The Tacoma Mountaineers Wilderness Navigation

The Tacoma Mountaineers Wilderness Navigation Course provides an introduction to orientation[1] and navigation[2] skills needed for outdoor activities. During the course you will learn to relate features on a topographic map to your surroundings, use your compass to determine bearings to objects in the field, use a map to determine your desired direction of travel, and determine your location on a map based on your surroundings.

The following will be covered through course lecture, field trip practice and recommended reading. Use these objectives to prepare for the final exam.

Use of topographic maps
- What the colors mean
- Contour lines
- Measuring Distance
- Recognizing topographic features (ridges, valleys, peaks, bowls, saddles, steep areas, flat areas, etc)
- Care of a map during a trip (keep it dry)

Use of a Compass
- Description of the parts
- The difference between True North and Magnetic North
- How to set the declination
- Taking bearings in the field
- How to plot a bearing on the map

Orientation with the Map and Compass
- Determining your position on a line
- Determining your point position with position on a line and trail intersection
- Determining your point position with position on a line and altitude
- Determining your point position by use of a line intersection
- Determining the desired bearing from the map

The course consists of four sections: 1) a reading and homework assignment, 2) a three hour workshop consisting of a lecture and in-class assignments, 3) a one-day field trip, and 4) a final exam. **The course will be graded. Students that do not achieve a passing grade of 80 % will not receive credit for the course.** Scoring of the course will consist of:

Pre-workshop homework assignment 10 %
Workshop participation and assignment 20 %
Navigation Field Trip 50 %
Navigation Final Exam 20 %

Pre-Workshop Homework Assignment

- Read this manual.
- Read one of the following:
  - *Freedom of the Hills,* 7th edition, Chapter 5.
  - *Wilderness Navigation, 2nd Edition,* by Burns & Burns, Chapters 1-5, and 10.
- After doing the reading, complete the navigation homework problems.

[1] Orientation is the science of determining your exact position on the earth.

[2] Navigation is the science of determining the location of your objective and of keeping yourself pointed in the right direction from your starting point to your destination.

Navigation Workshop

- Bring the completed homework assignment to class.
- Bring USGS Chikamin Peak map or purchase one the night of the workshop (bring check for $3).
- Bring paper and pencil for working problems.
- Bring your compass (see below for course compass requirements).
- Sign up for the field trip during the workshop.

Navigation Field Trip

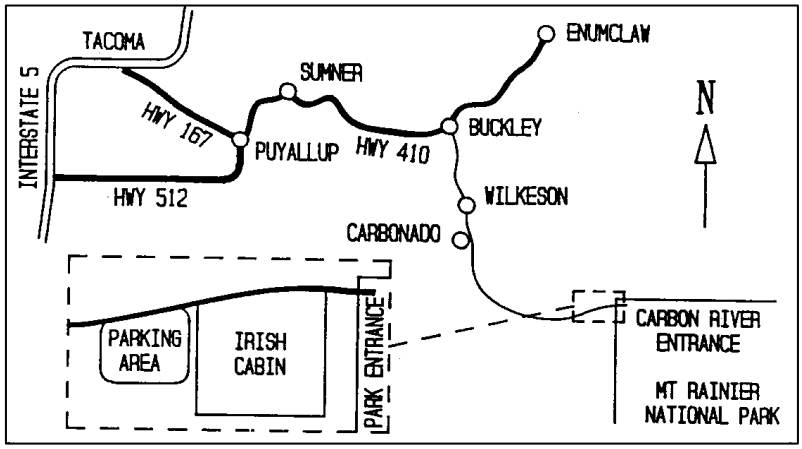
The navigation field trip is an all day trip in a wilderness setting. You should prepare, dress, and bring the necessary equipment as if going on a day hike. You will be expected to take bearings to objects, relate features to a topographic map, determine your position on a map, and navigate through a wilderness course with little or no assistance.

Place: Irish Cabin (see map – allow at least 1.5 hours travel time from Tacoma I-5/SR 512 intersection)
Time: Arrive at 7:00 and be ready to go by 7:30 AM
Duration: Approximately 7:30 AM to 4:00 PM
Prerequisites: Completed homework assignment and Navigation Workshop

- Re-read one of the following:
  - *Freedom of the Hills,* 7th edition, Chapter 5.
  - *Wilderness Navigation,* 2nd Edition, by Burns & Burns, Chapters 1-5, and 10.
- Use your compass to practice taking bearings in town and practice reading your map.
- You will be given a topographic map of the area at the field trip.
- Required equipment:
  - 10 essential system (map not required)
  - Rain gear – suitable for brush beating
  - Wool or synthetic pile clothes (either on you or in your pack) – No Cotton
  - Day Pack
  - Hiking boots (expect muddy conditions and standing water)
  - Lunch and drink
  - A walkie-talkie, if you have one (set to channel 9.4).

Directions To Irish Cabin

In Buckley, leave 410 just past the 410 Café and follow signs to Wilkeson (SR 165). Heading South from Carbonado toward the Park, you will come to a fork in the road after crossing a one-lane bridge. (Be careful. It can be slippery.) Take the left (SE) fork, which leads to the Carbon River Entrance. Do not take the right fork, which goes to Mowich Lake. "Irish Cabin" is about 0.3 – 0.4 mi. from the entrance to Mount Rainier Park. Look for the crowd. There is a gate.



Final Exam

A final examination will be handed out at the end of the field trip. The examination will be due two weeks after the field trip.

2006-2007 Course Committee

Position	Name	Home Phone	Email
Navigation Chair	Eric Kelly	253-312-5981	irishgnat@yahoo.com
Field Trips	Gary Zink	253-631-4004	garyzink@comcast.net
Records	Laura House	206-824-4235	duanehouse@aol.com
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Compass Requirements

Adapted from http://www.mountaineers.org/navigation/

All compasses have a magnetized needle that points north, and have a way to indicate direction of travel. Mountaineering requires a compass with additional qualities. Compasses which hang from parka zippers or hook on watchbands are not suitable for this course or as part of your ten essentials. Good compasses are easily found, but most compasses on the market are not suitable for use in this course.

Every year, some students buy unsuitable compasses, usually the result of not following the guidelines below. Often, a sales person (who may or may not know the requirements of a good compass) was asked for advice. To complicate things further, our local outdoor stores sometimes run out of stock of the recommended compasses. Sales people will usually try to recommend alternatives (mostly unsuitable). They aren't malicious, but in fact are trying to be helpful. In reality, a good mountaineering compass has no substitute. Retailers will carry a variety of compasses, some suitable, some not.

Required Compass Features

1. **Adjustable declination**: A moveable orienting arrow, which provides a built-in declination adjustment. If there is one feature which simplifies map and compass work, this is it. Compasses with adjustable declination can often be identified by the presence of an adjustment screw on the back of the housing (on the underside of the compass, look at the bezel - the screw is usually brass or copper colored).

   All students **MUST** have a compass with **adjustable declination**. Be aware that REI's compass summary sheet has been incorrect (and may still be), about adjustable declination, particularly on some Brunton compasses. Be very sure to understand these requirements, not merely to read the REI summary sheet.

   If you already have a compass without adjustable declination, **you may not use it** in this course. Recent experience indicates that such compasses detract from the learning experience.

2. A **transparent rectangular base plate** with a direction of travel arrow and a sighting mirror.

   Transparency allows map features to be seen underneath the compass.

The rectangular shape provides straight edges and square angles for plotting and determining intersections on the map.

3. A bezel (the rotating housing) at least 2" in diameter and marked **clockwise** from 0 to 360 degrees in increments of **two degrees** or less. (Some compasses are numbered backwards, in a counterclockwise direction. Others are numbered in quadrants of 90 °. These are not suitable for use in this course.) In general, bezels should be large to allow use while wearing gloves - the larger size also improves accuracy. While selecting your compass, make sure you try adjusting the bezel to several settings. The bezels center should be firmly located so that it does not slide around the center post while being rotated. Some compasses allow some slop between the bezel and the base plate, detracting from the accuracy of measurements.

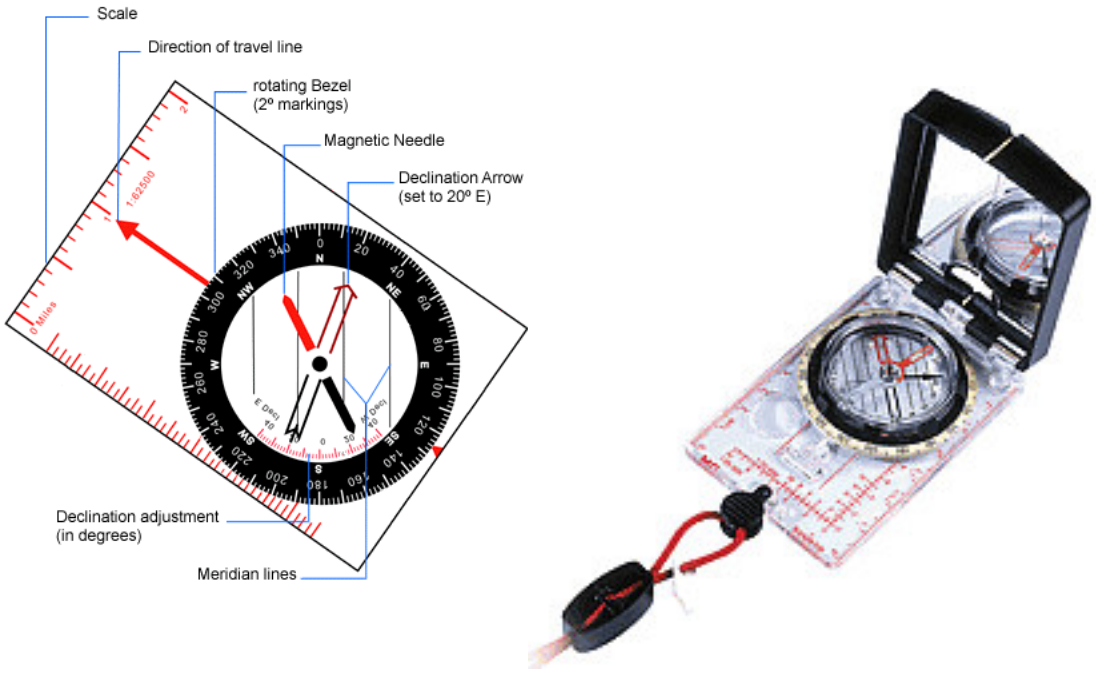
4. **Meridian lines**: Marks on the bottom of the interior of the circular compass housing, marked with parallel 'meridian lines', which rotate with the bezel when it is turned. The meridian lines run parallel to the north-south axis of the bezel, however turned. Meridian lines are necessary for plotting and determining intersections on the map.

5. A full-length declination arrow or parallel lines (see illustration below), extending over both the north and south ends of the bezel face. Some compasses have a pair of short parallel lines towards the north end of the bezel, which are intended to serve the general purpose, but don't provide an adequate reference for needle alignment in precision situations.

6. A 3 to 4-inch base plate. A longer straight edge makes map work easier.

7. A sighting mirror in the cover: This reduces errors introduced when moving the compass from eye-level after sighting to waist-level for reading the dial.

The figures below delineate the compass features required for the course – note that the mirror has not been included in the figure on the left for clarity.



Required Compass Features and Typical Mountaineering Compass

Additional Recommended Features

A liquid-filled housing is highly recommended to reduce erratic needle movement. In some cases, steadying the compass needle can be difficult.

An inclinometer: a gravity driven arrow that allows you to measure slope angle.

A luminous dial.

Note: "Quadrant-type" compasses marked from 0 to 90 degrees in each quadrant are not acceptable because they are difficult to use.

Recommended compasses

Compasses must have the first 7 features listed, **including** a declination adjustment mechanism and a sighting mirror. Don't buy a new compass without these features. The declination adjustment can usually be identified by the presence of a small adjustment screw on the back of the bezel (on the underside of the compass).

The following list includes compasses that are equipped with appropriate features. This list is not all inclusive, but is representative of good quality, fully equipped compasses suitable for this course and for other mountaineering activities. Prices for a good compass start at about $50.

Compasses which may be SUITABLE for the course include:

- Silva Ranger CL515
- Suunto MC-2D
- Suunto MC-2G(Global or Navigator) NOTE: Some of these are not adequate.

Unacceptable compasses

Compasses are unsuitable for mountaineering if they are too small for accurate bearings, do not have meridian lines, do not allow declination to be adjusted, are numbered in 5 degree increments, have non-transparent housings, do not have degree markings from 0 to 360, or cannot be used for measuring and plotting bearings on a map.

Features that make a compass undesirable or unsuitable:

- Lack of a straight edge for plotting lines on a map
- Lack of declination adjustment
- Lack of meridian lines inside the bezel
- Small size -- less than 3.5" x 2.2"
- Small bezel - less than 2" in diameter

UNSUITABLE compasses for this course:

- SILVA model Guide Type 26
- NEXUS model Star 7N2
- BRUNTON model 8020 GPS
- BRUNTON model 9020 G

Unusual compasses

There are two unusual compasses offered by Brunton (the Eclipse models) which are acceptable, but are not well suited for most mountaineering activities. They are very accurate, and of high quality. We will accept (but not encourage) the use of these compasses in the course.

Resources

www.rei.com
www.deakin.com in Vancouver, BC (1-800-663-3735)

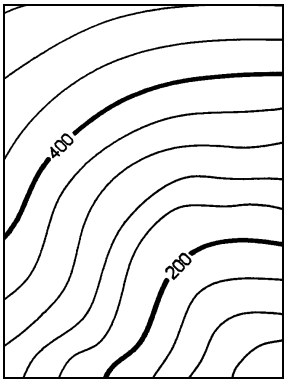
Navigation Fundamentals

Navigation in mountainous terrain and wilderness areas requires a set of skills, of which using a map and compass is only one part. These skills will not only assist in reaching a destination, but may also be necessary for taking an alternate route. Navigation is an art because of the abilities and techniques required, and a science because it is based on the systematic application of physical laws. All navigation, from the most elementary to the most complex, involves two things: (1) Determining your present location; and (2) Getting from one known point to another.

Maps

The first thing that should be known about a map is that it's nothing more than a drawing or representation of a piece of the earth's surface. It's a drawing of the earth as would be seen from an airplane, looking straight down. Being able to visualize terrain features from contour lines is one of the most useful map reading skills that can be developed. The map not only shows terrain, but also streams, rivers, lakes, roads, trails, and sometimes man-made objects.

Maps are drawn to **SCALE,** which is usually printed at the bottom of the map. This means that a certain distance on the map equals a certain distance in the field. A map is said to have a **LARGE** scale when there is a lot of detail within a given area. A **BAR SCALE** is usually printed at the bottom in three different units: miles, feet, and kilometers. To find the distance in the field, measure the distance between the two points on the map. Take this measurement and place it just under one of the bar scales, and then read the field distance.



What is a Topographic Map?

(→) The distinctive characteristic of a topographic map is that the shape of the Earth's surface, or terrain, is shown by contour lines, represented by thin brown (sometimes red) lines. Contours are imaginary lines that join points of equal elevation on the surface of the land above or below a reference surface such as mean sea level.

Contour intervals are not the same on all maps. Typically, they are 40 ft, 80 ft, 100 ft, and, sometimes, as much as 250 ft, depending on the scale of the map and the steepness of the terrain. Usually every fifth contour line is wider, and its elevation is printed periodically along its length.

A topographic map shows more than contours. The map includes symbols (see under "symbols" below) that represent such features as streets, buildings, streams, and woods. These symbols are constantly refined to better relate to the features they represent, improve the appearance or readability of the map, or to reduce production cost.

Consequently, within the same series, maps may have slightly different symbols for the same feature. Examples of symbols that have changed include built-up areas, roads, intermittent drainage, and some type styles.

Reading Topographic Maps

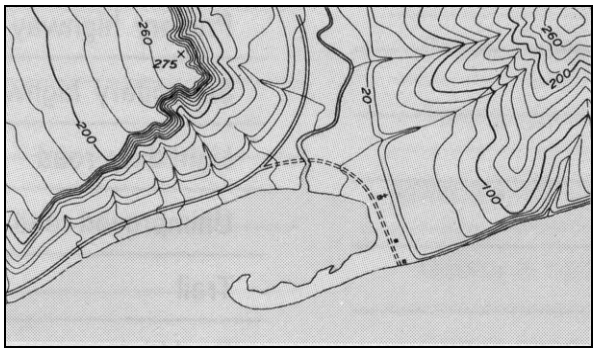
Interpreting the colored lines, areas, and other symbols is the first step in using topographic maps. Features are shown as points, lines, or areas, depending on their size and extent. For example, individual houses may be shown as small black squares. For larger buildings, the actual shapes are mapped. In densely built-up areas, most individual buildings are omitted and an area tint is shown. On some maps post offices, churches, city halls and other landmark buildings are shown within the tinted area.

The first features usually noticed on a topographic map are the area features such as vegetation (green), water (blue), information added during update (purple), and densely built-up areas (gray or red).

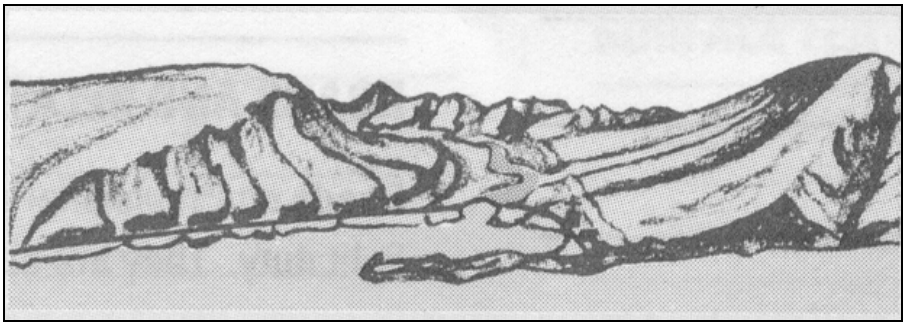
Many features are shown by lines that may be straight, curved, solid, dashed, dotted, or in any combination. The colors of the lines usually indicate similar kinds or classes of information: topographic contours (brown); lakes, streams, irrigation ditches, etc. (blue); land grids and important roads (red); other roads and trails, railroads, boundaries, etc. (black); and some features that have been updated using aerial photography, but not field verified (purple).

Various point symbols are used to depict features such as buildings, campgrounds, springs, water tanks, mines, survey control points, and wells.

Names of places and features also are shown in a color corresponding to the type of feature. Many features are identified by labels, such as "Substation" or "Golf Course."



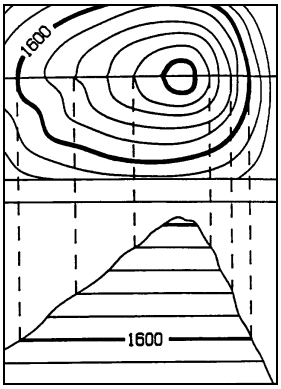
Topographic contours are shown in brown by lines of different widths. Each contour is a line of equal elevation; therefore, contours never cross. They show the general shape of the terrain. To help the user determine elevations, index contours are wider. Elevation values are printed in several places along these lines. The narrower intermediate and supplementary contours found between the index contours help to show more details of the land surface shape. Contours that are very close together represent steep slopes. Widely spaced contours, or an absence of contours, means that the ground slope is relatively level. The elevation difference, or height, between adjacent contour lines, called the **CONTOUR INTERVAL**, is selected to best show the general shape of the terrain. A map of a relatively flat area may have a contour interval of 10 feet or less. Maps in mountainous areas may have contour intervals of 100 feet or more. The contour interval is printed in the bottom margin of each U.S. Geological Survey (USGS) map.



Recognizing Topographic Features: The land features shown on the left are represented by the contour lines in the figure above.

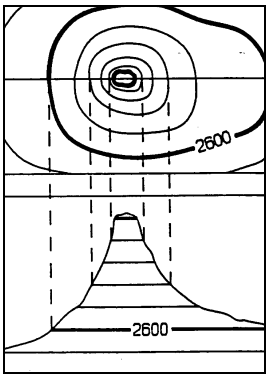
Terrain Interpretation

Interpretation of topographic maps is quite simple.



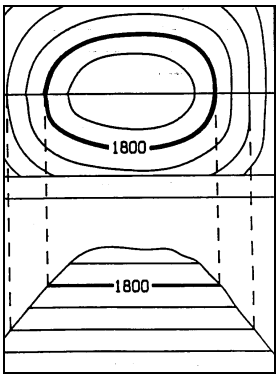
(←) Contour lines widely spaced show a gentle slope. When they are close together, the slope is steep.

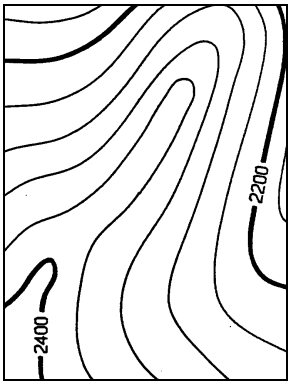
(→) Contour lines across a stream always come together in a **V**. The point of the **V** points upstream.



(→) The hilltop is flat when the contour lines are widely spaced at the top.

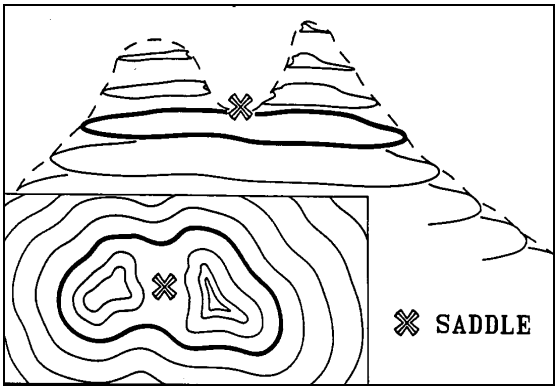
(←) When the contour lines are close together at the top of a hill, the hilltop is pointed.





(←) Another terrain feature is the **Ridge.** A ridge is a fairly long and narrow piece of terrain. Standing on a ridge, the ground will go uphill in one direction and downhill in the other three directions. The **U**'s point downhill.

(→) Sometimes contour lines show two hilltops fairly close together. The lower terrain between the two hilltops is called a **Saddle**.



Roads, railroad tracks, power lines, and other man-made objects are usually shown in black, glacier and permanent snowfields in white, vegetation in green, and blue is used for water features. The date of the survey, revision date of the map, and the reference names of adjacent maps for other areas are usually given as well. Study the contour lines, symbols, colors, and other features before going to the field.

The magnetic needle in the compass is attracted by the earth's magnetism, and that's why it points north. However, on a map there are two north references to be considered. One is **Magnetic North**, which is where the magnetic lines of force come together. The other is **True North**, which is located geographically by longitude (north-south) lines that pass through each of the earth's poles. The compass needle points to magnetic north, which is located in the Hudson Bay region of northeast Canada, but moves slightly each year. Maps and directions are usually based on true north, which does not move.

Topographic Map Symbols

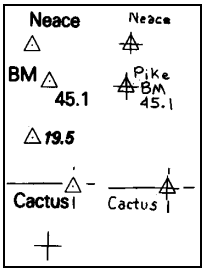
U.S. Department of the Interior, U.S. Geological Survey publication (excerpt)

USGS Symbols (examples)

Control Data Monuments

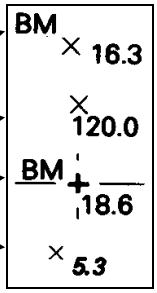
Horizontal Control

Permanent Mark
Elevation Mark
Checked Spot Elevation
At Corner section
Unmarked



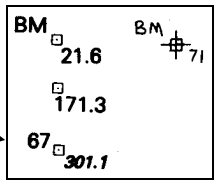
Vertical Control

With Tablet
Recoverable Mark
Benchmark at corner section
Spot Elevation



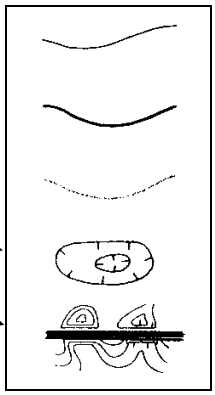
Boundary Monument

With Tablet
Without Tablet
With Number and Elevation



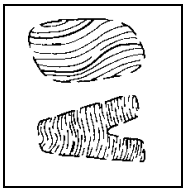
Contours

Intermediate
Index
Supplementary
Depression
Cut; fill



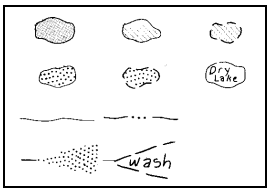
Glaciers

Contours
Form Lines



Lakes, Wash

Intermittent Lake/Pond
Dry Lake
Narrow Wash
Wide Wash



Topographic Map Information: For more information about topographic maps produced by the USGS, Call 1-800-USA-MAPS.

Using A Map And A Compass

Declination

USGS maps, and most other maps you will use for wilderness navigation, are oriented such that true north is towards the top of the map. **True north** is defined by the axis the earth rotates about on a daily basis. The needle in your compass will align itself with the local magnetic field (**magnetic north**) which generally is not aligned with true north, thus we need a measurement of the difference between true north and local magnetic north to relate compass measurements to our maps. **Declination** is the angle between true north and magnetic north. The amount of declination in a given area depends on the location of that point on the earth. Where true and magnetic north are the same direction, then the declination is zero. In North America, zero declination runs roughly from west of Hudson Bay down along eastern Lake Michigan to the Atlantic coast of Georgia. At any point on the west side of this line, the compass needle will point east of true north. This is called **Easterly** declination. Conversely, at any point east of zero declination, the compass needle will point west of true north. This is called **Westerly** declination. In North America, the declination varies from 30 degrees east in Alaska to 30 degrees west in Labrador. In the Washington Cascades the declination is approximately 18 degrees East. Be sure to check your map for the correct declination and make sure the measurement referred to on the map is current – declination changes with time (approximately one degree per decade in this area). By setting the declination on your compass you automatically correct for the difference between magnetic north and true north allowing you to relate compass bearings directly to your map.

Bearings

The direction from one point to another, on a map or in the field, is called a **Bearing.** Sometimes bearings are referred to as **course** or **azimuth**; they are the same thing. When a bearing is determined from a map it is measured relative to True North and is known as a **true bearing**. If you measure a bearing with a compass that does not have a declination setting, or the declination is set to zero, you are measuring a bearing relative to magnetic north, which is known as a **magnetic bearing**. When measuring a bearing with a compass that has declination properly set for your area you are automatically correcting for the difference between magnetic north and true north, thus the resulting bearing is a true bearing.

The proper form for recording a bearing is to use three digits with a T for true bearing or M for magnetic bearing appended to the digits.

The principal/cardinal directions in true bearings are:

0/360T—North	045T—North-East	090T—East	135T—South-East
180T—South	225T—South-West	270T—West	315T—North-West

Field Bearings

When measuring a bearing between your current location and another feature such as a peak or lake with your compass you are taking a **field bearing**. Follow the steps below to take accurate field bearings.

Shooting accurate bearings with your compass:

- Do not wear the lanyard around your neck if it is not long enough to fully extend your arm.
- Place the compass flat in the palm of your hand.
- **Keeping the compass level**, raise your hand away from you (arm extended) and to eye level.
- Move the mirror so that you can see the magnetic needle and the declination arrow in the mirror (approx. 45° angle).
- **Close one eye** when sighting a target.
- Sight the desired target with the sighting notch on the top of the mirror (move your entire body left or right to locate the target – not just your arm or hand). (Note: Some compasses also have a sighting "notch" at the base of the mirror.)
- **When sighting the target make sure that the thin line on the mirror is aligned with the needle pivot.** The target, the sighting notch, the thin line on the mirror, and the needle pivot should all be aligned for an accurate reading.
- Move the bezel until the **needle is parallel along its length to the sides of the declination 'arrow' or lines** (don't just look at one end of the needle**)**. On most compasses, the red end of the magnetic needle

should be pointed at the red end of the declination arrow (unless you are taking a back bearing). (Note: Some compasses only have parallel lines instead of an arrow.)
- Check again that you are **holding the compass level**.
- Read the bearing at the index line.
- Be aware that metal objects near the compass could affect its reading – your watch, altimeter, bracelets, pencils with metal clips or eraser holders, metal roofs, cars, etc.

Orienting The Map With A Compass

This operation will align true north on the map with true north in the field. (It is assumed that declination is set correctly on your compass, which is approximately 18 degrees E for the Central Washington Cascades).

1. Rotate the graduated dial on the compass so that 0 appears at the index line.
2. Place a compass straightedge on any longitude (north-south) line of the map.
3. Physically turn both the map and compass until the magnetic needle is aligned in the orienting arrow.

Map To Field Bearing

This technique is used when the present location (start point) and objective/landmark (end point) are known. **The map does not have to be oriented.** In determining the true bearings on the map, the magnetic needle direction is disregarded since the compass is only used as an instrument for measuring angles (a protractor).

1. Place a compass straightedge along a line connecting the start point and end point. The direction of travel arrow must point towards the end point (objective/landmark.)
2. Rotate the graduated dial so that the meridian lines are parallel to the longitudinal (north-south) lines on the map. The orienting arrow will also point towards true north (if you have set the declination on your compass the orienting arrow will actually point approximately 18 degrees east of north).
3. The true bearing is the number at the index line (XXXT).
4. To use in the field, hold the compass in front of you, chest high, and level so the magnetic needle is free to swing. Turn your body until the magnetic needle is aligned inside the orienting arrow.
5. The direction of travel arrow will point in the field to the end point (objective/landmark) selected on the map.

Field To Map Bearings (Intersection)

Determining an intersect requires a minimum of two (2) known landmarks, and it is best if they are at right angles to each other. This technique is used when landmarks are known and the point at which the bearings are taken is not. Intersection is sometimes referred to as “cross bearings,” or “triangulation;” they are the same thing. The most common landmarks are two (2) peaks. However, another choice could be a peak and a geographical feature, such as a stream/river, ridge/valley, shoreline, etc.

1. Point the ‘direction-of-travel’ arrow at the first known landmark.
2. Hold the compass in front of you, chest high, and level so the magnetic needle is free to swing. Rotate the graduated dial until the orienting arrow is aligned with the magnetic needle.
3. The bearing is the number at the index line (XXX.)
4. Place the compass on the map so that:
   a) One of the straightedges is on the landmark (known point.)
   b) The ‘direction-of-travel’ arrow points to the landmark.
   c) The north arrow on the graduated dial points towards true north (straight up) on the map.
   d) The meridian lines are parallel with the longitude (north-south) lines on the map.
5. The point at which the bearing was taken is somewhere along the line formed by the straightedge.
6. Repeat steps 1 through 5 for the second known landmark.
7. The point at which the bearings (lines) cross is your location.
8. If possible, it is desirable to get more than two landmarks for bearings.

NOTE: The map does not have to be oriented to do steps 4 and 5. Disregard the magnetic needle for working on the map; the compass is only used as a protractor.

Care And Use Of A Map

Always remember two things: 1) that a map buried in your pack is just extra weight that your are carrying if you don't use it, and 2) if it's a soaking mass of goo because of rain, its still no good.

- Keep the map **easily accessible** in an exterior pocket or where it can easily be reached - if you can get it easily, you will use it more often.
- Keep it dry!!! These maps are a magnet for rain and humidity. They turn into a paste like material when they get wet. You can buy expensive map cases or use something as simple as a zip lock bag, but have something to place the map in to keep it dry.

Navigation Techniques

Leapfrogging

To leapfrog, person (A) sets a desired bearing on his/her compass while person (B) walks in the general direction of the bearing for a desired distance, or until just before the two parties are unable to see each other and/or communicate. Person (A) has person (B) move until they are lined up with the bearing. (A) is now free to walk towards (B) without trying to exactly following the bearing. (A) then "leapfrogs" past (B) allowing them to switch roles where (B) can now direct (A) to the correct bearing.

Back Bearings

A back bearing is the opposite direction to your desired bearing. Back bearings are used when you are following a particular bearing and want to ensure you are still on that bearing line by taking a back bearing to an identifiable object at your starting point. To increase your accuracy when leapfrogging, person (B) can take a back bearing to person (A) to ensure accurate alignment along the desired path. There are two simple ways to take a back bearing:

- *The easiest way to take a back bearing is to simply keep your compass set to your desired bearing, but align the south seeking end of the magnetic needle (typically white or black) with the pointed end of the declination arrow.*

- *Another way to take a back bearing is to set your compass to 180° from your desired bearing and shoot back to your partner. If your bearing is less than 180°, the back bearing is found by adding 180°. If the bearing you are on is greater than 180°, the back bearing is found by subtracting 180°. For example, if you are following a bearing of 82° set your compass to 262° and sight your partner.*

Intermediate Objectives

Many times obstacles will be in your path such as streams, crevasses, or heavy brush. If you can see over the obstruction you may be able to sight past the obstruction to an identifiable object such as a tree or rock that is exactly on your bearing line. Once you have identified the object, you are free to take whatever route is easiest to the object and then resume following your bearing.

Offsets

When you cannot see around an obstacle or identify an intermediate objective, you can use an offset to navigate around the obstruction. To navigate along an offset (see the figure below):

- Travel a paced distance **90°** from the original bearing.
- Resume your bearing parallel to your original course to pass the obstruction
- Return to your original course by turning **90°** in the opposite direction as before and pace off the distance to your bearing line.