*
flowering dogwood	*Cornus florida*	water oak	*Quercus nigra*
hazel alder	*Alnus serrulata*	water tupelo	*Nyssa aquatica*
honeylocust	*Gleditsia triacanthos*	white oak	*Quercus alba*
live oak	*Quercus virginiana*	willow oak	*Quercus phellos*
loblolly pine	*Pinus taeda*	winged elm	*Ulmus alata*
longleaf pine	*Pinus palustris*	yellow-poplar/tulip-poplar	*Liriodendron tulipifera*

Practice Tree
Identification Scoresheet

Name _____ County _____ Circle One: Jr. Sr.

	American basswood		mockernut hickory
	American beech		Northern red oak
	American elm		overcup oak
	American holly		pecan
	American hornbeam/blue beech		pignut hickory
	ash		post oak
	Atlantic white cedar		red maple
	baldcypress		red mulberry
	black cherry		redbud
	black locust		river birch
	black oak		sassafras
	black tupelo/blackgum		scarlet oak
	black walnut		shagbark hickory
	black willow		shortleaf pine
	blackjack oak		silver maple
	boxelder		slash pine
	buckeye		slippery elm
	cherrybark oak		sourwood
	chesnut oak		Southern catalpa
	common persimmon		Southern magnolia
	cucumbertree		Southern red oak
	Eastern cottonwood		sugarberry
	Eastern hemlock		sugar maple
	Eastern hophornbeam		sweetgum
	Eastern redcedar		sycamore
	Eastern white pine		Virginia pine
	flowering dogwood		water oak
	hazel alder		water tupelo
	honeylocust		white oak
	live oak		willow oak
	loblolly pine		winged elm
	longleaf pine		yellow-poplar/tulip-poplar

Tree Measurement

Objectives

It is often necessary to measure standing trees to estimate the volume of forest products that could be obtained from the trees. Because most timber is bought and sold on a volume basis (usually by the board foot volume), it is a good idea to have some estimate of total volume per acre and volume by product before selling timber. Therefore, tree diameters are measured for two primary reasons:

1. Determining stand structure diameter distribution or number of trees by diameter class. That is, what does the stand look like?
2. Estimation of tree volume or weight.

Contest Rules

1. The International ¼-Inch Rule is used to estimate tree volume. A calibrated tree scale stick, or Biltmore stick, will be used to measure the tree's diameter at a point 4 ½ feet above the groundline (diameter at breast height); and the merchantable height is calculated in 16-foot logs and 8-foot half-log lengths. Each team is required to furnish their own tree scale stick for the competition.
2. A plot of land (1/10, 1/5, or 1/4 acre) will be designated for use in this competition. Participants will be required to record the total volume of saw timber on 1 acre as determined from the sample plot volume.
3. Each participant will estimate and record the values of each designated tree. Tree diameters will be taken to the nearest 2-inch class. Tree heights will be taken to the nearest full half-log for sawtimber. A half-log is defined as being 8-feet long. The minimum log will be 10 inches D.B.H., one log merchantable length, and have a minimum top diameter of 8 inches.
4. Each tree volume will be found in the volume table furnished to participants. Record sawlog volumes as found in the table. Total all sawlog volume after all designated trees have been estimated.
5. Junior and Senior participants may have different score sheets as appropriate.
    a. For Seniors, one point will be awarded for each correct species identification, two points DBH, and two for number of 16-foot logs for a possible total of 80 points.
    b. For Juniors, one point will be awarded for each correct species identification, two points DBH, and two for number of 16-footlogs for a possible total of 80 points.

6. Twenty points will be allowed for the correct sawtimber volume per acre. Remember, the total volume will be the volume per acre as represented by the plot. Point allocation will be 20 for + or - 5% of the official volume, 15 points for + or - 10%, 10 points for + or - 15%, and no points over + or -15%. Example: If 4,000 bd. ft. is the official volume, then 3800 bd. ft. through 4200 equals 20 points; 3600 to 3799 and 4201 to 4400 equals 15 points; 3400 to 3599 and 4401 to 4600 equals 10 points; and under 3400 and over 4600 has no points.
7. Senior participants will receive a maximum score of 70 points. Junior participants will receive a maximum score of 60 points.

Measurement of Standing Trees

Because the shape of a tree is like a cylinder, its volume may be determined by measuring its **diameter** and **height**. Diameter of standing trees are measured by time-honored custom, at 4½ feet above ground on the uphill side of the tree. This is referred to as diameter at breast height, or **DBH**.

The height of a standing tree may be measured as **total** (entire height from groundline to the top) or **merchantable**. Merchantable height varies depending on the product that will be cut.

For example, if a tree could produce a **pole** or **piling**, you would measure its height in 5-ft increments.

The top diameter is fixed by certain specifications. If a tree is to be cut into logs, its height usually will be measured in 16-foot logs to the nearest half-log.

To measure diameter, you may use a **caliper**, **diameter tape**, or **tree scale stick**. Since the tree scale stick is to be used in the contest, the method of using it will be explained.

Figure 1 shows how the tree scale stick is used to find tree diameter.
Use the flat side of the stick, labeled as *Diameter of Tree (in inches)*. Hold the stick level at 25 inches from the eye, against the tree, at a height of 4½ feet above ground.

Note: Practice is needed to find both the 4½-foot point in relation to your height and the 25-inch distance to eye. Sight at the left or zero-end.

This and the tree bark should be in the same line. The zero-end of the stick is moved so that when you look along the end of the stick, you are looking at one side of the tree at breast height. Now, **DO NOT MOVE YOUR HEAD**. Just move your eye across the stick to the right-hand edge of the tree. Where the line from the edge of the tree to your eye intersects the stick is the measurement of diameter. Read the tree diameter to the nearest even inch. Hold the stick perpendicular to the tree.

To measure the **merchantable height** of a tree, pace out 66 feet from the base of the tree to a point where the entire tree can be seen. Hold the tree scale stick so that the side labeled as *Number of 16- foot log* faces you. The **zero-end** should point toward the ground. Plumb the stick, at 25 inches from the eye. Sight the zero-end to appear to rest at the stump height. **DO NOT MOVE YOUR HEAD OR THE STICK.** Look up the stock to the point where the top of the last merchantable cut would be made in the tree (8-inch diameter or at the first major fork or other major defect). Read saw logs to the nearest full one-half log.

Note: Practice on pacing is needed to find the 66- foot point. The 25-inch distance from eye to stick is still the same as in measuring tree diameter.

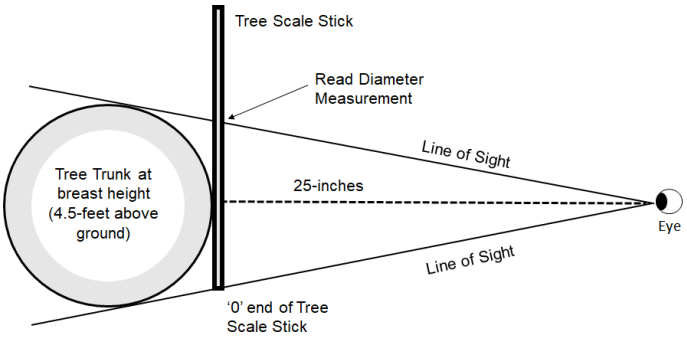

Figure 1. Method of using a tree scale stick to obtain tree diameter.

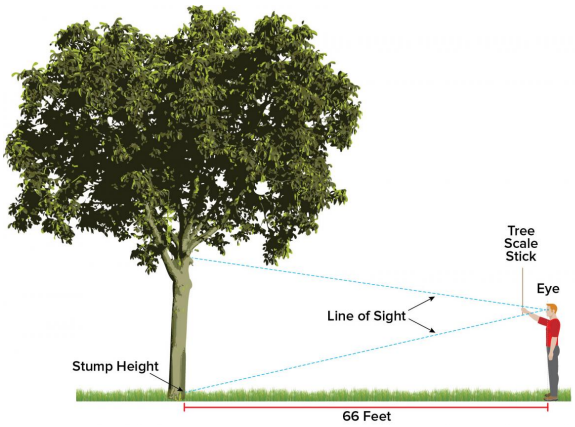

Figure 2. Method of using a tree scale to obtain tree height. Source:Ohio State University Extension, https://ohioline.osu.edu/

Using a Volume Table

The volumes listed in the volume table are composites of actual volumes, on an average basis, for the product indicated. Once the tree measurements are determined, read down the left-hand column until you come to the row containing the tree diameter at breast height (DBH). Move across from left to right until you come to the column containing the tree merchantable height at the top. At the intersection of that row and column, you will find the merchantable volume of the tree. Read and record each tree volume directly and separately.

Note: For contest purposes, do not use the volume table on the tree scale stick.

Volume (board feet) by Number of Usable 16-foot Logs

DBH	1	1.5	2	2.5	3	3.5	4	4.5
10	36	48	59	66	73			
12	56	74	92	106	120	128	137	
14	78	105	132	153	174	187	200	
16	106	143	180	210	241	263	285	
18	136	184	233	274	314	344	374	
20	171	234	296	348	401	440	480	511
22	211	290	368	434	500	552	603	647
24	251	346	441	523	605	664	723	782
26	299	414	528	626	725	801	877	949
28	347	482	616	733	850	938	1027	1114
30	403	560	718	854	991	1094	1198	1306
32	462	644	826	988	1149	1274	1400	1518
34	521	728	934	1119	1304	1447	1590	1727
36	589	826	1063	1274	1485	1650	1814	1974

Reference

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Additional Resources

Make your own tree scale stick:
https://4hforestryinvitational.org/training/tree-measurement-contest/scale-stick-download

How to measure with a Biltmore stick:
https://4hforestryinvitational.org/training/tree-measurement-contest/scale-stick-measurement

Practice Tree Measurement Scoresheet- Senior Division

Name: _____
County: _____
Club: _____

#	Tree Species (1 pt.)	DBH (2 pts.)	# of 16 foot logs (2 pts.)	Board Feet
1				
2				
3				
4				
5				
6				
7				
8				
9				
10				

Total board foot volume in plot = _____

Total board foot volume per acre = _____

FOR SCORING OFFICIALS ONLY		
(a) subtotal of tree scores =		50 pts. Possible
(b) subtotal of volume per acre =		20 pts. Possible
Total Score (a+b) =		70 pts. Possible

Practice Tree Measurement Scoresheet- Junior Division

Name: _____
County: _____
Club: _____

#	Tree Species (1 pt.)	DBH (2 pts.)	# of 16 foot logs (2 pts.)	Board Feet
1				
2				
3				
4				
5				
6				
7				
8				

Total board foot volume in plot = _____

Total board foot volume per acre = _____

FOR SCORING OFFICIALS ONLY		
(a) subtotal of tree scores =		40 pts. Possible
(b) subtotal of volume per acre =		20 pts. Possible
Total Score (a+b) =		60 pts. Possible

Compass Traverse

Introduction

Foresters are often required to estimate ground distances by the pacing method and to determine direction of travel using a compass. This exercise is designed to emphasize pacing and compass work. This will be accomplished by measuring a course of five lines. The lines may be level or slope up or down hill, and successive lines may or may not be continuous.

Pacing is an expedient, but crude, method of determining distance on the ground. It is useful in cruising timber and running out land boundaries. A pace is two full steps. Heel to toe is **not acceptable**. On level, open ground, pacing can become fairly accurate with enough practice, but on slopes and brushy or rocky areas, its accuracy diminishes. To correct for slope, in pacing, the following suggestions from the Forestry Handbook are provided:

In difficult terrain, no attempt should be made to maintain a standard pace. Instead, allow for its inevitable shortening (downhill as well as uphill) by repeating the count at intervals.

For example, on moderate slopes, count every tenth pace twice: 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 10, 11, etc. On steeper slopes, it may be necessary to repeat every fifth count: 1, 2, 3, 4, 5, 5, 6, etc. On the steepest slopes in very heavy brush, in swamps, or among boulders, every count may have to be repeated. Consistent accuracy in pacing under such conditions is attained only by practice and is maintained only by constant checking.

Contest Rules

1. Each contestant should determine the number of paces he or she takes per 66 feet on a practice course prior to the contest. Instructions will be given to the participants before beginning the course. The exercise will be completed on an individual basis.
2. Each contestant will measure the azimuth and distance for each line, record the measurements on a score sheet, and return the score sheet to the official in charge.
3. Participants may use only the following equipment: a) Silva Ranger-type azimuth compass, b) pencil and clipboard, c) scoresheet, and d) calculator.

4. The course layout will consist of five lines with marked corners. Set compass declinations to zero
5. Each contestant will have 20 minutes to complete the course.
6. A maximum of 20 points is possible for each of the five lines, 10 points for the correct azimuth, and 10 points for the correct distance. One-half point will be deducted for each degree of error in the azimuth up to a maximum of 10 points per line. One-half point will be deducted for each foot of error in distance up to a maximum of 10 points per line. Participants may receive a maximum total score of 100 points.
7. Participants should fill in the azimuth and distance for each line.
8. No writing in the box for points.
9. Distance should be rounded to the nearest foot.
10. The azimuth should be rounded to the nearest degree.

Additional Resources

Compass and Pacing Guide from the National 4-H Forestry References
https://4hforestryinvitational.org/training/compass-traverse-contest/Pacing.pdf

Getting directions with a compass:
https://www.youtube.com/watch?v=hn7OxKEr34M&list=PLkNoAmOtt__9m3_CJY3_PqEjSqks9DcY4&index=9

Practice Compass & Pacing Scoresheet

Name: _____

County: _____

Division: (circle one) Junior Senior

Club: _____

Line	Azimuth (Degrees) (10 pts.)	Distance (feet) (10 pts.)
A-B		
B-C		
C-D		
D-E		
E-F		

FOR SCORING OFFICIALS ONLY		
(a) subtotal of azimuth scores =		50 pts. Possible
(b) subtotal of distance =		50 pts. Possible
Total Score (a+b) =		100 pts. Possible

Insect and Disease Identification

Introduction
Different insects have various requirements for food, habitat, and development. We have both beneficial insects and detrimental insects. Insects, or examples of their damage, will be displayed through specimen or photographs/slides. Spelling, including capitalization, must be the same as that on the Official List of Species to be correct.

Participants will be asked to identify diseases that cause excessive dollar loss to the forest industry and society. Specimens will be selected and displayed which are representative of diseases and damage.

Contest Rules

1. Participants will be required to identify twenty insects, disease, or damage specimens selected from the official lists. Participants will be judged on the accuracy of identification and the spelling of the common names. Scientific names will not be required. Incomplete names will be counted as wrong. For example, recording “caterpillar” instead of “eastern tent caterpillar.”
2. Participants will be given a specific amount of time to identify each specimen.
3. Five points will be given for each correct common name. One point will be deducted for each misspelled name. The common name must be the one used in the official list.
4. It is recommended that each team bring a magnifying glass.

References
Alabama Forestry Commission, Fusiform Rust, https://forestry.alabama.gov/Pages/Informational/Diseases/Fusiform_Rust.aspx

Anderson, R. L., USDA Forest Service, Bugwood.

Brodeck, A., Maggard, A., & Eckhardt, L. (2020). Alabama Cooperative Extension System, Auburn University. Managing Pine Bark Beetles in Urban Forests. FOR_2049. https://www.aces.edu/blog/topics/ forestry/managing-pine-bark-beetles-in-urban-forests

OBrien, J., USDA Forest Service, Bugwood.org

Southern Forest Insect Work Conference, Southern Forest Insect Work Conference, Bugwood.org

Additional Resources
Alabama Forestry Commision Insects and Diseases Pages:
https://forestry.alabama.gov/Pages/Fire/Forest_Insects_Diseases.aspx

Identifying Pine Plantation Pests:
https://forestry.alabama.gov/Pages/Informational/Images/Pine_Pest_Field_Guide.pdf

Official Insect Species List

Common Name	Scientific Name
Nantucket pine tip moth	*Rhyacionia frustrana* (Comstock)
Locust borer	*Megacyllene robiniae* (Forester)
White pine weevil	*Pissodes strobi* (Peck)
Gypsy moth	*Lymantria dispar* (L.)
Eastern tent caterpillar	*Malacosoma americanum* (Fabricius)
Pine webworm	*Tetralopha robustella* (Zeller)
Fall webworm	*Hyphantria cunea* (Drury)
Black turpentine beetle	*Dendroctonus terebrans* (Oliver)
Ips engraver beetle	*Ips spp.*
Conifer sawflies	*Hymenoptera: Diprionidae*
Southern pine beetle	*Dentroctonu frontalis* (Zimmerman)
Pales weevil	*Hylobius pales* (Hbst.)
Periodical cicada	*Magicicada septendecim*

Figure 1. Gypsy moth larvae

Figure 2. Southern pine beetle pitch tube.

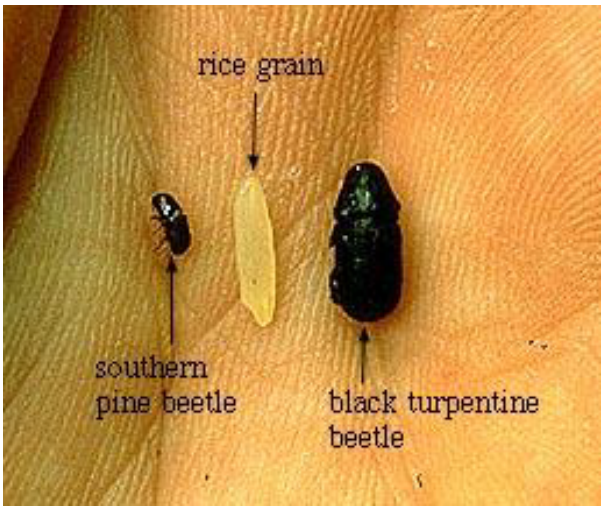

Figure 3. Joseph O'Brien, USDA Forest Service, Bugwood.org

Official Disease Species List

Common Name	Scientific Name
White pine blister rust	*Cronartium ribicola*
Oak wilt	*Certacoystis fagacearum*
Chestnut blight	*Cryphonectria parasitica*
Black knot	*Apiosporina morbosa*
Nectria canker	*Nectria gallingena* or *Nectria magnoliae*
Dutch elm disease	*Ceratocystis ulmi*
Annosus root rot	*Heterobasidion irregulare*
Brown spot needle blight	*Scirrhia acicola*
Fusiform rust	*Cronartium fusiforme*
Cedar-apple rust	*Gymnosporangium juniperi-virginianae*
Red heart	*Fomes pini*
Hypoxylon canker	*Hypoxylon spp.*
Artist conk	*Fomes applanatus*

Figure 4. Brown spot needle blight. Source: Joseph OBrien, USDA Forest Service, Bugwood.org

Figure 5. Black knot. Source: Joseph OBrien, USDA Forest Service, Bugwood.org

Figure 6. Fusiform rust. Source: Robert L. Anderson, USDA Forest Service, Bugwood.org

Practice Insects & Diseases Scoresheet

Name: _____

County: _____

Division: **(circle one) Junior Senior**

Club: _____

#	Species (Common Name)
1	
2	
3	
4	
5	
6	
7	
8	
9	
10	
11	
12	
13	
14	
15	
16	
17	
18	
19	
20	

Topographic Map Interpretation

Objectives

Topographic maps provide a graphic portrayal of forests and natural land features on the ground. They provide information about locations such as the terrain, water resources, land use, the presence of infrastructure like roads, and distance on the ground between points of interest. When you are managing forest resources, these are important factors. Though many technologies exist that can be used for examining forested land and associated features, it is important that you are able to interpret maps and use them to develop a broader understanding of landscapes.

Each team member will have the opportunity to identify symbols and land features shown on a topographic map, calculate the change in elevation between two points on a map, measure the distance between two points on a map, determine the azimuth of the line of travel between two points on a map, and determine the slope between two points on a map. All symbols and land features to be identified will be selected from the official list.

Contest Rules

1. Instructions will be given to the participants before beginning the exercise. They will complete the exercise within an allotted amount of time and on an individual basis. Participants are provided with a score sheet and are required to identify map symbols and land features, calculate elevations, measure distances, determine the azimuth of lines of travel, calculate the slope between pairs of points, and record the information on the score sheet. All locations and points of interest will be identified with a UTM grid address. No supplementary markings of any kind will be present on the map used in the contest.

2. Each participant will identify map symbols and land features based on a provided set of UTM grid addresses and visual observation of the map. They are scored on the accuracy of identification and the spelling of the names (no deductions for capitalization). Incomplete names will be considered incorrect. 2 points will be awarded for each correct name, for a total of 10 points possible. 1 point will be deducted for a spelling error. Example: Recording “highway” instead of “primary highway,” “contour index line” instead of “index contour line,” “unimproved Rd.” instead of “unimproved road.”

3. Each participant will observe 2 points of interest that are located on the map using provided UTM grid addresses. The participant will then calculate the change in elevation between the two points. Refer to the bottom of the map for the contour interval. This is worth 8 points. No partial credit will be given.

4. Each participant will determine the distance between 2 points of interest located on the map with provided UTM grid addresses by using an engineer's-scale ruler to measure the on-the-map distance and converting their measurement to an on-the-ground distance using the appropriate scale factor. Answers should be rounded to the nearest 100 feet. This is worth 8 points. No partial credit will be given.

5. Each participant will determine the grid north azimuth of the line of travel between 2 points of interest on the map identified by UTM grid addresses, using a UTM grid reader and an engineer's-scale ruler. Correct answers are within ±2 degrees of accuracy and are awarded the full 8 points. Answers within ±3 degrees of accuracy will be awarded 4 points.

6. Each participant will then convert their grid north azimuth to a magnetic north azimuth. Application of the correct conversion factor to the grid north azimuth will be awarded 8 points, regardless of the accuracy of the grid north measurement answer previously given. No partial credit will be given.

7. Each participant will determine the % Slope between 2 points of interest identified by UTM grid addresses. The correct answer is worth 8 points if it is reported within ±2% of the judges' accepted answer. Partial credit will not be given.

8. Participants may only use the following equipment: a) 1:24,000 100-meter UTM Grid Reader, b) pencil, c) engineer's-scale ruler, d) magnifying glass, e) score sheet, and f) calculator.

9. Participants will be provided with: a) 7.5 Minute Series Map, b) engineer's scale ruler, c) calculator, d) magnifying glass, and e) score sheet.

10. Participants may receive a maximum total score of 50 points.

Change in Elevation

The first step in determining the change in elevation between two points on a map is to identify the *contour interval* of the map (ex: 20- feet). This number tells the reader the change in elevation/height (in ft.) between each contour line on the map. On USGS 7.5-Minute Quadrangle Maps such as the one used in this competition, the contour interval will be listed at the bottom of the map, below the visual map scale bars.

The second step is to figure out the elevation (ft.) for each point of interest, using the map's contour lines and contour interval as guides. You will then find the difference between the two elevation values, subtracting the lower value from the higher value. Report the resulting distance in feet on your scoresheet.

If a certain point falls in between two contour lines, add half of the map's listed contour interval to the lower of the two contour line values that border the point. For points which are encircled by a single contour line, such as peaks or depressions, add (for peaks) or subtract (for depressions) half of the map's contour interval from the elevation value of the contour line that encircles your point of interest.

Measuring Distance

Method One: Using the Engineer's-Scale Ruler

Knowing the distance between two points on the ground can be useful in land management. Using a topographic map and an engineer's-scale ruler, you can estimate distance on-the-ground based on the distance on a topographic map. The first step is to identify the scale of the map (ex: 1:24,000 for USGS 7.5-Minute Quadrangles). Flip your ruler so that you are measuring with the "20-factor" side, which will be indicated by the presence of a large "20" above the start of the ruler's measurement lines. Next, hold your ruler flat on the map such that it creates a parallel line which intersects both points of interest. Record the distance of your line in inches, measuring using the 20-factor side of the ruler.

Once you have measured a distance on the map using the 20-factor side, you will multiply that value by 1,000 to obtain your on-the-ground distance, being sure to round to the nearest 100 feet.

Method Two: Using Paper and Pencil

Line up a blank piece of paper such that the edge of the paper forms a parallel line that intersects both points indicated in the question. Using a pencil, mark the location of each of the points by drawing a tic mark next to each of the points on your piece of paper.

Move to the scale bar corresponding to feet at the bottom of the map. Place your paper such that the right-hand tic mark lines up exactly with one of the labeled "thousand feet" points to the right of the "0" mark on the scale bar, while also ensuring that your left-hand tick mark is located in between the "1,000" mark and the "0" mark on the smaller scale located to the left of the "0" mark on the scale bar. This will provide you with the "thousands" portion of your on-the-ground distance.

Now, look at the left-hand tic mark and determine where on the smaller scale the tic mark falls. If the left-hand tic mark falls exactly on the line between a bright and dark section of this smaller scale, then you should add the appropriate multiple of 200 feet to the “thousands” portion of your distance. If the left-handed tic mark falls in the center of one of the boxes, add the value of the lower 200-foot interval to your “thousands” value, as well as an additional 100 feet. Report this value on your scoresheet.

Azimuth of a Line of Travel

Finding a Grid North Azimuth

A UTM grid reader and an engineer’s-scale ruler can be used with a topographic map to determine the azimuth of the line of travel between two points. The steps are as follows:

1. Lay the UTM grid reader flat on the map, directly centered over the first point mentioned in the question. Ensure that the grid reader is oriented so that each of its four edges is parallel with the corresponding yellow UTM grid line.
2. Lay your ruler on top of the UTM grid reader. Then, adjust the position of the ruler so that one of the edges of the ruler forms a parallel line that intersects both points of interest.
3. Using the protractor values printed around the edge of the UTM grid reader, read the degree value at which the edge of the ruler forming the parallel line crosses the protractor.
4. Record this azimuth in degrees.

Converting to a Magnetic North Azimuth

While a Grid North Azimuth is useful for determining an azimuth on a flat map, the Magnetic North Azimuth is the reading that a compass would deliver in the field. A UTM grid reader reads an azimuth based on grid north (GN), so to report a magnetic azimuth for the line of travel, we need to convert the Grid North Azimuth into a Magnetic North Azimuth. This requires two steps:

Step 1: Converting the Grid North Azimuth to a True North Azimuth by adding or subtracting an indicated declination value.

1. Locate the declination angles at the bottom left of the topographic map. Grid North is the line labeled “GN.” True North is the line with star (or labeled “TN”) and the Magnetic North (MN) line is labeled “MN.” Beneath each will be listed a certain declination value; these values indicate the amount by which grid north (GN), and magnetic north (MN) deviate from True North.
2. If the grid north line points to the left of the True North line, you will subtract the declination value listed underneath the grid north line from your Grid North

Azimuth. If the grid north line points to the right of the True North line, add the declination value to your Grid North Azimuth. You will now have a True North Azimuth.

Step 2: Converting the True North Azimuth to a Magnetic North Azimuth by adding or subtracting an indicated magnetic declination value.

3. Now, look for the magnetic north line. If the magnetic north line points to the left of the True North line, add the indicated declination value to your True North Azimuth value. If the magnetic north line points to the right of the True North line, subtract the declination value from your True North Azimuth. You will now have a Magnetic North Azimuth.
4. Record the Magnetic North Azimuth on your scoresheet to the nearest whole degree.

% Slope Between Two Points

The slope is the ratio between the difference in elevation of two points and the on-the-ground distance between those points. The formula for calculating a slope is often summed up with the phrase “rise over run.” For this contest, the slope between two points is reported as a percentage value. For example, a 10% slope value means that, for the line of travel between the two points in question, the elevation increases by 10% for each unit of on-the-ground distance travel. For topographic map applications, the formula for % Slope is as follows:

$$\%\ \text{Slope} = \frac{Difference\ in\ Elevation\ (ft)}{On\text{-}the\text{-}Ground\ Distance\ (ft)} \times 100\%$$

To calculate the % Slope between two points, you will need to apply two skills that you have already learned: Using an engineer’s-scale ruler or pencil/paper to measure the distance between two points on the map and using contour information to determine elevation differences. Therefore, a simple process for determining % Slope for any two points on the map is as follows:

1. Locate your two points of interest using the provided UTM coordinates and site descriptions.
2. Determine the difference in elevation between these two points, and the on-the-ground distance between them by using the techniques described above.
3. Using your calculator, divide the difference in elevation by the measured on-the-ground distance to obtain a decimal slope ratio.

4. Multiply this decimal slope ratio by 100% to obtain your final % Slope result. This is the result that you will report on your scoresheet.

Map Symbol Identification

Colors and different types of symbols are used to represent important features on topographic maps such as boundaries, surface and below-surface features, and contours. Locations of water resources, prominent land cover, and placement of infrastructure such as a dam, are all examples of information that can be represented with map symbols. Thus, topographic maps provide information that is useful for managing land, conducting environmental assessments, and timber harvest planning. A common symbol set may be used among topographic maps in production; however, some symbols may slightly vary, and some are useful only for certain geographic locations. In this competition, participants will locate and identify symbols of interest by using a UTM grid reader in conjunction with a provided UTM grid address. All symbols will be taken from the official symbol library used by the USGS for the US Topo map series.

The official list of map symbols for the contest are as follows:

1. Fire Station
2. Hospital
3. Police
4. Cemetery
5. Court house
6. School
7. Post Office
8. Cabin
9. Campground
10. Park Headquarters
11. Picnic Area
12. Ranger Station
13. Shelter
14. Trailhead
15. Visitor Center
16. Airport Runway
17. Railroad
18. Dam
19. Intermittent stream
20. Perennial stream
21. Freshwater forest/shrub wetland
22. Index contour line
23. Intermediate contour line
24. Ridge
25. Valley
26. Peak
27. Saddle
28. Depression

US Topo Series Map Symbol Library

STRUCTURES

Emergency Service Features

- Fire Station
- Hospital
- Police

Public Service Features

- Cemetery
- City/Town Hall
- College/University
- Court House
- Post Office
- Prison
- School (K-12)
- State Capitol
- Trade/Technical School
- US Supreme Court
- The White House

Recreational Features

- Cabin
- Campground
- Park Headquarters
- Picnic Area
- Ranger Station
- Shelter
- Trailhead
- Visitor Center

Oil & Gas Pipeline Features

- Oil/Gas Pipeline*

TRANSPORTATION

Airport Features

- Airport Runway
- Heliport
- Seaplane

Railroad Features

- Railroad

Road Features

- Closed Road
- Expressway
- Ferry
- Four Wheel Drive
- Local Connector
- Local Road
- Ramp
- Secondary Highway
- Tunnel

Road Shields

- Interstate Route (25)
- State Route (470)
- US Route (830)
- Forest Service Primary Route (240)
- Forest Service Secondary Route (420)
- Forest Service High Clearance Route (720)

Trails

- Snow
- Terra
- Water

HYDROGRAPHY

Hydrographic Features

- Area of Complex Channels
- Canal/Ditch
- Coastline
- Underground Conduit
- Dam
- Earthen Dam
- Nonearthen Dam
- Estuary
- Flume
- Foreshore
- Gaging Station
- Gate
- Ice Mass
- Inundation Area

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US Topo Series Map Symbol Library

HYDROGRAPHY – *continued*

- Intermittent Lake
- Perennial Lake
- Levee
- Lock Chamber/Spillway
- Ocean
- Pipeline
- Underground Pipeline
- Playa
- Settling Pond
- Tailings Pond
- Rapids
- Reef
- Reservoir
- Nonearthen Reservoir
- Rock
- Nonearthen Shore
- Spring
- Intermittent Stream
- Perennial Stream
- Submerged Stream
- Tunnel
- Wash
- Waterfall
- Well

Wetland Features

- Freshwater Emergent Wetland
- Freshwater Forested/Shrub Wetland

TERRAIN

Shaded Relief

- Shaded Relief

Contour Features

- Index (8000)
- Intermediate
- Supplemental
- Depression Index (4000)
- Depression Intermediate
- Depression Supplemental

LAND COVER

- Woodland

IMAGES

- Orthoimage

BOUNDARIES

Designated Areas

- National Wild and Scenic Rivers

Federal Administered Lands

- American Indian, Alaska Native, and Native Hawaiian Area
- Bureau of Land Management*
  National Park Service
  U.S. Fish and Wildlife Service
  U.S. Forest Service
- Department of Defense
  National Cemetery
- National Monument
- Wilderness Area

Jurisdictional Boundaries

- County or Equivalent
- State or Territory
- International

*Currently on Alaska US Topo maps only

PLSS

- Land Grants
- Section (1 – 36)
- Section (protracted) (1 – 36)
- Township/Range (T 34 NR 79 W)
- Township/Range (protracted) (T 34 NR 79 W)

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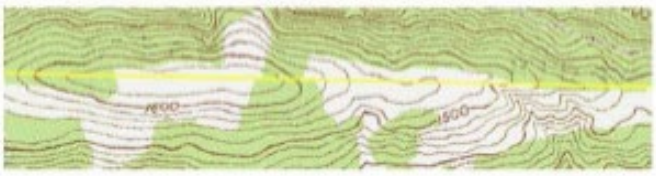
Additional Geological Features for Topographic Maps

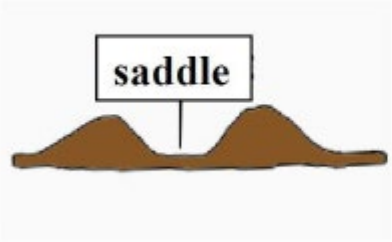
Note: These features are not official “symbols” per se, but they have been deemed important enough for navigation and land management considerations that participants are expected to know how to identify them during the Topographic Map Interpretation contest.

peak



ridge

valley



Practice Topographic Map Score Sheet

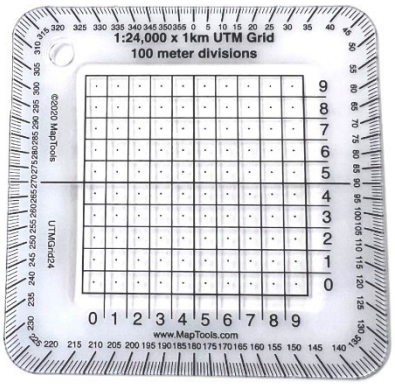
TOPOGRAPHIC MAP SCORE SHEET			
STATE:	GROUP:	CONTESTANT:	
QUESTION	MAP SYMBOL OR FEATURE		SCORE 2 pts ea
1			
2			
3			
4			
5			
CALCULATIONS			SCORE 8 pts max each
DISTANCE			
GRID AZIMUTH			
MAGNETIC AZIMUTH			
ELEVATION DIFFERENCE			
% SLOPE			
		TOTAL SCORE	

Topographic Map Interpretation Example Questions

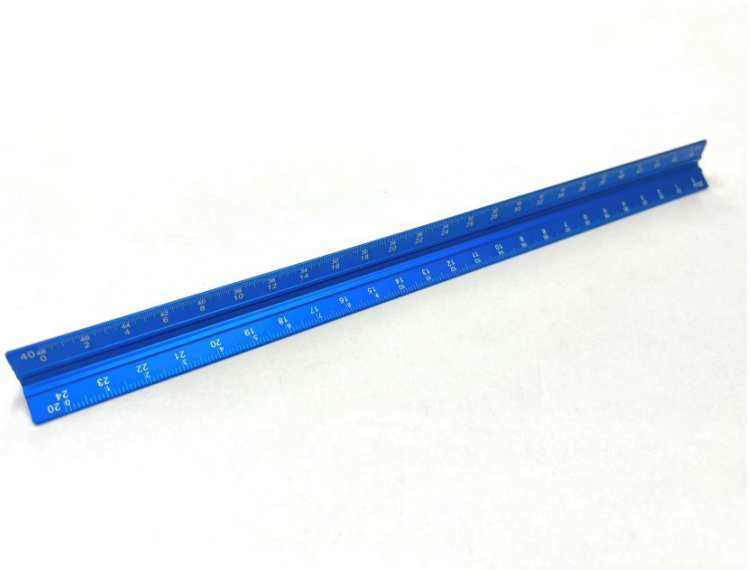
All Examples Based on the 2022 Big Meadows, VA US Topo Series Map

Necessary Supplies

The primary tools used in this contest are the 1:24,000 100-meter UTM Grid Reader, and an Engineer's Scale Ruler. Ensuring that you are familiar with the proper methods of using both tools is essential to your success in this contest.



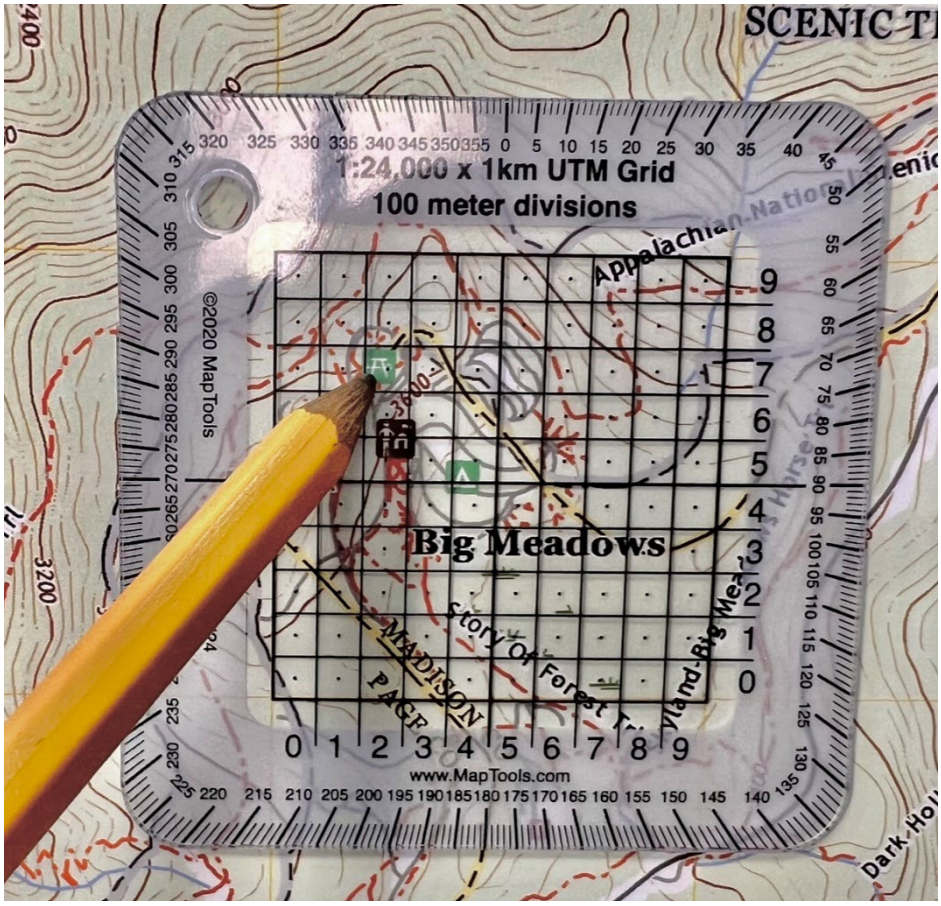
1:24,000 UTM Grid Reader



Engineer's Scale Ruler

Example 1: Identify the symbol or feature located at UTM 232677

Locate the grid square referenced within the question. First, find the intersection of the appropriate easting and northing line. Then, use your grid reader to break down the UTM grid square located at this intersection into its 100-meter divisions. Read the appropriate column and row number to locate your symbol.

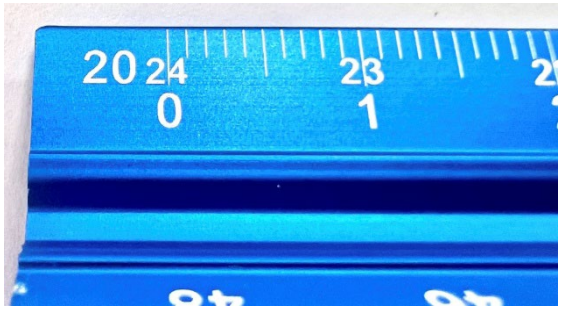


Pencil is pointed at UTM 232677

We see the symbol of interest. If we have studied, we should recognize this as a **Picnic Area**, and report that as the answer on our score sheet.

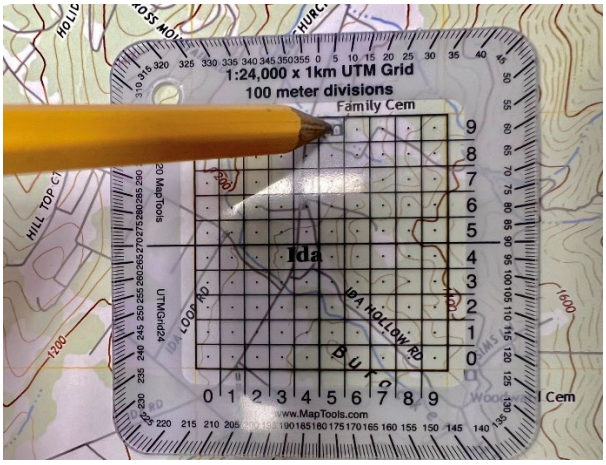
Example 2: What is the distance from Somers Family Cemetery (UTM 245749) to the intersection of Ida Loop Road and Hollow Run Road (UTM 241745)?

Begin by finding the 20-factor side of your engineer's scale ruler, indicated by a large "20" written beside the ruler's measuring lines.

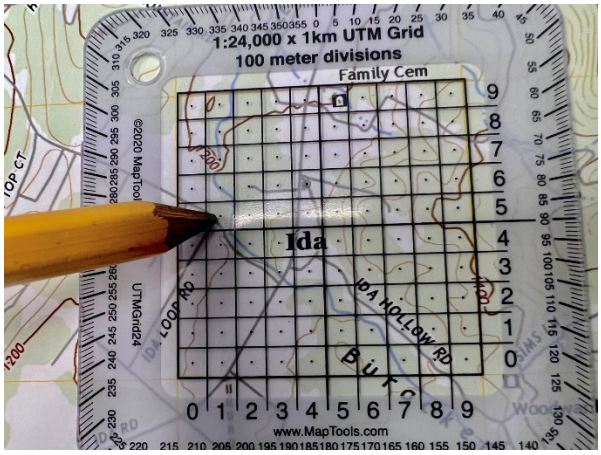


A large "20" indicates the 20-scale ruler

Using the UTM grid reader and the relevant easting and northing lines, locate the relevant points: Somers Family Cemetery at UTM 245749, and the intersection at UTM 241745.



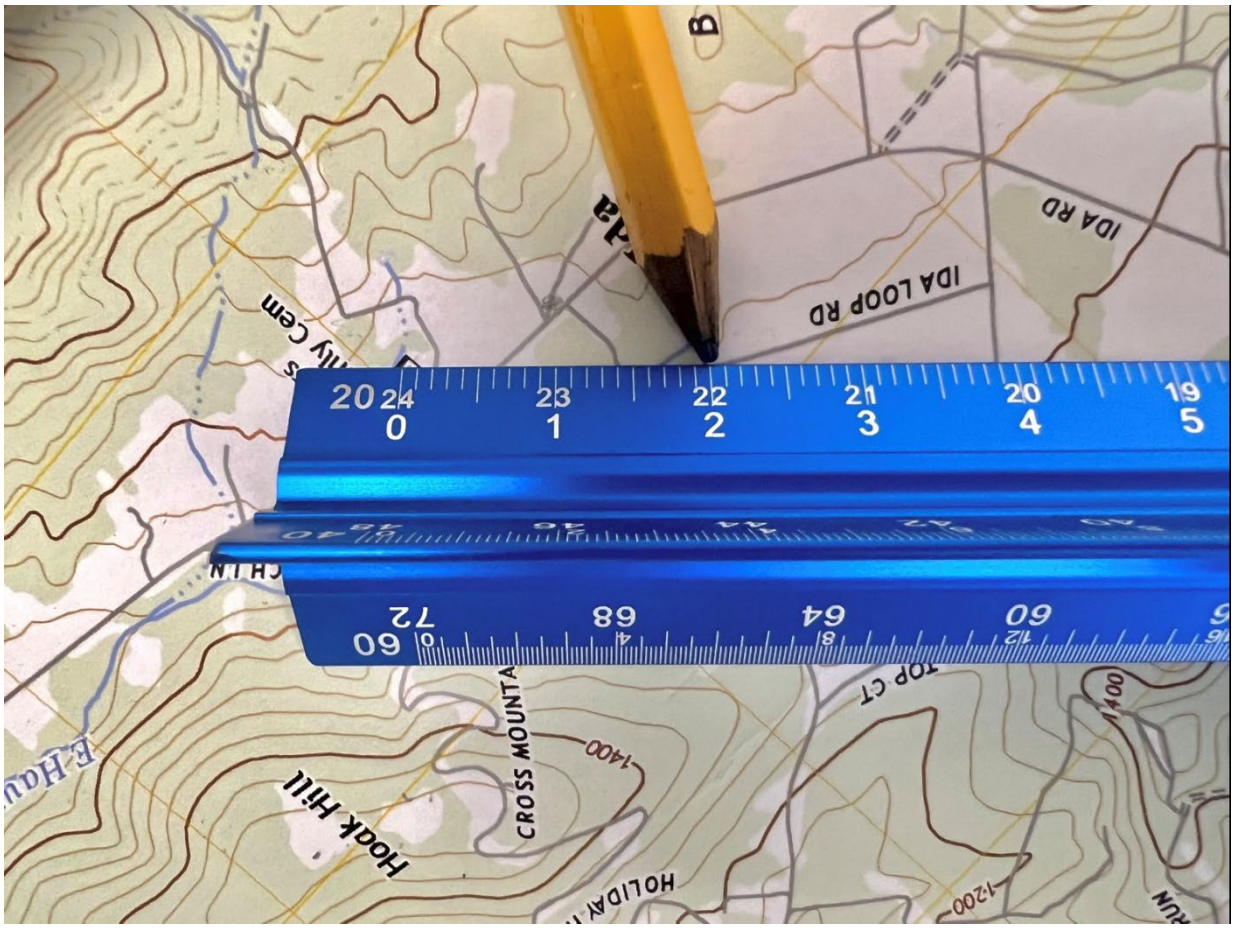
Somers Family Cem – UTM 245749



Intersection – UTM 241745

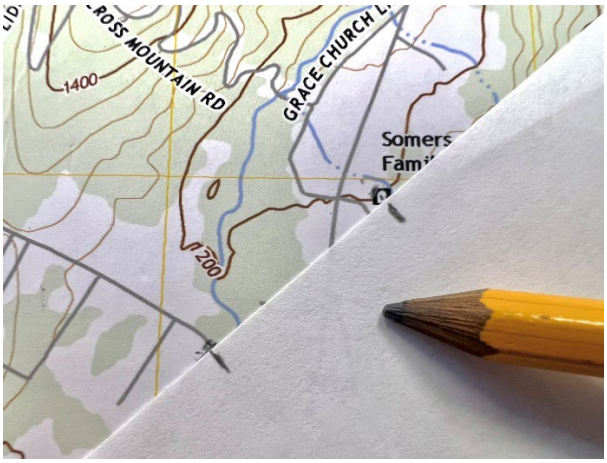
Now, measure the distance between the points.

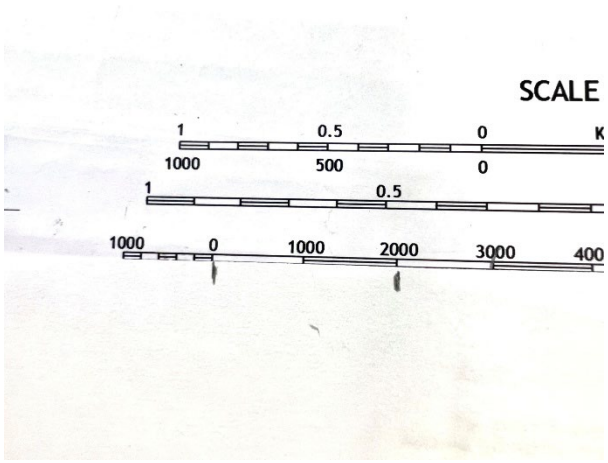
Method 1: Use your 20-factor engineer's scale ruler to measure the distance between the two points. Multiply the measured value by 1,000 and report the result on your score sheet to the nearest 100 feet.



Method 1 Result: **2 * 1,000 = 2,000 feet**

Method 2: Using the edge of a blank piece of paper and a pencil, draw two tick marks corresponding to each point of interest. Use the visual scale bar (in feet) at the bottom of the map to determine the distance between the two tick marks to the nearest 100 feet. Report this distance on your score sheet.



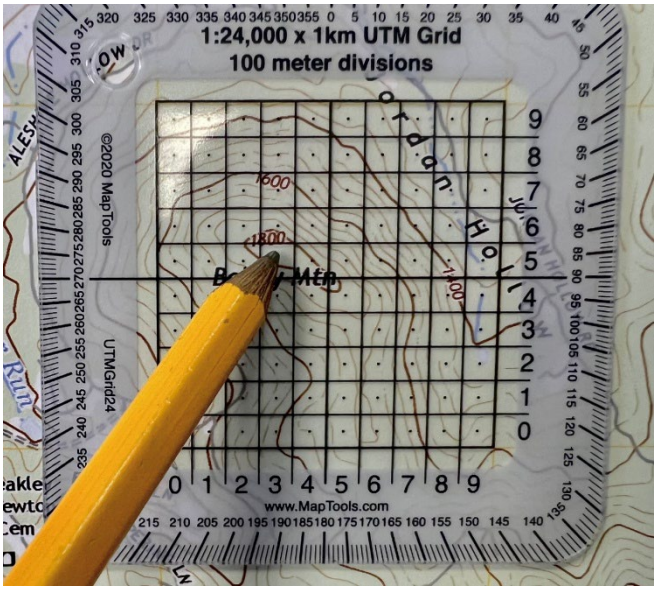


Method 2 Result: **2,000 feet**

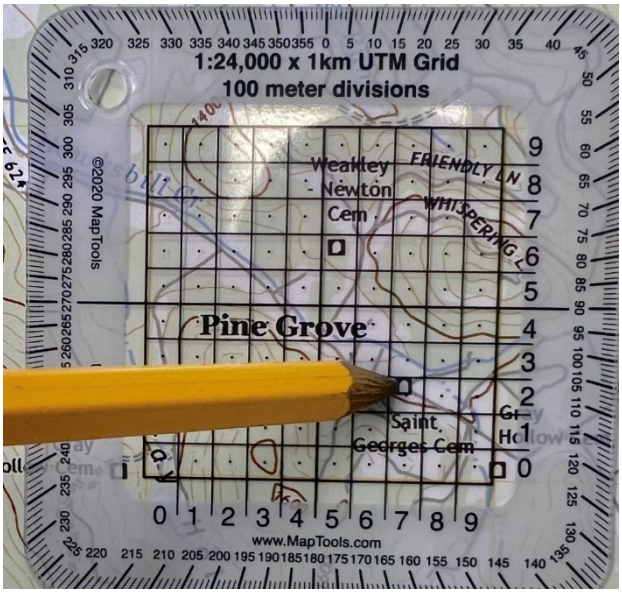
Both methods produce the same result: **2,000 feet** (Report this value on your score sheet.)

Example 3: What is the azimuth from the peak of Bailey Mountain (UTM 203695) to Saint Georges Cemetery (UTM 197682)?

Begin by using your UTM grid reader to locate the relevant points.

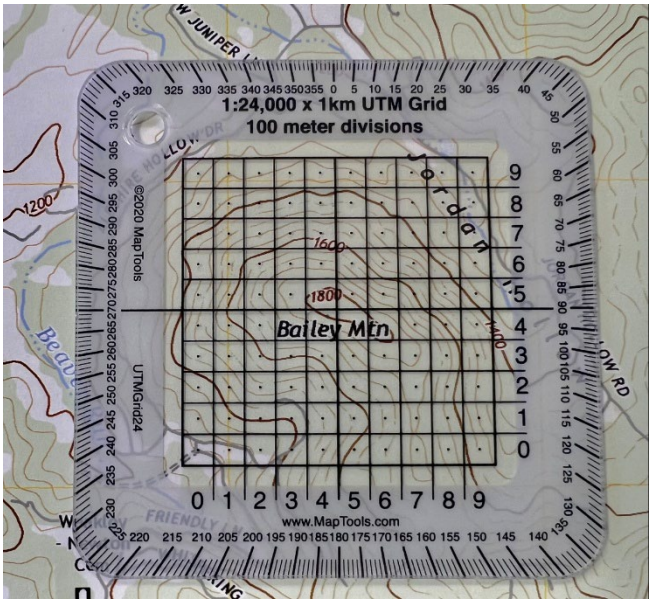


Peak of Bailey Mtn – UTM 203695



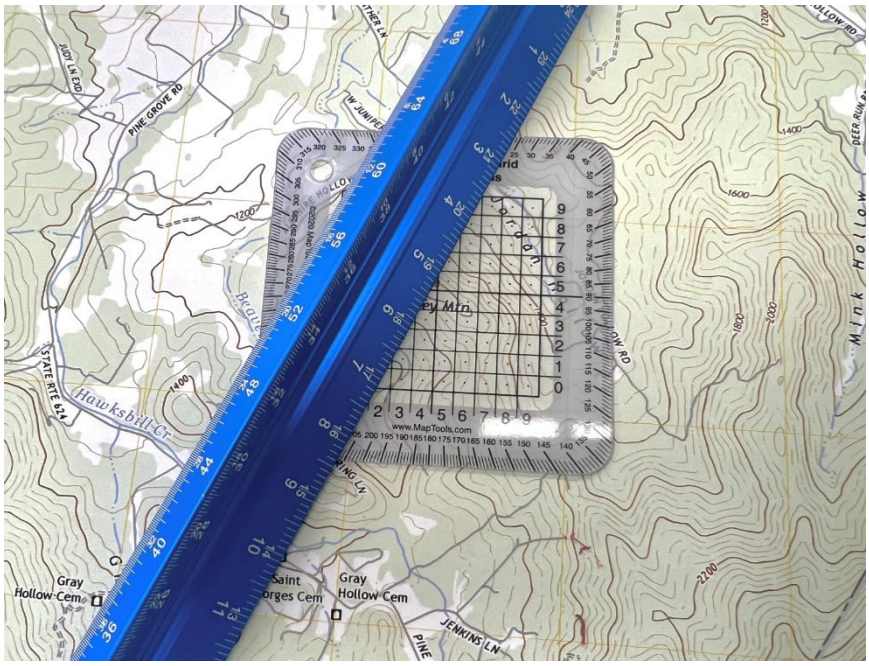
Saint Georges Cem – UTM 197682

Then, center your grid reader over the first point listed in the question, ensuring that the edges of the grid reader are parallel with the yellow grid lines on the map.



UTM 203695 is centered in the grid

Lay your engineer-scale ruler over the UTM grid reader, such that one edge of the ruler forms a parallel line that connects both points.

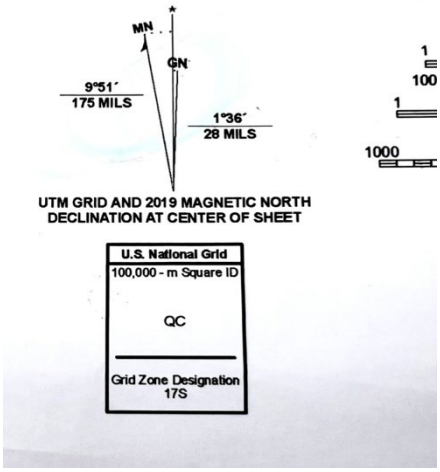


Now, using the protractor printed along the outer edge of the UTM grid reader, read the angle across which the parallel line formed by the ruler falls.

Result: 207° GN

Example 4: Convert the Grid Azimuth from Part 3 into a Magnetic Azimuth. [Round to the nearest degree]

Begin by examining the declination chart to the left of the scale bars at the bottom of the map.



To convert from a Grid North Azimuth to a Magnetic Azimuth, we must first convert to a True North Azimuth, which requires converting Grid North to True North based on the declination value provided. Recall that a compass reads in the clockwise direction; because the movement from Grid North to True North is counterclockwise, it moves the starting point of our reading backwards; therefore, we add the declination value indicated beneath the “GN” line to our previous azimuth. We do not need to round our answer until the final step.

GN to N: 207° + 1° 36’ = 208° 36’

True North Azimuth: 208° 36’ N

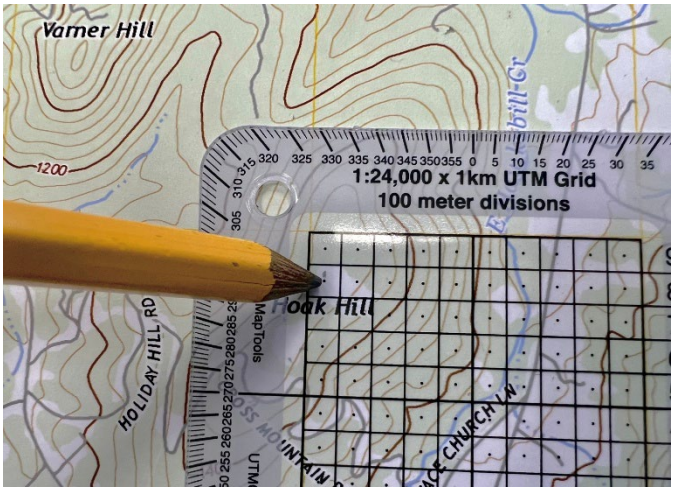
Now we convert our True North Azimuth to a Magnetic Azimuth through the same process. Again, we are moving counterclockwise, so we add the declination value to our True North Azimuth.

N to MN: 208° 36’ + 9° 51’ = 218° 27’ = 218°

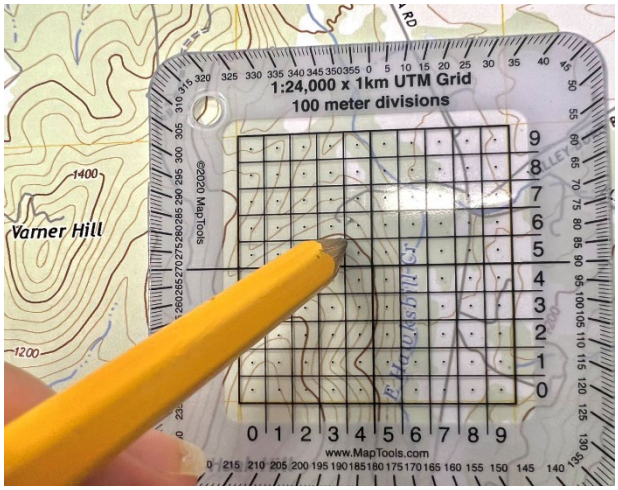
Magnetic North Azimuth: 218° MN (Report this on your score sheet)

Example 5: What is the difference in elevation between the peak of Hoak Hill (UTM 240758) and the point on the index contour line located at UTM 244766?

Begin by locating the points of interest using your UTM grid reader.

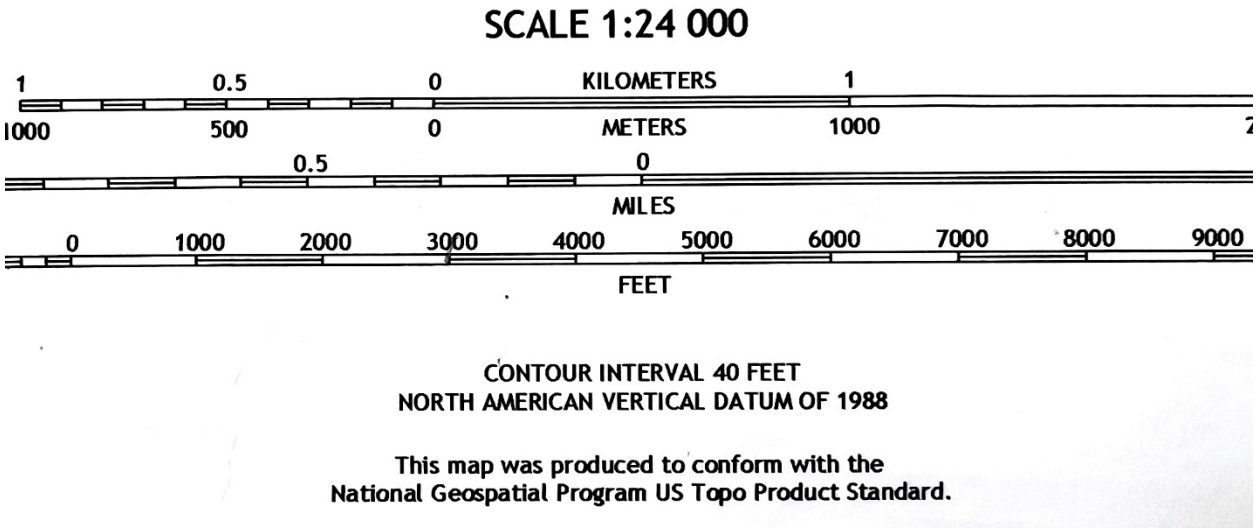


Peak of Hoak Hill – UTM 240758



Index Contour Line – UTM 244766

Determine the elevation of each point by referencing the contour interval of the map and the elevations of contour lines surrounding the points of interest. The contour interval can be found below the visual scale bars at the bottom of the map.



Contours Surrounding UTM 240758

The Index Contour Line at UTM 244766

Peak of Hoak Hill – UTM 240758: 1,480 feet + 20 feet = ***1,500 feet***

- **UTM 240758** is a peak. Based on the rule for points in between contour lines, we determine the elevation value of the contour line that encircles the peak. In this case, it is 1,480 feet. We then add half of our contour interval of 40 feet to this elevation.

Index Contour Line – UTM 244766: ***1,200 feet***

- The labeled value of the index contour line at UTM 244766 is 1,200 feet.

Difference in Elevation = ***1,500 feet*** – ***1,200 feet*** = ***300 feet***

The elevation difference between the two points is **300 feet**. Report this value on your score sheet.

Example 6: Calculate the % Slope of the line of travel between the same two points used in Example 5.

Recall the formula for % Slope.

$$\% \text{ Slope} = \frac{Difference\ in\ Elevation}{On\text{-}the\text{-}Ground\ Distance} \times 100\%$$

If we did not already know the elevation difference between the two points, then we would need to use the method described in **Example 5** to determine this value.

Similarly, if we did not already know the on-the-ground distance between the two points, we would need to use one of the two methods described in **Example 2** to determine that value.

On-the-Ground Distance, Method 1: 2.8 * 1000 = **2,800 feet**

Once these values have been determined, simply substitute them into the formula.

$$\% \text{ Slope} = \frac{300\ feet}{2{,}800\ feet} \times 100\% = .107 \times 100\% = 10.7\ \% = \mathbf{11}\%$$

There is an **11% Slope** between these two points. Report this value on your score sheet.

Forest Evaluation

Objectives

This contest has been developed to provide senior forestry teams an opportunity to discover the site factors and stand factors that affect the growth of forest crops. The competition is divided into four parts:

I. Site Evaluation
II. Stand Evaluation
III. Recommended Practices
IV. Forest Inventory

Contest Rules

1. Senior forestry teams will complete the forest evaluation contest as a **group**. This is not an individual event.
2. Teams are given a specific amount of time to complete each part of the contest. Seventy-five points are possible for each part, with a total of 300 points possible for the entire contest.
   a. For Part I, sections A, B, C, D, and E have a possible value of 15 points each.
   b. For Part II, all categories except for Stocking have a possible value of 10 points each. The Stocking category is worth 25 points.
   c. For Part III, each correct answer of tree species, crown class, DBH, and height in 16-foot logs are worth 3 points. Board-foot volume per acre and tree value per acre are worth 7.5 points each, provided that they are within +/- 10% of the correct value.
   d. For Part IV, each management practice is worth 7.5 points each.

I. Site Evaluation

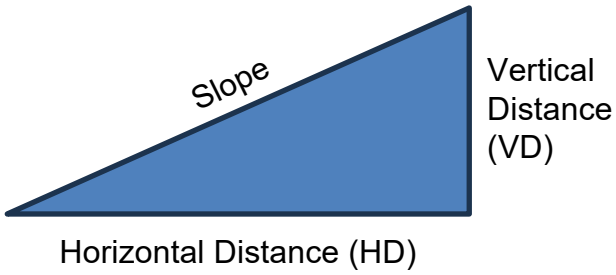
The **site** is the habitat or environment in which a plant or plant community lives. A number of site factors determine its desirability as a location for tree species. These factors include soil depth, slope percent, aspect, and slope position. These factors can be used to determine the forestland capability class of a particular tract of land.

Soil depth is the distance from the soil surface down to unweathered rock or an impermeable layer, which restricts water movement and root penetration. For contest purposes, shallow soils are less than 24-inches deep, and deep soils are greater than 24-inches deep.

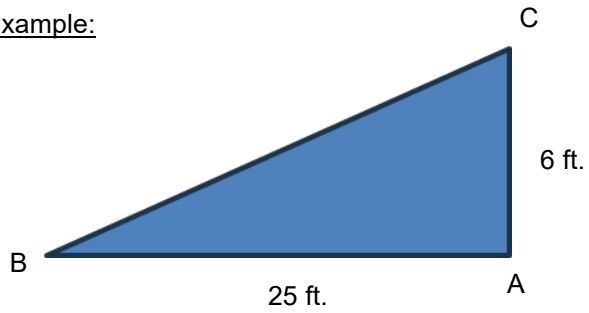
Slope is the change in elevation between two points, and slope percent is the number of feet of rise or fall in 100 feet of horizontal distance.

Slope percent can be measured with an Abney level or a clinometer. For contest purposes, slope percent is broken into the following categories:
0 to 20%
20 to 40%
40% and greater

Slope Percentage Formula:
Slope= (change in vertical distance/horizontal distance) x 100

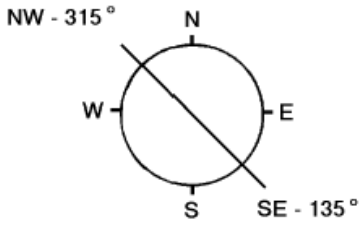


Example:



Slope= (AC/AB) x 100
Slope= (6/25) x 100 = 24%

Determining aspect:



Aspect is determined by taking a compass reading while facing down a slope and is measured clockwise. The direction water would run gives the compass direction. Any slope facing north and east of a line extending from 315°NW to 135°SE is considered to have a desirable northeast exposure. Any slope facing south and west of the same line is considered to have a less desirable southwest exposure.

Slope position is determined only on hilly sites. The positions are classified as upper 1/3, middle 1/3, and lower 1/3. Ridge tops or level plateau and bottomlands are classified separately in land capability.

Forest land capability classes are described below for the purpose of this contest:
Class I- Excellent has few limitations for tree growth. Most sites have little slope and no erosion problems. The soil is fertile and holds water well. It is well drained, but not droughty. These sites will produce timber well.
Class II- Good is usually gently sloping. In some cases, there are drainage problems that affect tree growth.
Class III- Fair may be fairly steep. Soils may have low fertility and tend to be droughty.
Class IV- Poor may be very steep with shallow soil. Sites may be rocky, shady, have low fertility and be very dry.

II. Stand Evaluation

For the purpose of the contest, grazing damage is defined by the following three categories:

Severe: reproduction eaten and trampled out, soil compacted, and bark rubbed off large trees
Slight: animals have only slightly affected the condition of the forest
None: no evidence of grazing damage

Fire may be present as a destructive agent or a management tool. Wildfire can be very destructive, particularly in hardwood forests. Destruction of the litter layer on the forest floor, crown scorch or burning of the foliage, and scalds or scars on the tree trunk are all evidence of wildfire damage. A prescribed burn is a forest management tool that can be used to manage competing vegetation, prevent fuel accumulation, and improve wildlife habitat without damaging the crop trees.

Forest types have been defined by the Society of American Foresters since 1932. The recognition of forest types is necessary because different forest types require different management. For the purpose of this contest, size distribution is classified into four categories for the purpose of this contest:

Reproduction: stems 0 to 1-inch DBH
Saplings: stems 1 to 3-inches DBH
Poles: stems 3 to 12-inches DBH
Sawtimber: stems more than 12-inches DBH

Note: In all-aged stands, there may be two or more size classes represented. In many even-aged stands, there will be only one size class.

Figure 1. All-aged stand.

Stand origin can vary from one stand to another, even though the stands are of the same forest type and size distribution. Timber stands may originate by several different means. Natural stands may arise from seed or from sprouts. Sprout or coppice forests can become unhealthy because disease and decay organisms are sometimes transmitted from the parent trees to the spouts through the root systems. Stands which originate from planted seedlings or seeds are called plantations. These stands may be of higher quality than their predecessors, if genetically improved seeds or seedlings are used.

Stocking is a term used to describe how well the trees in a stand utilize the available space. A well-stocked stand is one in which the trees are well distributed, and all the space is utilized, but the trees still have room to grow. An understocked stand is one in which there are open spaces between the tree so that the stand will not produce its full potential. An overstocked stand is one which is so crowded that trees are growing very slowly, and so are dying because of too much competition.

III. Recommended Practices

A list of forest practices appears on the Forest Evaluation Contest Score Sheet. Teams should consider each practice, and answer “yes” if they recommend applying the practice in the designated timber stand or “no” if they don't recommend it. The practices recommended should be those that will improve the stand and enhance multiple uses.

Streamside Management Zone (SMZ) applies to an evaluation site with a flowing stream within the boundaries.

IV. Forest Inventory

a. Species of each numbered tree should be listed using the common names from the Official Tree Identification Species List.
b. Diameter at breast height of each tree should be measured and recorded in 2-inch diameter classes.
c. Height in 16-foot logs of each tree should be measured and recorded to the half-log.
d. Volume in board feet of each tree should be determined and recorded using the provided volume table.
e. Crown class of each tree should be determined and recorded as either dominant, co-dominant, intermediate, or suppressed (as defined in the glossary).

Figure 2. Timber harvesting

FOREST EVALUATION SCORE SHEET

State _____ Total Score_____

I. SITE EVALUATION (75 points total)**: Circle one** for each section as applicable (A) Soil Depth (15 pts), (B) Slope Percent (15 pts), (C) Aspect (15 pts), and (D) Slope Position (15 pts).

A. Depth of Soil	Deep - 24" or more						Shallow - less than 24"					
B. Slope Percent.	Rolling 0-20%		Steep 21-40%		Very Steep 41%+		Rolling 0-20%		Steep 21-40%		Very Steep 41%+	
C. Aspect	NE	SW	NE	SW	NE	SW	NE	SW	NE	SW	NE	SW
D. Slope Position												
Lower 1/3	I	II	I	II	I	III	I	III	II	III	III	IV
Middle 1/3	I	II	II	III	II	III	II	III	III	IV	IV	IV
Upper 1/3	II	III	III	III	IV	IV	III	IV	III	IV	IV	IV

E. Forest Land Capability Class (15 pts)**:** Determine the proper class by drawing a line down from the **Aspect** circled and across from the **Slope Position** circled. The Roman numeral where these lines intersect indicates the class. **Circle the class below**.

I. Excellent II. Good III. Fair IV. Poor

Part I Score_____

II. FOREST STAND EVALUATION (75 pts total)**:** (Circle the correct answer in each section).

Grazing Damage (10 pts)
1. Grazed
2. Un-grazed

Fire (10 pts)
1.Un-burned
2. Wildfire
3. Prescribed Fire

Stocking (25 points)
1. Under stocked
2. Over stocked
3. Well stocked

Forest Type (10 pts)
1. Mixed Oaks
2. White Pine
3. Cove Hardwoods
4. Red Oak, White Oak, Hickory
5. Northern Hardwoods

Stand Origin (10 pts)
1. Natural regeneration
2. Plantation planting

Size Distribution (10 pts)
(May be more than one answer)
1. Seedlings
2. Saplings
3. Poles
4. Sawtimber

Part II Score_____

III. FOREST INVENTORY **Plot Size**_____

Tree #	Tree Species (3 pts ea)	Crown Class (3 pts ea)	DBH (3 pts ea)	# 16 ft Logs 4 max (3 pts ea)	Board-foot Volume	Tree Value
1						
2						
3						
4						
5						
Total Board Foot Volume and Tree Value in Plot						
Per acre values (7.5 points each)						

Crown Class: D = dominant, C = co-dominant,
I = intermediate, and S = suppressed **Part III Score**_____

IV. PRACTICES RECOMMENDED (75 pts total)**:** Check your recommend practices. (7.5 pts ea)

10. Which specie(s) would you favor on this site?_____
11. Protect the area from wildfire. Report any fire by calling 911 . . . . . _____
12. Stand is not yet merchantable, leave alone to grow . . . . . _____
13. Conduct a harvesting operation (If checked, select appropriate type below for pts). . . . . _____
    a. Conduct a thinning . . . . . _____
    b. Clearcut the stand and plant with a desirable species . . . . . _____
    c. Clearcut the stand and allow for natural regeneration . . . . _____
    d. Conduct a shelterwood or seed-tree harvest . . . . . _____
    e. Conduct a selection harvest . . . . . _____
    f. Conduct a salvage or sanitation cutting . . . . . _____
14. Use Best Management Practices and Sustainable Forestry guidelines . . . . . _____
15. Manage stand for non-timber forest products . . . . . _____
16. Manage stand for wildlife habitat improvement . . . . . _____
17. Manage stand for recreational opportunities . . . . . _____
18. Conduct a prescribed burn . . . . . _____
19. Fence the area from livestock . . . . . _____

Part IV Score_____

Forestry Quiz

Objectives

The primary objective of the 4-H Forestry Quiz is to provide an opportunity for youth enrolled in 4-H Forestry projects to demonstrate their knowledge of forestry and related subject matter.

Contest Rules

1. Participants will complete the Forestry Quiz on an individual basis.
2. The quiz will consist of true-or-false and multiple-choice questions. Participants should circle the correct answer to each question.
3. Points will be awarded for each correct answer. The maximum number of points possible will be 100.
4. Participants will have thirty minutes to complete the quiz.
5. All questions on the quiz will come from the following references:
    a. Alabama Forestry Invitational State Manual & Study Guide
    b. National 4-H Forestry Invitational Training Unit A – Trees https://4hforestryinvitational.org/wp-content/uploads/2025/03/unitA.pdf
    c. National 4-H Forestry Invitational Training Unit B – Forests https://4hforestryinvitational.org/wp-content/uploads/2025/03/unitB.pdf

Forestry Knowledge Bowl

Objectives

The Forestry Knowledge Bowl will provide an opportunity for teams of four participants to demonstrate their knowledge of forestry and related subject matter in a competitive setting where attitudes of friendliness, fairness, and excitement prevail.

Pairings for the competition bracket will be determined by the total of the top three quiz scores for each team. The team with the highest total score will be the top seed, while the team with the lowest total score will be the bottom seed.

Equipment

Panels: Two interconnecting panels, each to accommodate four participants plus a moderator panel with suitable controls are to be used. The equipment will be checked prior to the start of each round of competition.

Time keeping device: A stopwatch or other appropriate device is to be used.

Score keeping device: This may be a blackboard or flip chart.

Questions: A packet of questions for each round shall be prepared in advance. If there are several acceptable answers to the question, all answers shall be listed.

Setup: See the Forestry Knowledge Bowl contest suggested setup.

Officials

Moderator (Quiz Master): The moderator assumes complete direction of all rounds, asks all questions, designates participants to answer questions, accepts or reject all answers unless overruled by the referee judges, but may seek interpretation of questions that are ruled on unanimously.

Referee Judge: One or two judges may be used.

Timekeepers: One or two timekeepers will be used to indicate to the moderator the expiration of the time allowed in which to answer questions. The timekeepers may be one or both of the referee judges.

Scorekeepers: One or two individuals will keep score on each round.

Procedure of Play

Starting the Contest

1. Teams are assembled and seated at their respective panels. A team must have three members to be an official team.
2. The team captains shall be seated nearest the moderator.
3. The question packet is opened by the moderator.

Part I

1. A coin is tossed to determine which team captain will answer the first question.
2. The second question will be answered by the captain of the opposing team. The succeeding questions will be asked alternately of each team and rotated among team members until all questions have been asked.
3. Only the designated team member may answer the question. The member has 10 seconds to begin the answer and 10 seconds in which to complete the answer.
4. If the answer is correct, 10 points will be awarded to the team. No points will be given for partial or incorrect answers.

Part 2

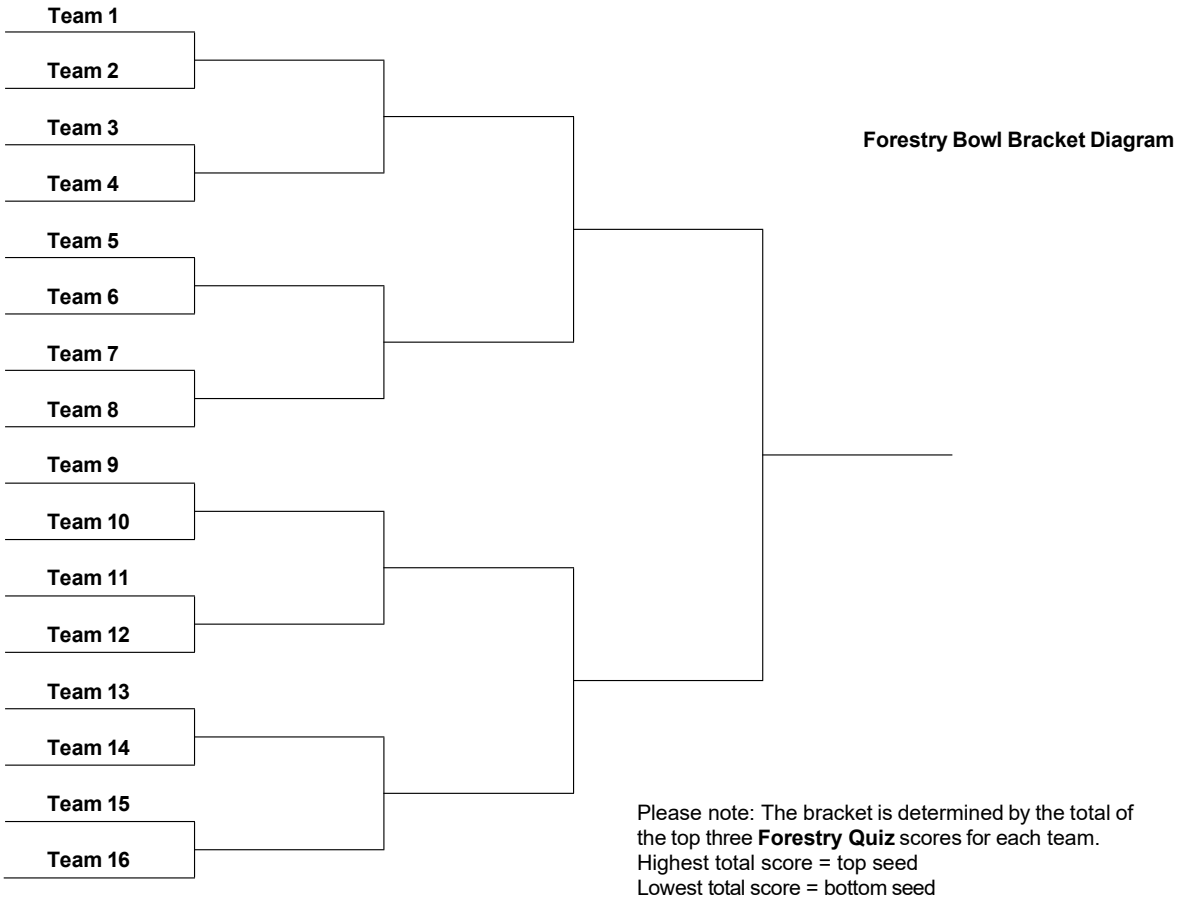
1. Part 2 begins with the moderator reading a toss-up question (as with all succeeding questions) until a contestant activates a buzzer.
    a. If a buzzer is activated during the reading of any question, the moderator immediately will cease reading the question and the contestant activating the buzzer shall begin the answer based on that portion of the question read.
    b. If the answer given is incorrect or no answer is given, 5 points are taken from that team's score and the moderator repeats the question. The opposing team

then has 10 seconds for any member to activate the buzzer and answer the question. If the answer is incorrect, 5 points will be taken from that team's score. No team consultation is permitted.

2. At the completion of the reading of a question or when a buzzer is activated, 10 seconds are permitted in which to begin an answer and another 10 seconds are allowed in which to complete the answer. The answer will be given by the contestant activating the buzzer. No consultation on toss-up questions is permitted. It shall be the responsibility of the moderator to determine if an actual answer is started within this 10-second period.
3. If the time in which to answer a question elapses without a contestant activating the buzzer, the question is discarded.
4. If the toss-up question is correctly answered within the 10-second time limit, that team scores 5 points.

Completing the Contest

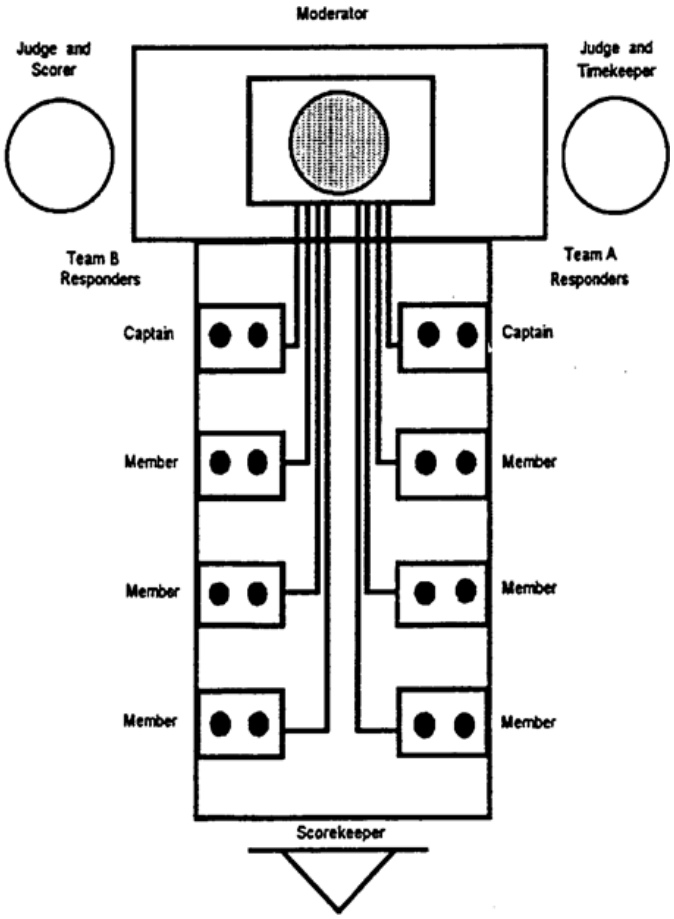
1. The moderator will continue reading toss- up questions until all toss-up questions have been asked or 30 minutes have elapsed, whichever comes first (except the last round which may last up to 45 minutes).
2. Following the final question, the scores of the two scorekeepers shall be compared. If there is disagreement as to the score of the game, the score that is tabulated on the written score card will be used.



Forestry Bowl Bracket Diagram

Please note: The bracket is determined by the total of the top three **Forestry Quiz** scores for each team.
Highest total score = top seed
Lowest total score = bottom seed

Suggested Bowl Setup



Glossary

Abney Level – An instrument used to determine the percent of slope of a site.

Acre – An area of land measuring 43,560 feet. A square 1-acre plot measures 209 feet by 209 feet, a circular acre has a radius of 117.75 feet.

Annual Ring – the combination of one earlywood layer (light colored) and one latewood layer (dark colored) seen in a cross-section of a tree. One annual ring usually represents one year of growth.

Aspect – A compass reading taken facing down a slope in the direction water would run, gives the compass direction of a slope.

Best Management Practices (BMP) – A practice or combination of practices that is determined by a state to be the most effective, practicable means of preventing or reducing the amount of pollution generated by nonpoint sources (such as managed forests) to a level compatible with water quality goals.

Biltmore Stick (Tree Stick) – A stick similar to a yardstick in appearance, but usually about 25 inches long. One side is scaled to read a tree's diameter by holding the stick horizontally at arm's length and against the tree at breast height. A Merritt hypsometer runs along one edge of the stick and is scaled to read a tree's height from 66 feet away from the tree's base. These two measurements are then used to find the tree's volume according to the volume table printed on one face of the stick.

Biodiversity – The variety of life forms in a given area. This can be categorized in terms of number of species, variety of plant and animal communities, genetic variability, or some combination of these categories.

Clinometer – Height measuring device.

Co-Dominant – Trees with crowns that form the general level of the crown cover and receive full light from the top, but very little from the sides.

Conservation – Gifford Pinchot, a turn of the century forester closely associated with President Theodore Roosevelt, applied the word to describe a natural resource philosophy. It meant "wise use." Through the years it has taken on an extended meaning that says, "wise use over a period of time." The time factor forces us to consider the consequences of current use compared to future use.

Coppice – A stand of forest originating from the stumps or roots of trees previously cut. Most hardwood species sprout readily when cut young. Very few conifers will sprout from the stump.

Cull – Tree or log of merchantable size, but no market value.

Crown Class – Tree crowns are classified as to the position in which they are found. The following are the main generally recognized classes: co-dominant, dominant, intermediate, suppressed.

Deciduous – A group of trees that lose all of their leaves every year.

Dendrology – The study of trees; tree identification.

Dominant – Trees with crowns that extend above the average of the tree crowns and receive light from directly above and some from the sides.

DBH – Diameter of a tree at breast height or 4½ feet above ground.

Duff – Often referred to as litter that is made up of materials of the upper layer of the forest floor. This includes freshly fallen leaves, twigs, and slightly decomposed organic matter.

Erosion – The wearing away of the soil and minerals by climatic agents such as wind and water.

Evergreen – A group of trees that do not lose all of their leaves every year but go through a gradual replacement by dropping only their oldest leaves each year. Instead of being bare in winter, these trees have leaves all year.

Exposure – That portion of the slope that is directly in the path of wind, rain, and sun. That part of a slope open to action of the elements.

Forest Land Capabilities – The productivity of the land as it is affected by particular location or position on a slope.

Forest Management – Caring for a forest so that it stays healthy and vigorous and provides the products and values the landowner desires.

Forest Types – A classification of species indicating the majority of the species represented in an area.

Forestry – The art and science of managing forests to produce various products and benefits including timber, wildlife habitat, clean water, biodiversity, and recreation.

Germination – This process occurs when viable seed meet favorable conditions that will allow it to grow.

Girdle – To chop or remove a strip of bark or a section of wood containing the food-carrying tissue of a tree in an even strip from the perimeter of the tree or twig.

Harvest – The removal of marketable products from the forest.

Intermediate – Trees that are shorter than the two preceding classes but with some branches extending into the general crown cover. Receives little light from above and none from the sides.

Mature Tree – A tree that has reached a maximum growth that the forest manager decides is a merchantable product.

Multiple-Land-Use – A term used to indicate the management of timber, wildlife, and recreation in an integral, consolidated program.

Merchantable Height – A term used to indicate the marketable length of a tree.

National Forests – These differ from National Parks in that recreation is not their only use. Recreation may be a primary use in some part of the national forest. For example, there are more acres of wilderness areas in national forests than national parks. The national forest system administers 154 forests and 19 grasslands. On most national forest land, timber, water, wildlife, recreation, and grazing are compatible resources. These are managed for productive and sustained yields according to the land's capability.

National Parks – The National Park Service was established by Congress to promote and regulate the use of national parks, monuments, and reservations and to conserve the scenery and the natural and historic objects and the wildlife therein. The Park Service administers 295 separate areas.

The Service manages some areas for historical or recreational uses. Each of the 35 national parks was established to preserve a unique natural area for enjoyment and study. National parks are confused with national forests.

Old Growth – This term describes eastern forests and virgin western forests with trees aged older than 100 years.

Partial Cut – Method of cutting mature trees, such as shelterwood cut, selection cut, or seed tree cut.

Pole – A young tree that is 3 to 12 inches DBH.

Prescribed Burn – Controlled burning to enhance forest management techniques in silviculture, wildlife management, fire hazard control, etc.

Preservation – In natural resources, other than wood preservation, this term is related to land use. The meaning stems from 19th century land reserves wherein areas and resources were set aside for limited or restricted use and development. Preservation often restricts land to recreation or scientific study. Preservation may be contrasted to the principle of multiple uses which rather intensively develops one or more of an area's resources.

Reforestation – Reestablishing a forest by planting or seeding an area from which forest vegetation has been removed.

Reproduction – A natural establishment of seedings or sprouts 0 to 1 inch DBH.

Residual Stand – That portion of trees left after any partial cut.

Rotation – The number of years required to establish and grow trees to a specified size, product, or condition of maturity. A pine rotation may range from as short as 20 years for pulpwood to more than 60 years for sawtimber.

Sanitation Cutting – The removal of dead, damaged or susceptible trees, essentially to prevent the spread of pests or pathogens and to promote forest hygiene.

Sapling – A young tree less than 3 inches DBH. The minimum size is usually placed at 1 inch DBH.

Seedling – A tree grown from seeds.

Silviculture – A term used to indicate the establishment, development, care, and reproduction of stands of timber.

Site – The combination of biotic, climatic, and soil conditions with the ecological factors of an area to produce forests or other vegetation.

Slope Position – A particular location on a slope as upper, middle, or lower slope; ridge top; or bottom land. A specific topographic location.

Snag – A standing dead or dying tree.

Sprout – A tree originating from a root or stump.

Stocking – A measure of the proportion of the area actually occupied by trees.

Streamside Management Zone (SMZ) – A strip of land adjacent to a water body or stream channel where soils, organic matter, and vegetation are managed to protect the physical, chemical, and biological integrity of surface water adjacent to and downstream from forestry operations. Also may be called a "filter strip" or "buffer zone."

Suppressed – Trees with crown entirely below the general crown level and receiving no direct light either from above or below.

Sustained Yield – Management of a forest stand to provide a constant supply of timber and revenue.

Timber Stand Improvement (TSI) – Any practice designed to improve a stand of timber by removal of vines, culls, and undesirable species.

Wilderness – In the strictest sense, this means an area that has never been developed by humans. A 1964 Wilderness Act defined it thus: "A Wilderness, in contrast with those areas where man and his own works dominated landscape, is hereby recognized as an area where the earth and its community of life are untrammeled by man, where man himself is a visitor and does not remain." In common use, the word is associated with these undeveloped areas and those set aside with little development. In some cases, human-made items are dismantled to reduce the area to a primitive state. Under these broader uses, some road-less areas are considered wilderness when the access is limited to hiking, canoeing, or horseback riding and the use is set aside for recreation. To most of the general public, wilderness experiences are gained in a number of settings involving wild but not necessarily true wilderness areas.

Wild fire – Fires burning out of control regardless of how or why they are started.

Wolf Tree – A tree that occupies more than its fair share of growing space.

Federal Laws Affecting Forestry

Laws form the basis for using and managing the nation's forests. Since 1890, more than 140 laws affecting forestry have been passed by the United States Congress and signed by the president. In the early years, most laws enabled or authorized the protection and management of the nation's forests. Many of the laws passed in recent years restrict or regulate the use and management of these forests. Some of the more important federal laws are described below.

Creative Act of 1891 – Authorized the president of the United States to set aside public lands bearing forests as public reservations commonly called Forest Reserves.

Organic Administration Act of 1897 – Provided the Forest Reserves, later to be called National Forests, were established to improve and protect the forests, to secure favorable conditions of water flow, and to furnish a continuous supply of timber.

Transfer Act of 1905 – Transferred the administration of the Forest Reserves from the United States Department of the Interior to the United States Department of Agriculture.

Twenty-five Percent Fund Act of 1908 – Established the procedure for paying the states 25 percent of the monies received from national forest timber sales to benefit public schools and public roads in counties where national forests are located. These payments are made in lieu of taxes.

Weeks Law of 1911 – Authorized purchasing and adding to the National Forest System forested, cut- over, or denuded lands within the watersheds of navigable streams which are necessary to regulate the flow of navigable streams or to produce timber.

Smith-Lever Act of 1914 – Established a Federal- State cooperative extension program to provide education for the public in agricultural and natural resources.

Clarke-McNary Act of 1924 – Authorized technical and financial assistance to the states for forest fire control and for production and distribution of forest tree seedlings. (Sections 1 through 4 were repealed by the Cooperative Forestry Assistance Act of 1978).

McSweeney-McNary Act of 1928 – Authorized a comprehensive Forest Service research program. (This act was repealed and supplanted by the Forest and Rangeland Renewable Resources Research Act of 1978.)

Multiple-Use-Sustained Yield Act of 1960 – Established a policy of multiple uses, sustained yield management for the renewable resources of the National Forest System.

McIntyre-Stennis Act of 1962 – Established a cooperative forestry research program for state land grant colleges and universities.

Clean Air Act of 1963 – Gave the federal government enforcement powers regarding air pollution for the first time. This act and subsequent amendments impact the forest industry by affecting prescribed burning for forest management and emissions from forest products manufacturing plants.

Wilderness Act of 1964 – Established the National Wilderness Preservation System by setting aside sections of federal forest land as wilderness.

National Environmental Policy Act of 1969 – Required that environmental considerations be incorporated into all federal policies and activities, and that all federal agencies prepare environmental impact statements for any actions significantly affecting the environment.

Federal Water Pollution Control Act Amendments of 1972 – Established as a national objective restoring and maintaining the chemical, physical, and biological integrity of the nation's water, and required area wide planning to prevent future water pollution that could be associated with growth, development, and land use, including timber management.

Endangered Species Act of 1973 – Provided for the protection and conservation of threatened and endangered fish, wildlife, and plant species. Directs all federal agencies to utilize their authorities and programs to further the purpose of the Act.

National Forest Management Act of 1976 – Established additional standards and guidelines for managing the national forests, including directives for national forest land management planning and public participation.

Cooperative Forestry Assistance Act of 1978 – Authorized the Secretary of Agriculture to work in cooperation with state foresters in nine cooperative forestry assistance programs. Among these programs is the Forestry Incentives Program, a federal cost-share program designed to encourage the management of private forest lands.

Renewable Resources Extension Act of 1978 – Authorized expanding the forest and rangeland renewable resources portion of the extension education program.

Forest and Rangeland Resources Extension Act of 1978 – Authorized expanding forest and rangeland renewable resources research.

Reforestation Tax Incentives (part of the Recreational Boating Safety and Facilities Improvement Act of 1980) – Provided tax credits and deductions for landowners who reforest their property as an incentive to encourage reforestation.

Food Security Act of 1985 (1985 Farm Bill) – Established the Conservation Reserve Program. The program was designed to conserve 40 to 45 million acres of highly erodible cropland by paying landowners to plant permanent vegetative cover, such as grass or trees, and maintain that vegetative cover for 10 years.

Food, Agriculture, Conservation, and Trade Act of 1990 (1990 Farm Bill) – Established the Forest Stewardship Program, a program designed to encourage multiple resource forest management on nonindustrial private forest lands. A companion program, the Stewardship Incentives Program, was designed to provide cost-share assistance funding to encourage the implementation of management practices.

Coastal Zone Act Reauthorization Amendments of 1990 – Required that states with Coastal Zone Management Programs develop and implement Coastal Nonpoint Pollution Control Programs to control sources of nonpoint pollution (including managed forests), which impact coastal water quality.

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