Making the Compass and Map Work for You

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Orienting Your Map

A map represents the lay of the land, so if you wish to match the geographic picture with the map image, you must accurately orient your map to the lay of the land. You can do this by picking out landmarks and then spinning your map to match those landmarks—assuming your map-reading skills and your geographic-interpretation skills are good enough. Still, geographic orientation is only roughly accurate, even with the best observation. For absolute accuracy you must turn to your compass. It will help you orient the map so it becomes an exact mirror image of the terrain around you.

Since the map is printed with the edge lined up with true North and your compass needle always points toward magnetic North, you'll have to account for declination to correctly align your map. The difference between the North shown on a topographic map and the North indicated by the magnetic needle on your compass is known as declination. Declination is either West or East, depending on which side of the geographic North your compass needle points. On USGS topographic maps declination is indicated by arrows printed on the bottom margin. The arrow with a star above it indicates true or geographic North. The shorter arrow with an MN above it indicates magnetic North. The number with the degree sign printed between the two arrows is the exact degree of declination.

There are several ways to ensure accuracy. First, you can orient the map simply by drawing magnetic lines across it that parallel the declination angle (in essence, you're adjusting the map to magnetic compass-speak). This is my favorite method: Once the magnetic lines are drawn, the magnetic needle, its orienting arrow, and the map are all speaking the same language, minimizing the possibility for field errors. The disadvantage of this method is that you have to draw magnetic lines across all the maps you plan to use in the field, and you must draw them very accurately using a protractor, a perfectly straight yardstick, and a relatively flat surface.

In my opinion the next best method—and a very close second to the first—is adjusting your compass to the declination indicated on the map (this time adjusting the compass to true-North map-speak). The advantage of this method is that once your compass is adjusted—assuming you have a built-in declination adjustment feature, which is worth the few extra dollars you'll spend to get it—you can forget about having to compensate for declination as long as you remain on that map. All you have to do is turn a screw, spin a dial, or adjust a scale—no drawing of lines whatsoever. The disadvantage is that you'll have to remember to adjust your setting when moving to adjacent maps with possibly different declinations—a very minor disadvantage, to be sure.

The third method involves the magic of numbers and mathematical calculation of the declination—not just when you're orienting the map, but also when you're taking bearings from the map or the field. If you are to be a well-rounded and skilled navigator, it's essential that you understand this method, although I personally hate it and rarely rely on it. Why? Because when

you're fatigued, stressed, anxious, or hurried, numbers add a distraction that can become quite confusing, dramatically increasing the possibility of error.

Orienting the Map to True North: Projecting Magnetic Lines

A common way to make the process of adjusting for declination easy is to use a protractor, a yardstick with a very straight edge, and a pencil to project the declination line across the entire topo. Your first step is to mark a point along the bottom border of the map and then place the center point of the protractor directly on your mark. Make another mark at the degree bearing indicated by the declination angle, being sure that your angle is facing the same way as the declination diagram. For example, a 10-degree declination to the East (the MN arrow is to the right of the arrow with the star above it) means you count 10 degrees to the right of the 0-degree marking on the protractor, placing a mark at 10 degrees. Now connect the two points and project the line all the way across the map using the yardstick. Finally, using this line as a guide, you can draw parallel magnetic-North lines 1 to 2 inches apart. With the azimuth set at North or 0 degrees, take the compass with the orienting arrow pointing due North on the azimuth, place the edge of the baseplate along one of the magnetic lines, and spin the map until the magnetic arrow is centered (boxed) within the orienting arrow.

Orienting the Map to True North: Using Your Compass's Declination Adjustment

No magnetic lines on your map? Then the next easiest method is to adjust your compass to the declination, which is simple if your compass features a built-in declination adjustment. Each manufacturer has a different way to accomplish this, so refer to the instructions that came with your compass. All methods accomplish the same thing, however. By moving the orienting arrow to the right of North (for East declination) or to the left of North (for West declination), the compass will read true or geographic North. To orient the map, place the edge of the compass baseplate along the printed edge of the map, then spin the map until the red end of the magnetic needle is centered (boxed) in the orienting arrow. Your map is now oriented to true North. You will note that the North–South line of your compass and the direction-of-travel arrow parallel the edge of your map to indicate true North, while the magnetic needle continues to point East or West, matching the angle of declination indicated by the map's declination diagram—nifty, isn't it? Once your compass is set with the azimuth at North or 0 degrees, you won't have to readjust the declination as long as you're navigating within the boundaries of that map. Don't forget, however, that as you move from map to map and region to region, the declination will change; you'll have to adjust the compass accordingly each time.

Orienting the Map and Adjusting for Declination by Adding or Subtracting

If you don't have a compass that features a built-in declination adjustment, you'll have to resort to turning the compass housing to compensate for the declination before each attempt to orient your map. If the MN arrow is on the left side of the true-North arrow, the declination is West and you turn the housing to the left (counterclockwise), counting each degree until North sits the designated number of degrees of declination to the right of the index point (10 degrees of West declination means you turn the housing until 10 degrees is indicated opposite the compass's index point: 360 degrees (North) + 10 degrees = 10 degrees. How did I get 10 degrees by adding 10 to 360? Remember that a compass is a 360-degree circle. You can't go higher than 360 degrees no matter how hard you try. So when you're adding to 360 degrees, you are, in actual fact, adding to 0 degrees and continuing around the circle to the right. If the

MN arrow is on the right side of the true-North arrow, the declination is East and you turn the housing to the right (clockwise), counting each degree until North sits the designated number of degrees of declination to the left of the index point (10 degrees of East declination means you turn the housing until 350 degrees is indicated opposite the compass's index point: 360 degrees (North) - 10 degrees = 350 degrees.

Should you opt for this method, realize that you aren't done with Math 101 just because your map is successfully oriented. Anytime you take a bearing from the map to the compass or field or from the compass or field to the map, you'll have to convert the reading so that it compensates for declination.

How?
To compensate for declination when you're taking a reading from the map that you want to use in the field, you must do the following: If the MN arrow is on the left side of the true-North arrow, the declination is West and you add the indicated degree amount to correct your bearing. If the MN arrow is on the right side of the true-North arrow, the declination is East and you subtract the indicated degree amount to correct your bearing.

To compensate for declination when taking a reading from the field that you want to use on the map, do the following; if the MN arrow is on the left side of the true-North arrow, the declination is West; subtract the indicated degree amount to correct your bearing. If the MN arrow is on the right side of the true-North arrow, the declination is East; add the indicated degree amount to correct your bearing .

Say what? It's really not as hard as it sounds. If your indicated heading is 80 degrees after taking a map bearing, and the map declination is 10 degrees East, turn your bezel 10 degrees East, subtracting the degrees, to leave you with a corrected bearing of 70 degrees.

Why is this important? In this example, if you didn't correct for declination and set off hiking on an 80-degree bearing, you would be off course by approximately 0.2 mile (920 feet) for each mile traveled (for each degree of error, you'll be approximately 18.4 feet off course for every 1,056 feet traveled)—no wonder you can't find that freshwater spring!

How Do I Take a Field Bearing?
Imagine that you're hiking toward a distant mountain peak that's presently visible from the ridge you're on, but you know that you'll soon lose sight of it in the woods. How can you be sure you'll stay on course? Hold your compass level at waist height and point the direction-of-travel arrow at the mountain peak. Rotate the compass housing until the red end of the magnetic compass needle is centered (boxed) within the orienting arrow. Your bearing may be read in degrees at the center index point—where the compass housing meets the direction-of-travel arrow on the compass baseplate.
To follow that bearing, pick the first major landmark in line with the direction-of-travel arrow (say a large evergreen)—one that you won't lose sight of once you're into the woods. Also, look over your shoulder and select a major landmark (say a rocky outcrop) directly behind you—again, one you won't lose sight of. Do not touch that compass dial! Walk directly toward the evergreen and don't worry that you can no longer see the mountain peak, because your compass reading has already been set at the index. Once you're at the tree, hold the compass

level once again, turn your body until the North end of the compass needle centers itself exactly inside the orienting arrow, and then find another landmark in line with the direction-of-travel arrow. Before you head out, take a back bearing by turning around with the compass still held level until the white end of the compass needle is centered inside the orienting arrow. Do you see the rocky outcrop in line with the direction-of-travel arrow? If so, you're on course for the mountain peak as planned. Turn around and head directly to your next selected landmark. Repeat the process until you arrive at your selected destination, the mountain peak.

How Do I Take a Map Bearing?

Oh, oh. You still want to head to that mountain peak, but this time you're enshrouded in dense fog. How are you going to get there? First, orient your map. Now, place the edge of the baseplate like a ruler with the direction-of-travel arrow pointing from your current location on the map toward your intended destination. The edge of the baseplate should exactly connect your current location and your intended destination. Being careful not to move either the map or the compass, rotate the compass housing until the North end of the compass needle centers itself exactly inside the orienting arrow. Your degree bearing is indicated at the index point. Now, without moving the compass housing, stand up—holding the compass level at your waist—and rotate your body until the North end of the compass needle centers itself exactly inside the orienting arrow. Your course is indicated by the direction-of-travel arrow. Follow the navigation directions above for taking a field bearing.

It's on the Map; How Do I Find It in the Field?

You can see where you are on the map, that much is certain. You've even picked out an interesting summit on the map, not too far from where you are now, and you want to explore it. But in scanning the terrain, you're having a hard time picking the summit out of the several others clustered nearby. What do you do? Follow the directions for taking a map bearing. Once you have the established bearing and have rotated your body, holding the compass at waist level until the magnetic needle is boxed or centered within the orienting arrow, you should be able to determine which summit you want— it's the one the direction-if-travel arrow is pointing toward.

It's in the Field; How Do I Find It on the Map?

You can see that distant summit, and you know where you are on the map, but you have no idea which summit on the map is the one you're looking at in the field. What's a navigator to do? First, orient your map. Then hold your compass level at waist height and point the direction-of-travel arrow at the mountain's summit. Rotate the compass housing until the red end of the magnetic compass needle is centered (boxed) within the orienting arrow. Your bearing can be read in degrees at the center index point—where the compass housing meets the direction-of-travel arrow on the compass baseplate. Taking care not to move the map, place one edge of the compass's baseplate directly on your current location on the map. Now, without moving the compass housing or moving the map in any way, pivot the compass around your known location point until the red end of the magnetic compass needle is centered (boxed) within the orienting arrow. Draw a line, either in pencil or in your imagination, along the edge of the baseplate toward the summits indicated on the map. The summit you're looking at in the field will be the one intersected by the line drawn from your location.

Establishing Bearings without Orienting the Map
Do you always have to orient a map to establish a bearing? No, although keep in mind that anytime you don't orient the map, you're increasing the opportunity for error. Still, these techniques are especially useful when you're trying to establish a bearing on the fly and you don't want to take the time to orient the map. What I most like about this technique is that you can accurately plan your entire trip at home, establishing correct bearings and then writing those bearings down to use when you actually head out into the field. Here's how to follow these "no-map-orientation-needed" procedures.

For a Map with Magnetic Lines Projected Across It
If you have magnetic lines drawn on your map, do not use your compass's built-in declination adjustment.

To Establish a Bearing from the Map (Map to Field): Connect your location with your destination, using the edge of your compass baseplate with the direction-of-travel arrow pointing toward your destination. Being careful not to move the compass, rotate its housing until the orienting arrow points to magnetic North (if you don't do this correctly and end up pointing the orienting arrow South, your bearing will be 180 degrees off) and the compass housing's orienting lines parallel the map's magnetic-Northlines. Ignore the magnetic needle entirely. Your bearing can be read at the index point.

To Plot a Bearing on the Map (Field to Map): After establishing your field bearing, do not move the dial. Place one edge of the compass on your known point on the map (if you know your location, place the bottom corner of the baseplate on your location with the direction-of-travel arrow pointing away; if you know a landmark but your location is unverified, place the top corner of the baseplate on the landmark, direction-of-travel arrow pointing at the landmark). Rotate the entire compass around the point until you align the orienting lines with the magnetic lines projected on your map. Draw a line on the map along the edge of the baseplate from your known point out; that's your bearing, plotted on the map.

For a Map with No Magnetic Lines, Relying on the Border
If you don't have magnetic lines drawn on your map, use the printed edge of the map or the grid lines projected across it. If your map doesn't have grid lines, you need to either extend a straight line from your location, through your destination, and to either the right or left printed edge of the map; or draw lines on the map that parallel its printed edge. You also need to compensate for declination, which is most easily accomplished by using a compass with a built-in declination adjustment.

To Establish a Bearing from the Map (Map to Field): Draw a straight line on the map that connects your location with your destination and extends through either the right (East) or left (West) edge of the map. Place the edge of your compass's baseplate with the direction-of-travel arrow positioned so that it's pointing in the same direction as your direction of travel would be on the map, from location to destination. Being careful not to move the compass, rotate the compass housing until the orienting lines are aligned with map's printed border or grid lines. Ignore the magnetic needle entirely. Your bearing can be read at the index point. You should get the same bearing as on a map with magnetic lines.

To Plot a Bearing on the Map (Field to Map): After establishing your field bearing, do not move the dial. Place one edge of the compass on your known point on the map (if you know your location, place the bottom corner of the baseplate on your location with the direction-of-travel arrow pointing away; if you know a landmark but your location is unverified, place the top corner of the baseplate on the landmark, direction-of-travel arrow pointing at the landmark). Rotate the entire compass around the point until you align the orienting lines with the printed border of the map or the grid lines on your map. Draw a line on the map along the edge of the baseplate; and that's your bearing on the map.

Minimizing Mistakes

I have learned over the years, and the lesson was reinforced not long ago during the Eco-Challenge, that even the most experienced navigator can make a mistake if he is not careful. Military cadets have been known to call in air strikes on their own platoon because of navigational errors—fortunately, this has occurred in practice sessions when personnel are afforded eternal life. Adventure racers head off in the wrong direction because fatigue inspired them to miss a critical step or misread a compass. One sleep-deprived navigator in a recent Eco-Challenge was discovered holding his compass the wrong way, with the direction-of-travel arrow pointing directly at himself.

Always double-check yourself and stay ever vigilant so that you do not do the following:

- Adjust for declination in the wrong direction.
- Miscalculate the declination correction.
- Try to follow a long leg on a bearing without accounting for drift—always hike from visible point to visible point to stay on course.
- Travel with the map and compass put away because "you know where you are." Always check your position with regularity.
- Hold a compass next to a metal object, such as a belt buckle, when trying to take a bearing.
- Take sloppy bearings. Always use the same eye and check your sighting two or three times.
- Incorrectly draw the magnetic lines on a map.
- Get confused and use the wrong end of the magnetic needle.
- Get confused and read the bearing from the opposite side of the index point.
- Point the direction-of-travel arrow in the wrong direction when you're establishing a bearing.