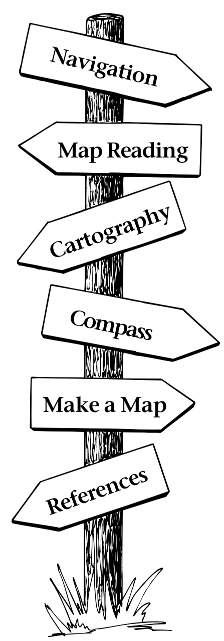
EM2474

OUTDOOR NAVIGATION

WITH MAP AND COMPASS

CONTENTS



Navigation
Map Reading
Cartography
Compass
Make a Map
References

OUTDOOR NAVIGATION
WITH MAP AND COMPASS

BACK-COUNTRY NAVIGATION

Many of us thrive on opportunities to travel and explore the "back country"—areas where there is little or no evidence of people. We in the United States have opportunities to visit such areas, with millions of acres of undeveloped back country in public parks, forest lands, and recreation areas. Seldom visited lakes, streams, ridges and mountain peaks are available for our enjoyment. Visiting these remote areas requires reasonably good health and physical condition, along with a few self-sustaining materials and skills. Knowing how to get there and back is a basic prerequisite to enjoying these quiet areas.

WHY LEARN MAP AND COMPASS?

Unless you choose to sit on earth like a mushroom or travel the "super trails," you'll want to know how to get to the more remote areas and how to return.

There are many reasons you might wish to improve your navigational skills. If you are an outdoor person, here are a few very special reasons:

1. Skillful use of map and compass opens new opportunities for outdoor exploration and travel. You have greater freedom to choose where to go, when, and with whom.
2. You will be more self-reliant and confident during your travels. That's important!
3. Knowledge of an area might be a timesaver—even a lifesaver.

Pathfinders in the early days used a highly developed skill of observation—establishing where they were going and remembering where they had been; reading the lay of the land, flow of the rivers, position of the sun, moon, and stars.

Today, back-country travel can be much simpler with a reliable map, a modern compass, and the skill to use both—together.

This manual can serve as:

1. An instructional manual for personal development of your outdoor navigation skills, using map and compass, and
2. A leader's guide for group instruction of outdoor navigation skills, with exercises and games that help make map and compass training a fun and sporting experience.

Here is a practical skill that is quick to learn, easy to teach, and fun. I suggest you learn or teach with a partner using the simplified step-by-step method. First learn about maps, next the compass, then combine the two as outlined in this manual.

CARTOGRAPHY AND MAP READING

When your family travels to a city for the first time, the driver probably uses a road map to help find the way. When you study a faraway land in school, your teacher has a map in the front of the room to help you to better understand where that country is.

Did you know that geologists and others have special kinds of maps to help them? One very helpful map that they use is called a *topographical map*. It shows how high and how low the land is.

You can see how difficult it would be to show high and low places (elevations) on a piece of flat paper. You have seen on your maps at school, colors which show different elevations. These maps are not completely accurate.

As you can see by the map legend in Figure 1, the different shades show each 500 feet of elevation. When a cross section of the land is drawn, the land is square and the mountains are flat. No slopes are shown as they really are. Geologists who study land shapes need a more accurate, clear picture to show exactly how the mountains slope and how deep the valleys are. So, the topographical map was developed. The

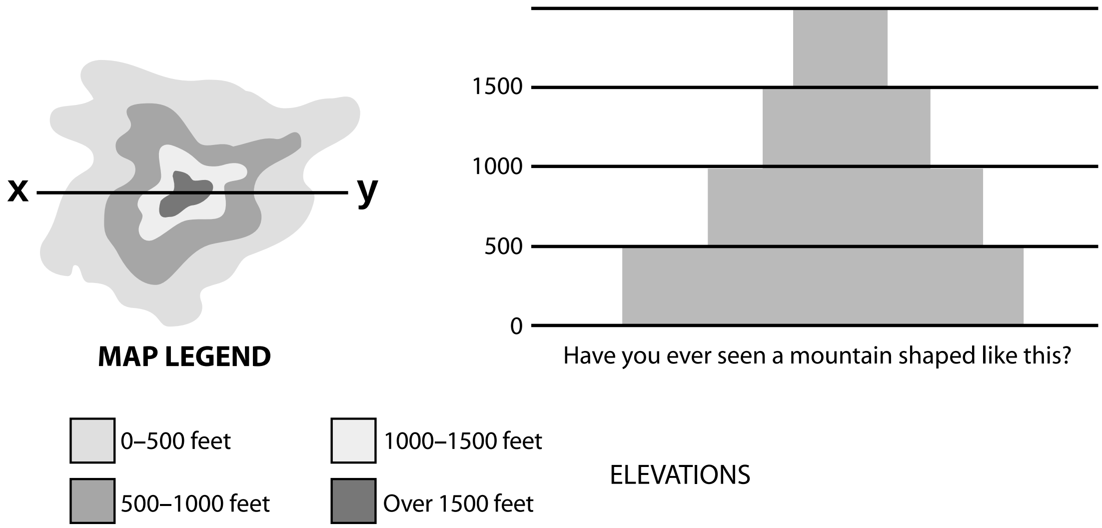


Figure 1. Sample relief map and cross section.

same land area shown in the above map is shown in a topographic map and a cross section (Figure 2).

It is easy to see that a much clearer picture of land can be made with a topographical map. As you can see, the closer together the lines, the steeper the slope. If the lines are farther apart, the slope is not as steep.

Perhaps you would like to show certain kinds of buildings or water, such as streams, rivers, bays, or lakes? You might want to show certain kinds of plant life or swamps and marshes. Certainly you would want to show roads and railways. Map-makers have developed symbols to represent these structures (Figure 3).

There are many more symbols used on topographical maps, but these are some of the more common ones. You could make a map of just about any area using these symbols.

Each type of map symbol has its own distinctive color: man-made features are shown on the map in *black* with the exception of heavy or medium-duty highways which may be overprinted in *red*. Water features are printed in *blue*. Vegetation is in *green*. Elevations are shown by thin *brown* lines called contour lines.

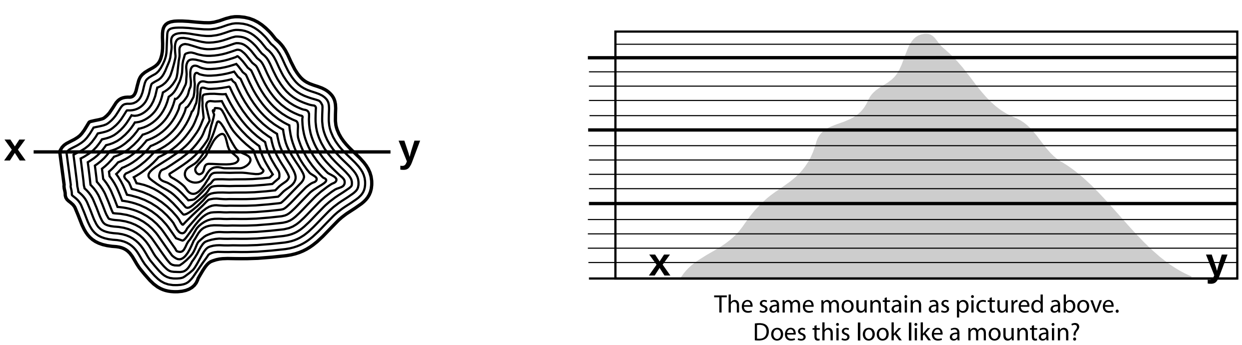


Figure 2. Sample topographic map and cross section.

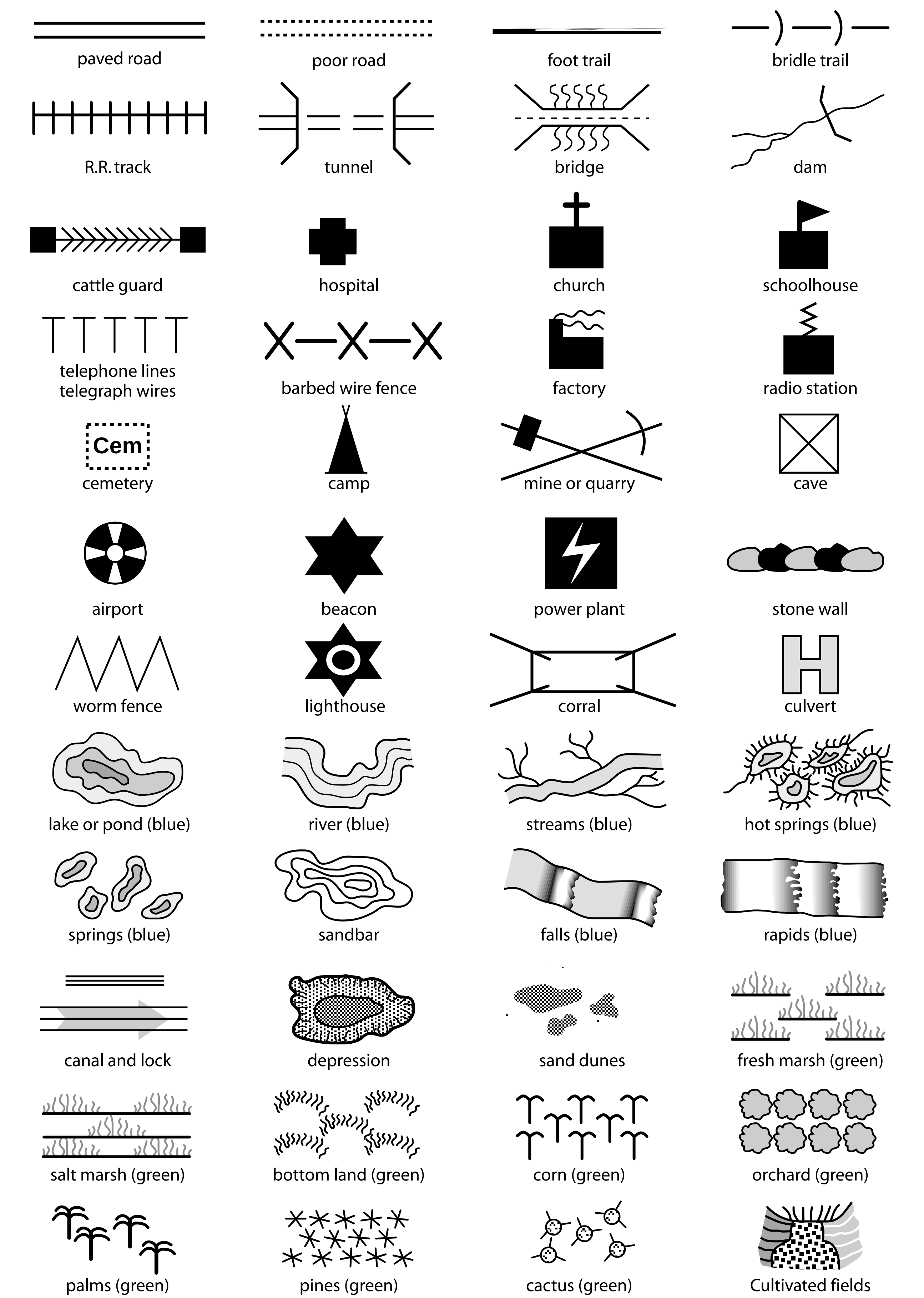


Figure 3. Map symbols.

The next illustration shows a picture of an area as you might see it from the air or from some high place. Below that you will see a map using symbols to represent the buildings and other land features (Figure 4).

Study the picture and the map of the picture. Can you see anything in the picture that you would add to the map? Can you locate the more important buildings and features on the map?

Sample Picture

Map of Picture

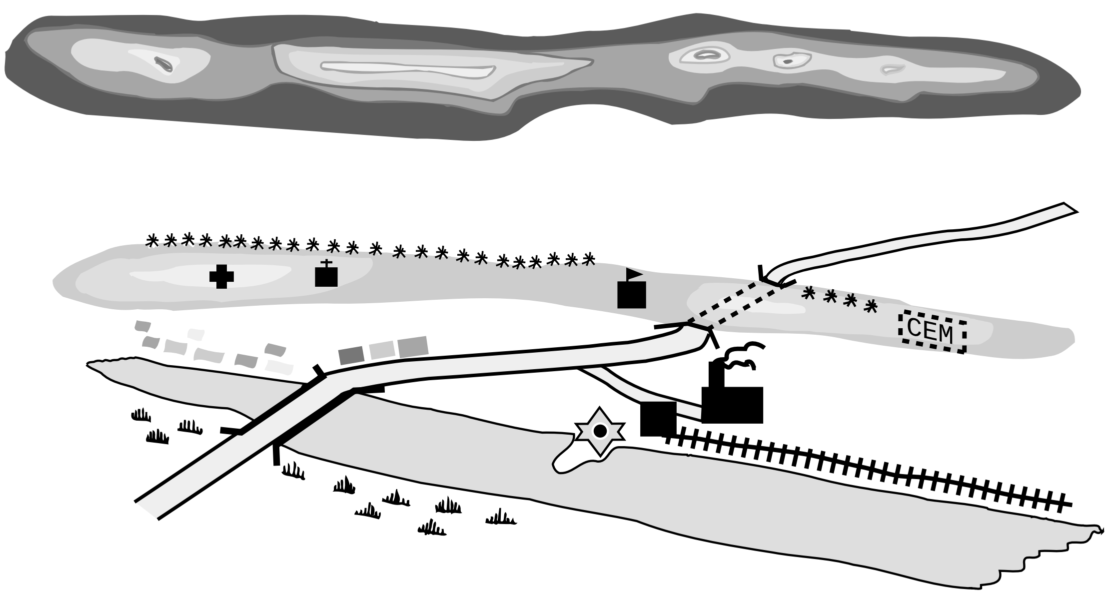


Figure 4. Sample picture and topographic map of same picture.

Activities

Topography Maps

1. Make a sketch with the following man-made structures and land forms included:

   a. mountains
   b. river
   c. paved road
   d. poor road
   e. fresh marsh
   f. bridge
   g. tunnel
   h. hospital
   i. school
   j. lighthouse
   k. factory
   l. church
   m. lake
   n. dam
   o. anything else

   Then on another sheet of paper draw a map of your sketch showing all these features.

2. Take a picture or draw a sketch of any local area you wish. Then draw a map showing those things in the picture and sketch.

3. Get a book from the library showing topographic maps, or any topographic map, and draw a sketch showing what a small area on the map would look like if it were in picture form.

4. Make a model of an actual or imaginary place (use plaster of Paris or papier-mâché) with buildings, vegetation, etc. Then make a map of your model.

5. Do a research project on the history of mapmaking, particularly on topographical maps, and enter your findings in your record book. Make illustrations.

6. Do a report in notebook form on any of the great men in cartography.

7. Do an online computer search using the key words "topography maps." Explore visuals, online activities, and information about this topic.

MAP AND COMPASS

Outdoor experiences can become safer and more interesting if you know how to use a map and compass. This information can help you become more familiar with the map and compass.

About Maps

A map is a scaled representation of the earth's surface. It is a useful tool in planning a trip or locating your position on the ground. Before leaving on a trip, outline your route of travel on a map. Study the map so you become familiar with the general area.

In addition to studying the map, talk to people familiar with the area, find out if the roads or trails are open or closed. Talk to land managers, gas station operators, old-timers, etc.

There are many different types of maps and you should choose the type to fit your trip.

Highway Map
Shows route to general area.

Planimetric Map
Shows general streams, ridge tops, trails, roads, etc. This map is often used by recreationists.

Topographic Map
Shows elevation differences using contour lines (lines connecting all points of same elevation together). Used by hikers and backpackers. Available from U.S. Geological Survey or book and mountaineering stores.

Land Surveys

To understand our maps in the western United States, you must know something of land surveys.

These surveys consist of a series of parallel lines forming a grid across part of the country, and started in the Northwest during the 1800s. This grid has been established on the ground and the lines and cross points (section and township corners) are marked on the ground.

Basic Elements for Land Surveys in Oregon and Washington

A starting point was needed in Oregon and Washington, so a point called the Willamette Stone was positioned near Portland, Oregon (Figure 5).

Figure 5. Map showing axis of land survey for Oregon and Washington.

An east-west line was established from this stone and was called the Willamette Base Line. The north-south line was called the Willamette Meridian. These two lines are the axis of the grid covering the states of Oregon and Washington. Thirty-six similar starting points and grids are found in other states.

General System for Numbering Townships

In order to further subdivide this area, lines were run at six-mile intervals parallel to the meridian and range lines. The lines running east and west were called township lines and were numbered consecutively north and south of the base line, e.g., Township 1 North (T.1 N.) was first row above base line and Township 1 South (T.1 S.) was first row below base line.

The lines running north and south were called range lines and were numbered consecutively east and west of the base lines, e.g., Range 1 East is first row east of the meridian line and Range 1 West is first row west of the meridian line. Each square (6 miles on each side) bordered by township and range lines is a separate township (Figure 6).

Numbering Sections in a Township

To further divide this gridded land area, each square or township (6 miles on each side) was divided into 36 sections, each 1 mile square. Each section contains 640 acres.

Sections are further subdivided as needed. One-fourth of a section is 160 acres (Figure 7).

Legal Land Description

Each piece of land has a legal description and can be referred to in order to locate your position or land ownership on the map.

The section and township survey lines on the map have been established on the ground by blazing or marking trees. Trees with slash marks on them face the section corners and act as reference points for location of the section corners. This work was done by surveyors many years ago.

Legend and Scale

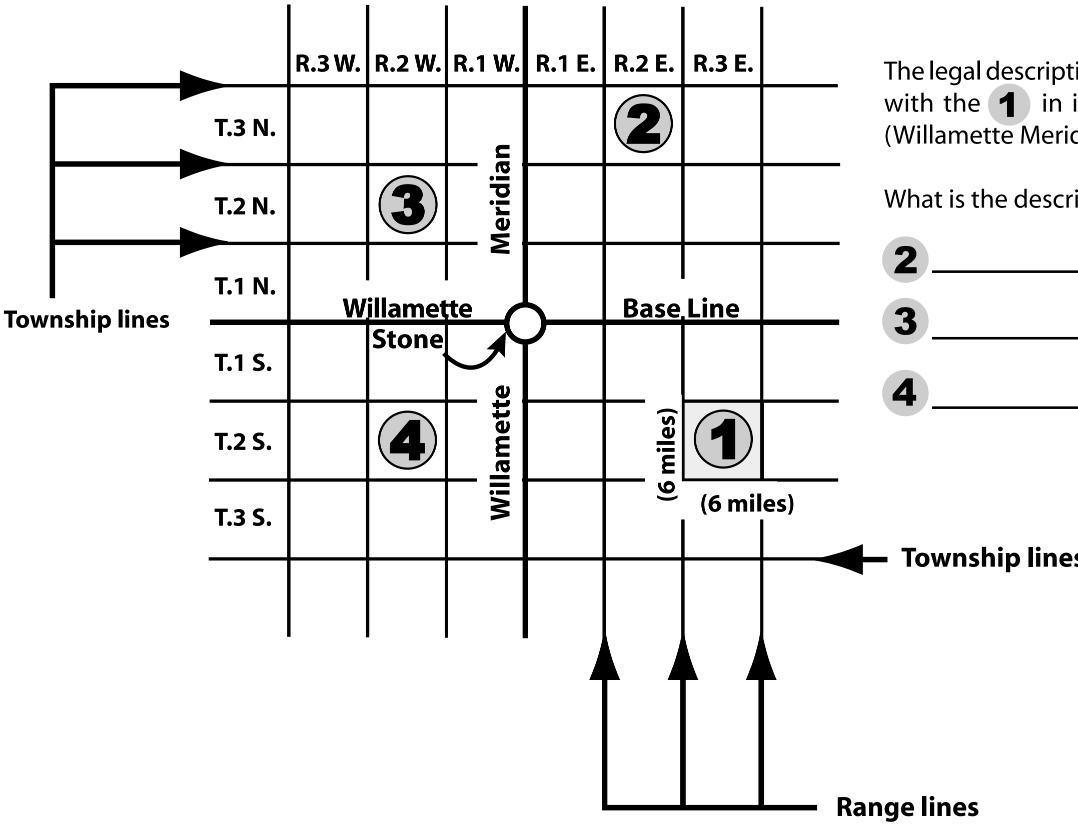
Each map has a scale that tells the distance relationship of that map to the ground. (Some maps have scales of 1" = 1 mile, 1/2" = 1 mile, etc.) The legend is very important to help you define the characteristics of the map. Legend shows roads, trails, streams, lookouts, mountaintops, some elevations, etc. (see map).

By using the legal description, the legend and the map scale, the map becomes a ready reference to identify points of interest on the ground.

USING THE COMPASS

A compass is a device for determining direction on the earth's surface by means of a magnetic needle freely swinging on a pivot and pointing to magnetic north.

Direction in the outdoors cannot always be determined by the orientation of a map or the position of the sun in the sky. Clouds, fog, darkness, trees, even mountains can obstruct your line of sight. This is when a compass becomes valuable.



The legal description of the township with the 1 in it is T.2 S. R.3 W.M. (Willamette Meridian).

What is the description of:

2 ____________________

3 ____________________

4 ____________________

Figure 6. Townships and their numbering system around Willamette Stone.

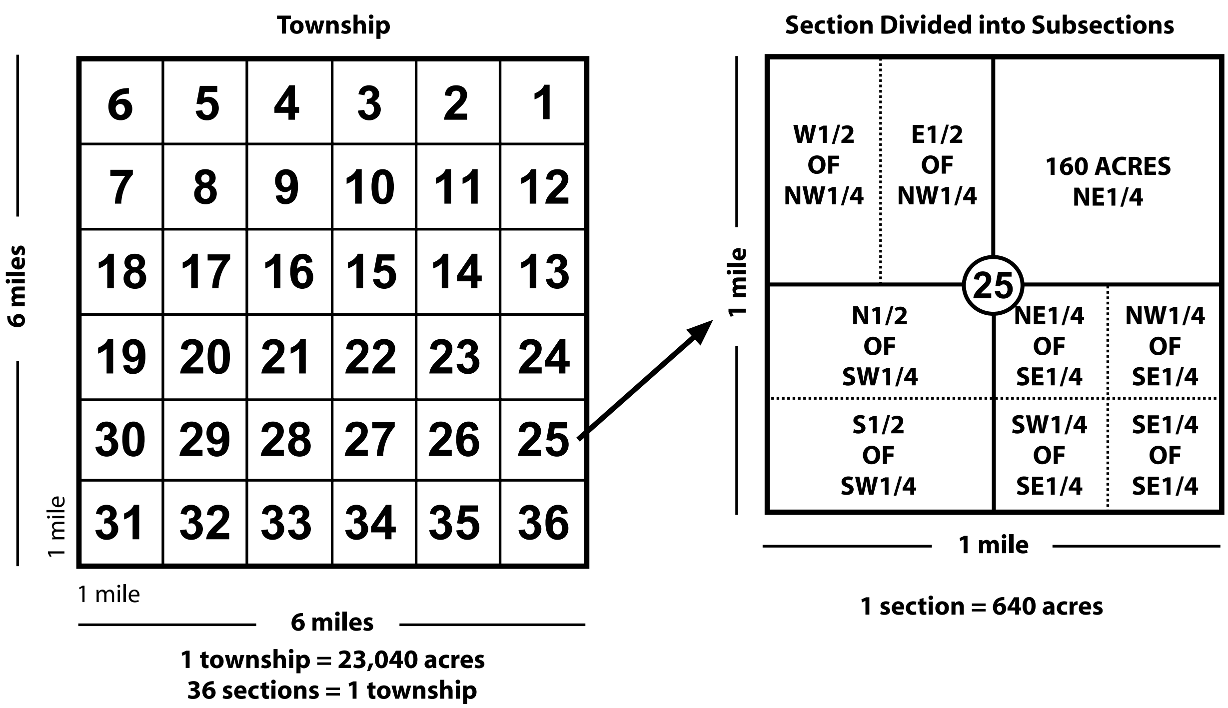


Figure 7. Diagram of township division into sections and subsections.

Using the compass can be easy if you practice with the following instructions.

Parts of the Silva Compass

There are different kinds of compasses, but we will discuss only the silva-type compass. The compass housing is divided into 360 equal parts numbered clockwise in consecutive order. Each equal part is called a degree or an azimuth. There are three main parts of a compass:

Compass needle
The red end points to magnetic north and the white end points south.

Compass housing
A movable dial with a 360° circle marked on the outer edge. The space between each line marked on the housing represents two degrees. There are four principal directions marked on a compass dial—North (0° and 360°), East (90°), South (180°), and West (270°). An orienting arrow also appears on the bottom of and inside the housing.

Baseplate
The base plate is used to indicate the line of travel as shown by the "direction of travel arrow" on the plate. The base can also be used to scale distances on a map.

Declination

When map and compass are used together, an adjustment in bearing readings must be made. Maps and land surveys are oriented to true north. Compass needles point to earth's north magnetic pole located approximately 1,000 miles south of the geographic North Pole, near Prince of Wales Island in northern Canada.

Angle of Declination
In different parts of the country the angle of declination varies. This is one reason why manufacturers do not build this correction right into the compass. Declination in Oregon and Washington is about 22° east of true north, near zero in Michigan, and approximately 20° west in Maine (Figure 8).

Compass Declination

Since Washington is west of the declination zero line, our compass needle will point east of true north as is shown in the illustration below. This is called easterly declination. We would always add our easterly declination to a magnetic compass bearing to get a true bearing.

Adjusting the Compass for Magnetic Declination

The following adjustment on your silva compass will simplify future corrections for declinations.

- Set the 360°, 0°, or N on the "direction of travel" line, C, as shown in Figure 9.
- Opposite the correct declination for this area (22°) scratch a line into the plastic base. We'll call this the "scratch line"; it is shown by the letter A in Figure 9. Ink the scratch line with

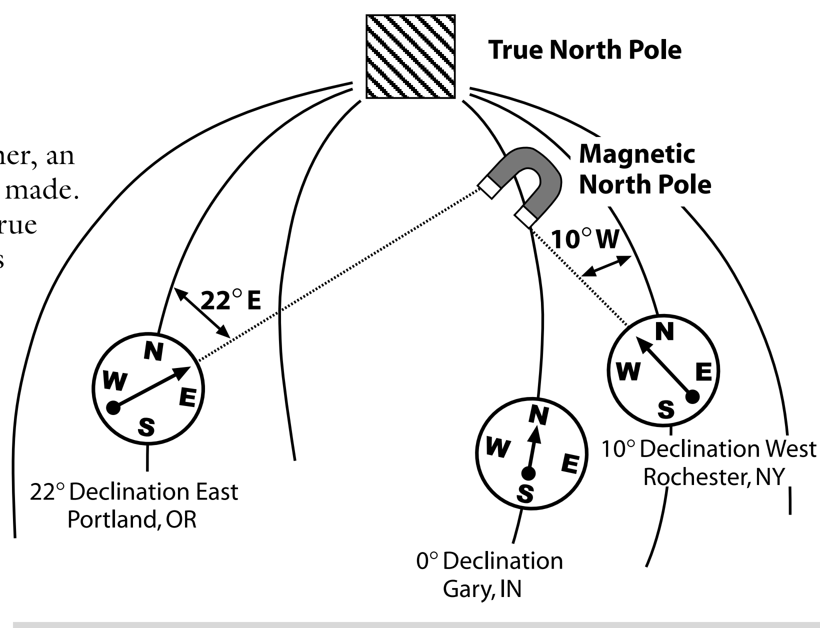


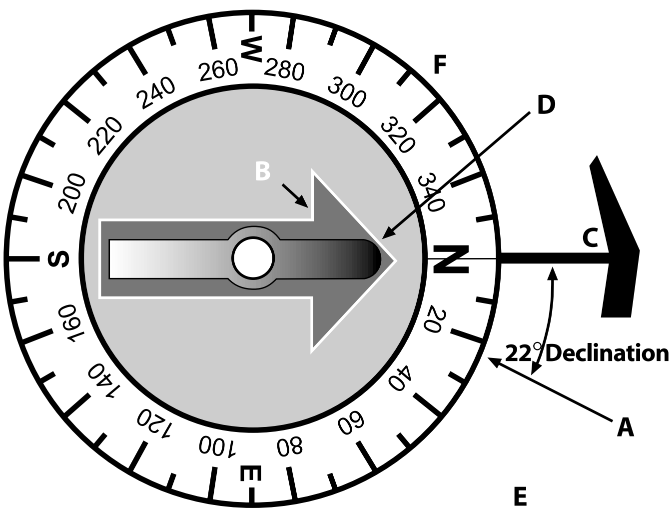
Figure 8. Diagram of earth's magnetic declination.

black or red India ink to make it smear-proof and to make it stand out.

- Once the proper declination has been set off on the compass, bearings can then be read from the scratch line for Washington and Oregon.

Orienting the Compass to Magnetic North

The first step in using your compass is to orient it. To orient a compass is to know your location in relation to north. When the "north" pointer of the free-swinging magnetic needle is directly over the orienting arrow and in line with the direction of travel line of the compass housing (make sure both north arrows are pointing the same way), the compass housing and needle are oriented pointing to magnetic north (as in Figure 9).



A = Etched scratch line (read true north compass bearings from here)
B = Orienting arrowhead
C = Direction of travel line (the way to go) (read magnetic bearings from here)
D = Magnetic needle
E = Baseplate
F = Graduated dial (0–360°) of compass housing

Figure 9. Diagram of parts of a silva compass oriented to magnetic north.

Orienting to True North

The compass can be further oriented to use in traveling a true north direction. Rotate the compass housing until the 360° or 0° (N on silva compass dial) is opposite the scratch line "A" made earlier on the compass base. This corrects for the declination or the difference between true and magnetic north. Hold the compass level, directly in front of you with the direction of travel arrow pointing straight out. Rotate your body until the north end of the magnetic needle is directly over the orienting arrow. The "direction of travel" arrow on the base is now pointing true north and if followed will lead you in that direction (Figure 10).

True vs Magnetic Bearings

Understanding and applying the differences between true (north) and magnetic (north) bearings might be confusing. Try to clarify it now before you continue. A bearing is simply a straight-line direction from one point on earth to another. A compass can describe that direction in

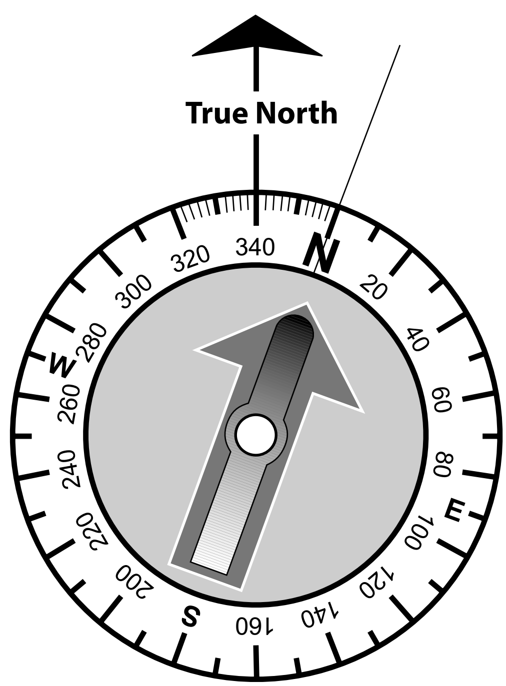


Figure 10. Diagram of silva compass oriented to true north where declination is 22° east.

angular degrees (0° to 360°), as it varies from one of two reference directions: (1) true north or (2) magnetic north. The direction of these north references varies, depending on where we are on earth. However, no matter where we stand, the north end of the compass magnetic needle normally points to earth's north magnetic pole. With practically all maps' north-south lines oriented toward earth's true North Pole, when we combine map with compass (to determine directions and locations) we must know how to convert the compass's magnetic north readings to true north readings. If we know the angle of difference between true north and magnetic north at the location on earth we are studying (declination), we can determine these true bearings.

A few definitions will help:

Bearing—a direction stated in compass degrees from a certain reference line on earth (usually a true or magnetic north reference line).

True Bearing—the angle in compass degrees (measured clockwise) between (1) the direction from the observer to earth's North Pole and (2) the observer's line of sight to the object of concern.

Magnetic Bearing—the angle in compass degrees (measured clockwise) between (1) the direction from the observer to earth's magnetic North Pole and (2) the observer's line of sight to the object of concern.

Declination—the angle of difference between true north and magnetic north—for a specific locality.

The illustration in Figure 11 will help clarify the difference between true and magnetic bearings.

For example, two people—one in Washington, one in Maine—have their compasses pointing to the same object ⓧ in Canada. The declination in Washington is 22° east; in Maine it is 22° west. The true bearings to object ⓧ are 32° and 328° respectively. Therefore, west of the 0° declination line (which runs through the Great Lakes area) you add the declination to the magnetic bearing to get the true bearing. You would subtract the declination from the magnetic bearing to get the true bearing when east of the 0° declination line.

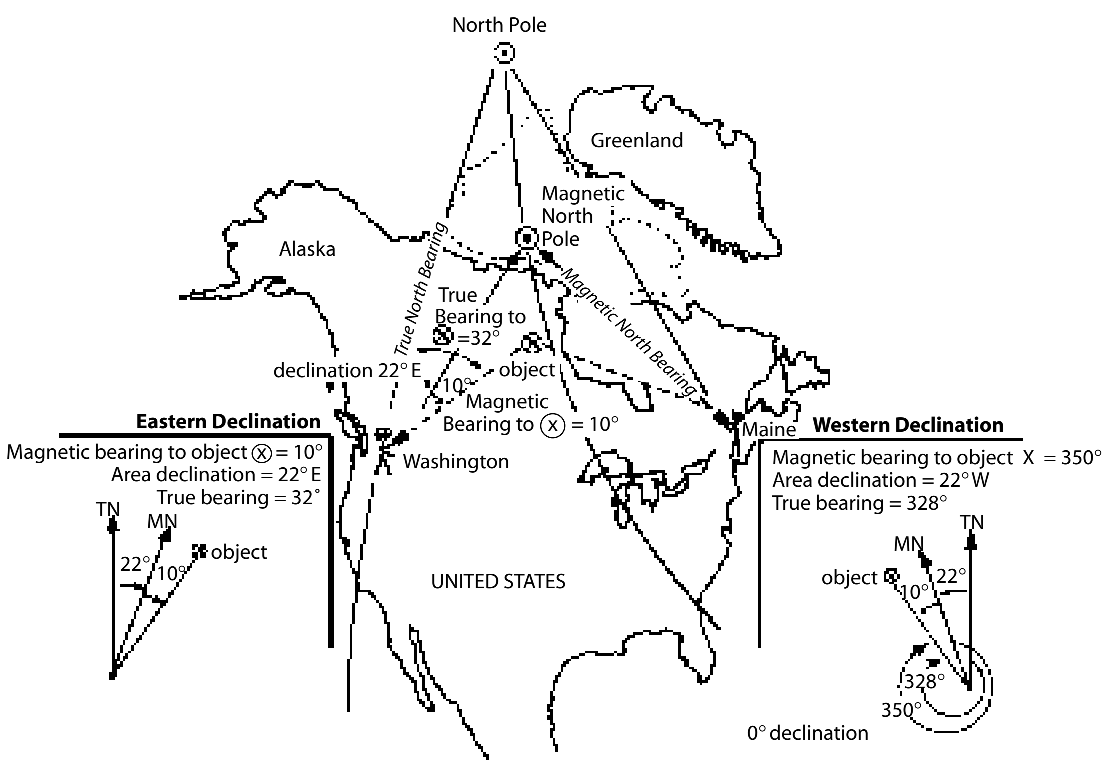


Figure 11. Illustration of differences between true and magnetic bearings.

Following Any Desired Compass True Bearing

Set your desired bearing (316° for example) over the scratch line (Figure 12).

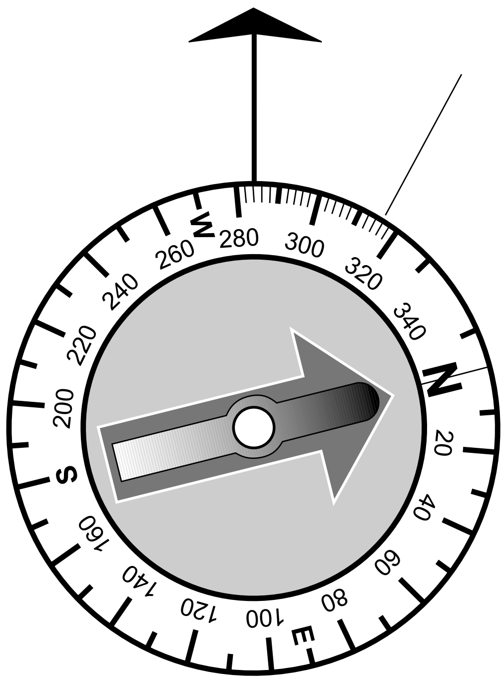


Figure 12. Diagram of silva compass set for a true bearing of 316°, where declination is 22° east.

- Hold the compass with two hands, in front of you and with your arms against your body. The direction of travel arrow (on the base plate) should be pointing away from you. Turn yourself, with the compass held rigid, until the *magnetic needle and the orienting arrow coincide with each other.* Look at the direction of travel arrow and raise your head looking in the same direction. This will be your direction of travel.

- Line up objects between you and the landmark so you can stay on course. You may have to check your compass bearing along the travel route to make sure you are on the right route.

Taking a True Bearing Reading on an Object in the Field

If you wish to determine the bearing of a landmark with your compass, point the direction of travel arrow at the object. Holding the compass rigid, turn the housing until the arrow in the bottom of the compass is directly under the free-floating needle. *Read the bearing at the etched scratch line.*

Cautions in Using a Compass

1. Be sure that the correct declination is set off on the compass. When running lines, always follow the line of sight or direction of travel arrow and not the direction of the needle. The compass is a delicate instrument; handle it carefully.
2. Always follow the line indicated by the compass rather than relying on your judgment as to the direction.
3. Remember the tree, rock, or other object sighted on your line of sight. When in doubt, take another compass reading.
4. Keep items containing steel or iron far enough away from the needle to avoid deflecting it.
5. Do not attempt to repair the compass except in emergencies.

Keeping on Line of Sight by Backsighting

While following a line of sight or a bearing, you might sometimes lose the landmark (tree or rock) you are moving toward and find it necessary to check your location to determine if you are still moving in the correct direction. To do this, you can sight back toward your starting point and then check your compass to see if you are still on the line. This requires sighting a back bearing which is in the exact opposite direction (180°) from the original bearing.

In turning to sight back along the course to your starting point landmark, the red-tipped needle will point in the opposite direction from the orienting arrow. You know you are on course if the white part of the needle (south pointer) lies directly over the orienting arrow when the direction of travel arrow points to the starting landmark. If not, move to one side or the other until alignment is made.

USING THE MAP AND COMPASS

Once you have learned to use the map and the compass separately, you should learn to use them together. Here are a few points you must know.

Orient Map and Compass to North

Set 0° or 360° on the *etched scratch line* on your silva compass. Set compass on the map with the direction of travel arrow pointing to the north end (usually top) of the map, and parallel to a northsouth grid line on the map.

Now carefully rotate the map (do not move the compass from its position on the map) until the magnetic needle is centered over the orienting arrow in the housing, both pointing to the etched scratch line (Figure 10). Your map and compass are now oriented to true north.

Determining the Direction from One Point on the Map to Another

If you wish to know the direction of travel from one location on the map to another, first orient your map and compass to true north. Then, keeping the map stationary, place a side edge of the compass on the map so it intercepts the two points of travel. Be sure the direction of travel arrow, which is parallel to the compass edge, points in the direction of the point to which you wish to go. Hold the compass in place and rotate the housing until the orienting arrow is directly under the needle.

The bearing is read from the compass housing at the etched scratch line. To travel this line of sight, follow the direction of travel arrow as previously described in "Following a Compass Bearing."

Another method for accomplishing the same task, but without orienting the map to north, is to place a side edge of the compass on the map so it intercepts the two points of travel, with the direction of travel arrow pointing in the direction of the place you want to go. Next, turn the compass housing so the lines next to and parallel with the orienting arrow are also parallel to the north-south range lines on the map. The orienting arrow must point to north on the map. Read the bearing at the direction of travel line "C" (Figure 13). The compass serves as a protractor using this method.

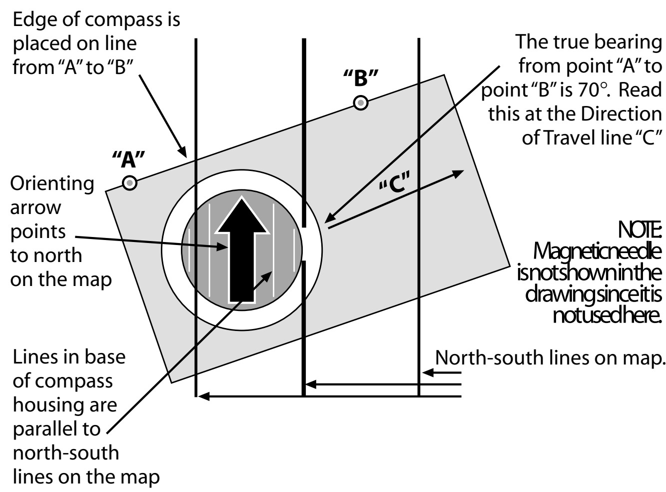


Figure 13. Compass used as protractor to determine a true bearing on map.

Placing a Compass Bearing on the Map

You might see a mountain in the distance and want to find it on your map. First, take a bearing reading of the mountain peak as described on page 13. Read this bearing at the scratch line. Then set that same bearing reading directly over the direction of travel line. (Do this by rotating the compass housing about 22° to the left if you live in Washington or Oregon.) Next, keeping one long edge of compass base plate on the point of the map where the reading was taken (where you were looking from), rotate the entire compass (not the housing) so that the orienting arrow points to north on the map (usually top), and the parallel lines (located on both sides of the orienting arrow on the bottom of the compass housing) line up (parallel) with the north-south lines on the map. Draw a line on the map along the compass edge, passing through the point from which the reading was taken. This line extended, should also pass through the mountain peak you were looking at.

How To Find Your Location from Two Known Landmarks

You are lost, but can see two landmarks which you can locate on your map. Take bearings with the compass on each of these landmarks from your location. Using the method just explained above, mark the two bearings on your map by drawing lines on the map from the known points (along the bearings you took) toward you. Where the two bearing lines intersect is your location on the map. (See Figure 14).

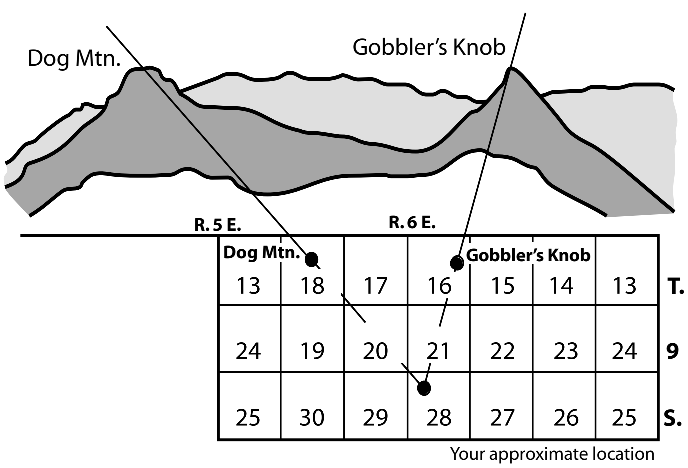


Figure 14. Illustration of determining your location on map from two known landmarks.

How To Determine Distances by Pacing

Every woodsman must know how to determine distances with some accuracy. Foresters step off distances while cruising timber, looking for section corners, determining if their equipment can be parked within a certain space, and many other occasions. Most of us use this method of estimating distances in our daily work and play.

The trick to accurate pacing is to use your natural walking stride, as you ordinarily would walk in both flat and hilly country.

First, you should determine the distance of your average step or pace. To do this, lay out a step course. Mark the starting point with a stake or other marker and accurately measure out a distance on level ground. I suggest a 100' to 300' straight-line course.

Stand at the starting point, feet together. Start walking naturally, straight toward the end point. Count the number of steps you take to walk the entire course. Most foresters use the double step pace method counting each two steps as one pace.

Each two steps is called a pace and is more accurate than counting each step because it averages the distance stepped with each foot. Some people step farther with one foot than the other, especially on rough or hilly ground, so it is better to use the pace method.

Count the number of paces you take to cover the measured distance. On a piece of paper, write down the number of paces required to walk the course. Pace it over again in the same manner—several times, and record the number of paces required—each time.

For example, here is how you could determine your average pace after walking a 300' course five times.

Number of Paces (2 steps/pace)

1st	walk	64
2nd	walk	65
3rd	walk	68
4th	walk	70
5th	walk	67

334 ÷ 5 = about 67 paces to walk 300'.

Add together the number of paces for all five trials. This is 334 paces. Now find the average by dividing by 5 (334 ÷ 5 = 66.8). This gives you about 67 which is your average number of paces in the measured distance you selected. If you now divide the measured distance (300 ft.) by 67 paces, you find that each pace represents 4.5 ft. (300 ÷ 67 = 4.48).

After determining your pace on level ground, lay out another course to include both flat and hilly ground. Go through the same process as outlined above. Follow the same procedure to get your average pace. Once you know the distance of your pace, you can estimate distances by pacing off the distance and multiply by the length of your average pace (ex. distance = 67 paces times 4.5' per pace = about 301.5 ft.).

You may also wish to learn your pace per chain (66') because distances in forestry are often counted in chains. There are:

20 chains to 1/4 mile
40 chains to 1/2 mile
60 chains to 3/4 mile
80 chains to 1 mile

In this case lay out a chain course. Find your pace per chain in the same manner you found it for 300 or 100 feet.

After you have established your average pace, test yourself on a measured 1/4 mile or mile as you walk to the school bus or to a neighbor's. In climbing steep grades your steps are naturally shortened. Make allowances accordingly. Foresters can explain these variations and tell you how to adjust for them.

In a hike along a trail or road, a club group can test pace a mile or more and check their paced distances against a known length of it.

Another way to estimate distance traveled is by time elapsed. This is influenced by various speeds and the terrain. To walk a mile might take 15 minutes on a road, 25 minutes along a trail, and an hour or more in the mountains.

Pace and Compass Exercises

On the following pages are some ideas that leaders can use and improve while developing pace and compass exercises (Figures 15–21).

Using the compass and pacing skills, you are now ready to try following a course from a set of bearings and distances. This can be done as a club activity under the guidance of a parent, leader, or local forester.

PACING CONTEST

Name ____

Address ____

My pace is ____________________ feet

		Error
Line 1. ________________	feet	________________
Line 2. ________________	feet	________________
Line 3. ________________	feet	________________
Line 4. ________________	feet	________________
	Totals	________________

Instructions:
Measure each line by pacing. Enter distance measured after each line. Deduct 2 points for each foot off in each line. Add all errors in feet under totals. Multiply by 2 and subtract from 100 for final score.

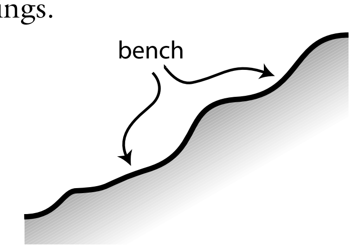
Figure 15. Pacing Contest Form.

Name ________________________________ Time: Start ________ hr. ________ min.
last first Finish ________ ________
Lapse ________ ________

START

1. From center of two marked trees, 146° to start of woods road
2. Left on road to crossroads
3. From intersection, 136° on road to Y
4. 22° follow road, cross washout, then stop
5. 120° on deer trail for approximately 100' to foot trail
6. 120° (approximate) on trail to Y
7. 220° then follow road to fence
8. 90° to creek bank
9. Upstream to second group of trees fallen across stream. (Site mark: dark clay cliff on west bank) Note: must make short detour into woods at one point as you go upstream.
10. Follow road (left) uphill to first bench
11. 180° on road to Y
12. 330° on road for approximately 150 feet to cedar stump on left
13. 280° cross country to top of hill
14. 230° for approximately 100 feet
15. 0° on road for approximately 350 feet to Y
16. Follow road's left fork, then right fork, cross washout, through intersection, and a few feet to road ending—narrowing down to trail
17. Follow trail to its end at slash cuttings
18. 270° to civilization

Instructions:
This course might take over 1 1/2 hours to complete. Do not cross fences or white boundary lines. You can return to the starting line and begin again. Use magnetic bearing readings.

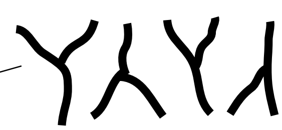


Definitions:

0° = might read N, or 360, or 0 on your compass
Intersection = a meeting of two or more trails, roads, or trails and roads
Bench = a flat piece of land above sloping land, such as a valley

Symbols:

° = Compass degrees (example 146° = 146 degrees)
’ = feet (example 100’ = 100 feet)
Y = a three-part intersection of various shapes



Take your compass sightings at center of intersection

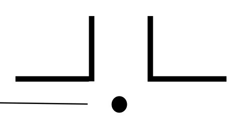
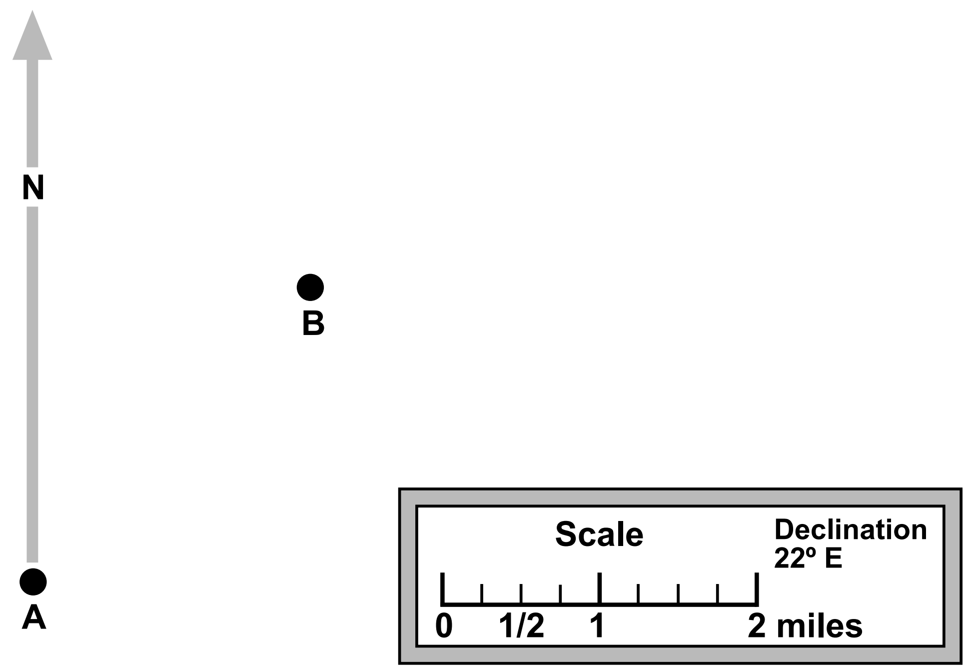


Figure 16. Sample Orienteering Course Form.

NAME ______________________________

AGE ________________



GIVEN: You are at A and want to hike to B.

QUESTIONS: 1. True north bearing from A to B = __________ degrees

2. Straight-line distance from A to B = __________ miles

Figure 17. Bearing and magnetic declination exercise.

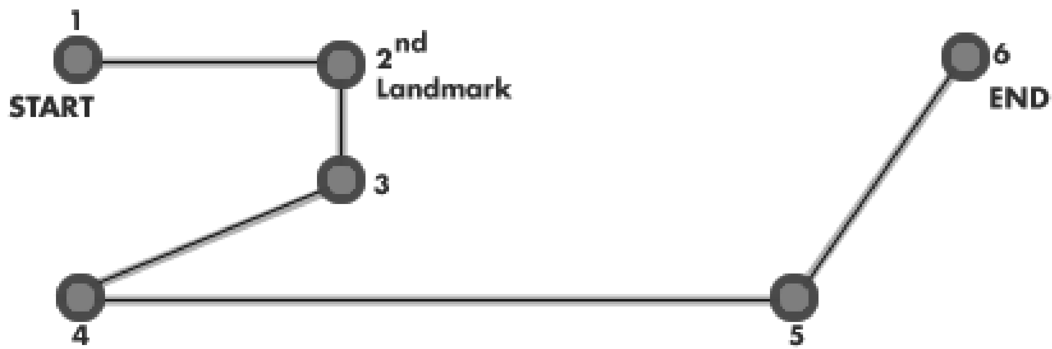
MAKE A MAP
A CLUB ACTIVITY

Here is a fun way to practice navigation with map and compass while learning and/or teaching with others. You can do this outdoors or inside, even in a large, single room. First you must know how to use the compass and determine distances by the pacing method.

Materials: forms ("Make a Map"), compass, pencil, and your overwhelming intelligence.

Directions: First, develop a course. Walk around and decide where the course should start, go, and end. Next, work out a series of straight-line pathways to the end.

Example:



Try to have at least 3, but no more than 8 landmarks. Landmarks could be a tree, fence post, bird-house, rock—outdoors; a door, room corner, the refrigerator—indoors. Landmarks are not necessary, but they sure help when you are a beginner. If you want to make the course more difficult, don't describe the landmarks on the map.

Pick a starting point (Landmark 1) that is easy to locate and describe. Where it says "STARTING POINT," identify it clearly so others using your map will know exactly where to start. Standing at Landmark 1 (starting point), read the compass bearing to Landmark 2 and record the bearing in degrees opposite Landmark 1 under "Bearing in Degrees." Use magnetic bearings with beginners, and true bearings with advanced participants. Estimate the distance between Landmarks 1 and 2 using the pace method and record. Recheck your bearing and distance determinations for accuracy. Repeat the process from Landmarks 2, 3, 4, etc. Finish at a spot that is easily described (example—front door of Kristy Jones' house). Write the description of the ending landmark where it says "Mapmaker Ended At."

When you have completed making your map, put down your name as "Mapmaker." Hide your answer by folding the paper where it says "Fold Up." Tape or clip the folded part in place.

Now give your map to others. See if they can follow your directions and get to the same finishing spot you did. If they do, congratulations to both the mapmaker and user. If you don't agree, see if you two can work it out. It's possible you both made some goofs. Make sure you try someone's map.

Starting Point (describe Landmark 1) ____

____

From ______________________ At __________________ For __________________ → To

Landmark		Bearing in Degrees		Distance in Feet	Description of Landmark
		Magnetic or	True		
No. 1	(START)	________	________	__________	No. 2 __________
2		________	________	__________	3 __________
3		________	________	__________	4 __________
4		________	________	__________	5 __________
5		________	________	__________	6 __________
6		________	________	__________	7 __________
7		________	________	__________	8 __________
8		________	________	__________	9 __________
9		________	________	__________	10 __________
10		________	________	__________	11 __________

Map User's Name ____ Age __________

Map User Ended At: ____

Tape—Here *Tape—Here* *Tape—Here*

Mapmaker's Name ____ Age __________

— — — — — — — — — — — — — — *Fold Up Here* — — — — — — — — — — — — — —

Mapmaker Ended At: ____

Figure 18. Make a Map Form.

NAME ____

STAKE No. ____________________ (use numbered stakes for problem number 4)

PACE COURSE

Given: X to Y is 100 ft.

Determine the length of your pace (100 ÷ number of paces = __________ feet/pace)

PROBLEMS

1. Distance from stake c to post x = __________ feet.
2. Magnetic bearing from stake c to post x = __________ degrees.
3. True bearing from stake c to post x = __________ degrees.

   Given: Magnetic declination for this area is 22° E.

4.

	Magnetic Bearing	True Bearing	Feet
From post x travel	272°		26
then	17°		40
then		28°	120
then	94°		70
then		360°	55

   Now set your stake and leave it.

5. "Bee-Line" Course

   From station number 1 travel in a straight line at a magnetic bearing of 165° through the woods to the road. Results = __________ feet off true course.

Figure 19. Pace and Compass Field Day Form.

		Maximum points ________
		Minus total error ________
Name ____________________	Age as of Jan.1 ____ Sex ____	Minus penalty points ________
Contestant No. ____________		Equals Total Score [ ]

Instructions: First, determine your length of pace. Next, get course starting time recorded. Complete course measurements. Get course finish time recorded. Compute and write down distances and degrees. Turn in form.

Time: Finish ________
Start ________
Elapsed ________
Penalty points ________

Determining Your Length of Pace

Given: distance between stakes X and Y = 100 feet.
So: 100 ÷ ____________ (number of paces) = ____________ (feet per pace)

Therefore ____________ (number of paces) (times) ____________ (feet per pace) = ____________ (distance in feet)

Pacing Stakes	No. of Paces	Distance in Feet	Official's Column Error
A_1 to B_1	______	______	______
A_2 to B_2	______	______	______
A_3 to B_3	______	______	______
		Pacing Error	______

Compass Stakes	Bearing Readings in Degrees	Official's Column Error
A_1 to B_1	______	______
A_2 to B_2	______	______
A_3 to B_3	______	______
	Compass Error	______

Sample Pace and Compass Layout

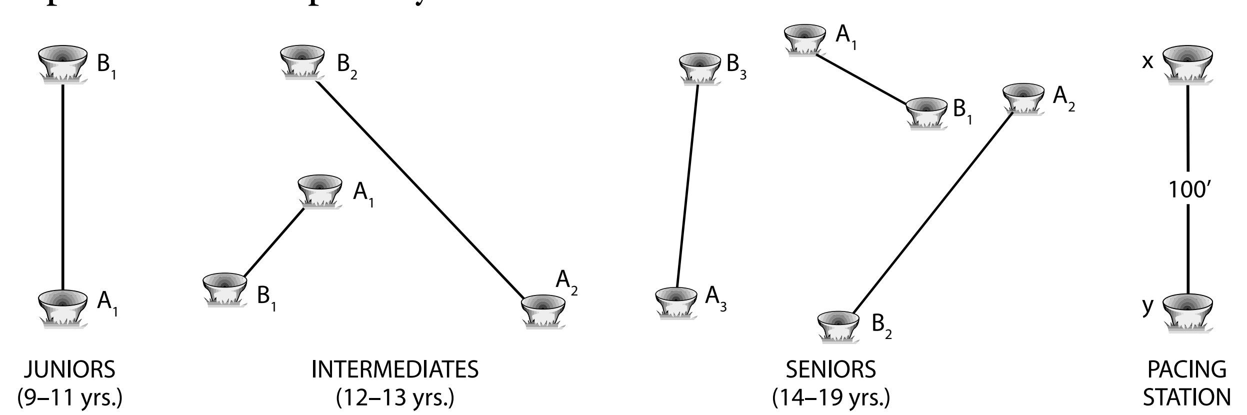


Figure 20. Pace and Compass Contest Form.

REFERENCES

Books

Basic Essentials Map and Compass, Cliff Jacobson, 1999.

Be Expert with Map and Compass: The Complete Orienteering Handbook, Bjorn Kjellstrom, Newt Heisley, 1994.

The Outward Bound Map and Compass Handbook, Glenn Randall, 1994.

Resources

TOPOGRAPHIC MAPS OF U.S.—order from U.S. Geological Survey, Distribution Section, Federal Center, Denver, CO 80225, or local bookstore.

http://www.silvacompass.com

http://www.topozone.com/

http://www.usgs.gov/

COOPERATIVE EXTENSION
WASHINGTON STATE UNIVERSITY

Prepared by John Munn, Snohomish County extension agent. Material on "Cartography and Map Reading" by Roger Easton, Olympia, Washington. Material on "Map and Compass" from Putting Conservation To Work—Recreation Aid No. 2, U.S. Forest Service, Portland, Oregon, 1965.

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