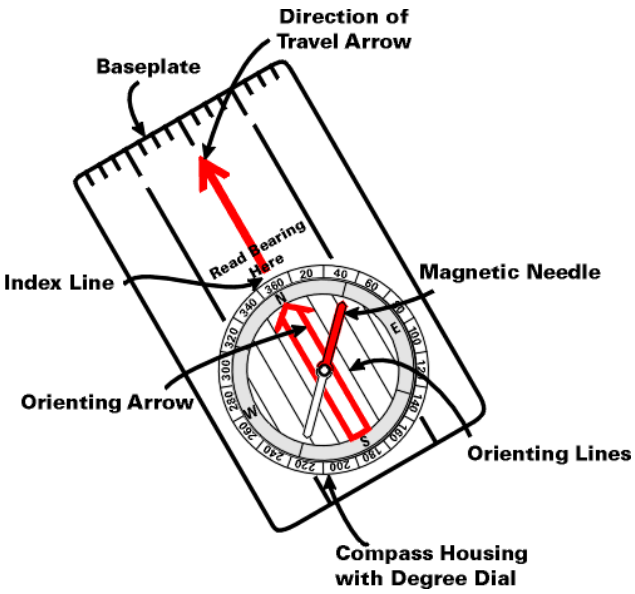
Using the Compass

The compass consists of a magnetized metal needle that floats on a pivot point. The needle orients to the magnetic field lines of the earth. The basic orienteering compass is composed of the following parts: (See Figure 6.6)

- Base plate
- Straight edge and ruler
- Direction of travel arrow
- Compass housing with 360 degree markings
- North label
- Index line
- Orienting arrow
- Magnetic needle (north end is red)

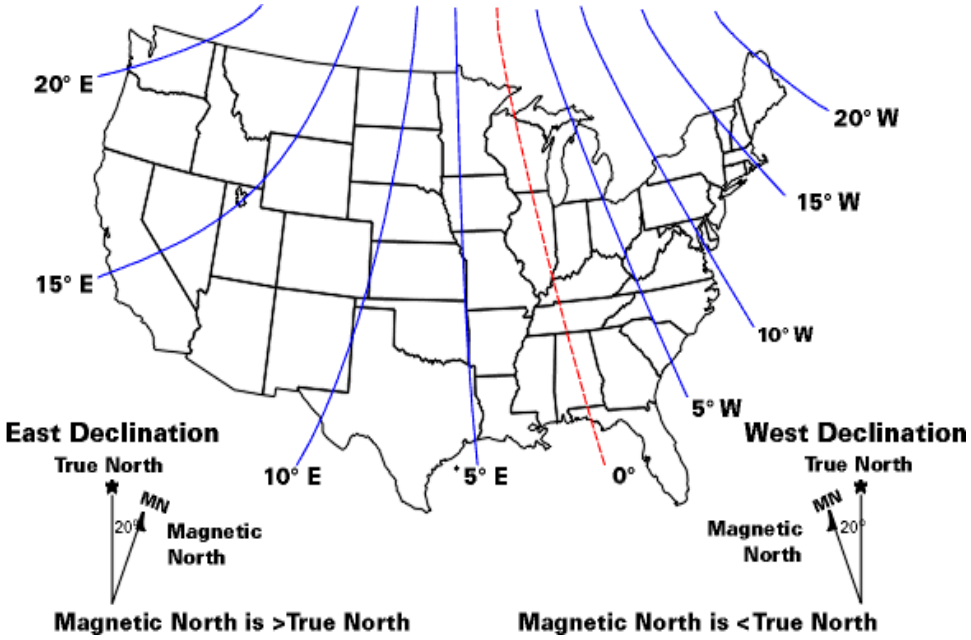


What is North?

No, this is not a silly question, there are two types of north.

- **True North:** (also known as Geographic North or Map North - marked as H on a topographic map - see Figure 6.8) is the geographic north pole where all longitude lines meet. All maps are laid out with true north directly at the top. Unfortunately for the wilderness traveler, true north is not at the same point on the earth as the magnetic north Pole which is where your compass points.

- **Magnetic North:** Think of the earth as a giant magnet (it is actually). The shape of the earth's magnetic field is roughly the same shape as the field of a bar magnet. However, the earth's magnetic field is inclined at about 11° from the axis of rotation of the earth, so this means that the earth's magnetic pole doesn't correspond to the Geographic North Pole and because the earth's core is molten, the magnetic field is always shifting slightly. The red end of your compass needle is magnetized and wherever you are, the earth's magnetic field causes the needle to rotate until it lies in the same direction as the earth's magnetic field. This is magnetic north (marked as MN on a topographic map). Figure 6.7 shows the magnetic lines for the United States (as of 1985). If you locate yourself at any point in the U.S., your compass will orient itself parallel to the lines of magnetic force in that area.



Declination

You can see that location makes a great deal of difference in where the compass points. The angular difference between true north and magnetic north is known as the **declination** and is marked in degrees on your map as shown in Figure 6.7. Depending on where you are, the angle between true north and magnetic north is different. In the U.S., the angle of declination varies from about 20 degrees west in Maine to about 21 degrees east in Washington. (See Figure 6.7). The magnetic field lines of the earth are constantly changing,

moving slowly westward (½to 1 degree every five years). This is why it is important to have a recent map. An old map will show a declination that is no longer accurate, and all your calculations using that declination angle will be incorrect. As you will see, understanding this distinction becomes important when navigating with a map and a compass.

Tricks of the Trail
Buy Your Compass for the Right Area: As well as the magnetic deviation east or west, compasses also show a vertical "dip" up and down. This dip varies in different parts of the world and compasses are specially calibrated for that dip. So you can't take a compass made for North America and use it in South America and get accurate readings.

Which North to Use

So we have two types of north to contend with. When you look at your map, it is drawn in relation to true north;, when you look at your compass, it points to magnetic north. T to make the map and compass work together you must decide on one North as your point of reference and base all your calculations on that. As you can see the following chart, failure to take declination into account can put you way off target.

Declination or Degrees Off Course	Error Off Target after Walking 10 Miles
1°	920 feet (280meters)
5°	4,600 feet (1,402 meters)
10°	9,170 feet (2,795 meters)

Using Map and Compass

Even after years of using a map and compass I could never remember how to correct for declination. Do I add declination or subtract it? What if I'm out west versus in the east? While navigating through dense fog on a sea kayaking trip, I finally came up with an easy way to remember. As long as you remember the basic principles, you can easily work it out in your head.

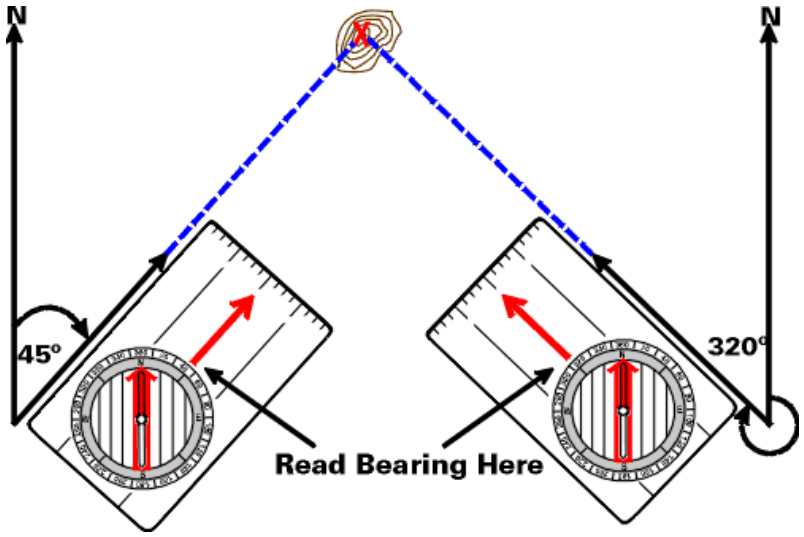
What's your Map Declination?

The first thing you need to know is where you are in relation to magnetic north. You can find this information by looking on your map legend. If you look at the map of North America in Figure 6.8 you will see the line roughly marking 0° declination. If you are on the line where the declination is 0 degrees, then you don't have to worry about any of this, since magnetic north and map north are equivalent. (Wouldn't it be nice if all your trips were on the 0 degree of declination line?) If you are to the right of that line, your compass will point toward the line (to the left) and hence the declination is to the west. If you are to the left of

the line, your compass will point toward the line (to the right) and hence the declination is to the east.

Bearings:

The compass is used primarily to take bearings. A bearing is a horizontal angle measured clockwise from north (either magnetic north or true north) to some point (either a point on a map or a point in the real world) (see Figure 6.8). Bearings are used to accurately travel to a destination or to locate your position. If you are working from your map, it is called a map bearing and the angle you are measuring is the angle measured clockwise from true north on your map to this other point on the map. If you are taking a bearing off a real point on the landscape with a compass, you are using your compass to measure the angle clockwise from magnetic north to this point on the landscape. This is called a magnetic bearing. Remember that the bearing is measured clockwise. If you think of true north as 12 o'clock then a bearing to the right of that (1 o'clock) is greater than true north and a bearing to the left of True north (11 o'clock) is less than true north.



Map Bearings & Magnetic Bearings:

If, you think about your map as an artist's rendition of the world. It displays true north, but it doesn't include magnetic fields as the real world does, so you need to make accommodations when going from your map to the real world. The real world doesn't have a true north—it's merely a construct of the map—so you have to make accommodations when going from the real world to your map.. The basic principle is this: *to correct for declination, you want the map bearing and the magnetic bearing to be equivalent.* If you are lucky enough to be on the line where the declination is 0°, both are already equivalent, or if you orient your map with your compass (see page 00) then you have made the two equivalent. Otherwise, you will need to make your own bearing corrections by adding or subtracting the declination amount. That gives us 4 possible permutations to work with:

1. **West Declination** - Going from a Map Bearing to a Magnetic Bearing

2. **West Declination** - Going from a Magnetic Bearing to a Map Bearing

3. **East Declination** - Going from a Map Bearing to a Magnetic Bearing

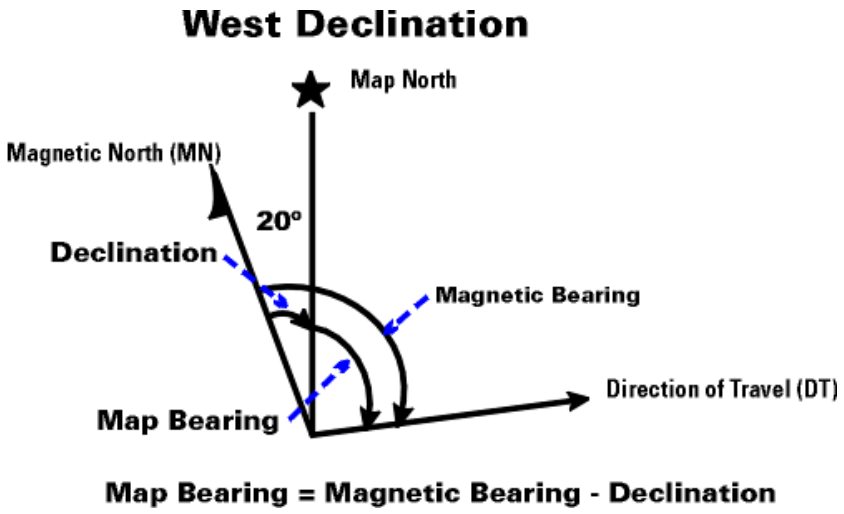
4. **East Declination** - Going from a Magnetic Bearing to a Map Bearing

West Declination:

If your declination is west, then magnetic north is less than true north and the map bearing is less than (<) the magnetic bearing . You need to make the two bearings equivalent by adding or subtracting the declination. This is illustrated in Table 6.2 and Figure 6.8b.

- **Map Bearing to Magnetic Bearing:** If you are taking a bearing from one point on your map to another point on the map with respect to true north, then you are working with the map bearing. Now you want to figure out where your position is in the magnetic bearing. In order to transfer this information back to your magnetic bearing you need to add the declination to your map bearing bearing to create the proper magnetic bearing. **Map bearing + Declination = Magnetic Bearing.**

- **Magnetic Bearing to Map Bearing:** If you use your compass to take a bearing from your current position to a point on the landscape, then you are working with the magnetic bearing. Now you want to figure out where your position is on the map. In order to transfer this information back to your map you need to subtract the declination from your magnetic bearing compass bearing to create the proper map bearing. **Magnetic Bearing - Declination = Map Bearing.**

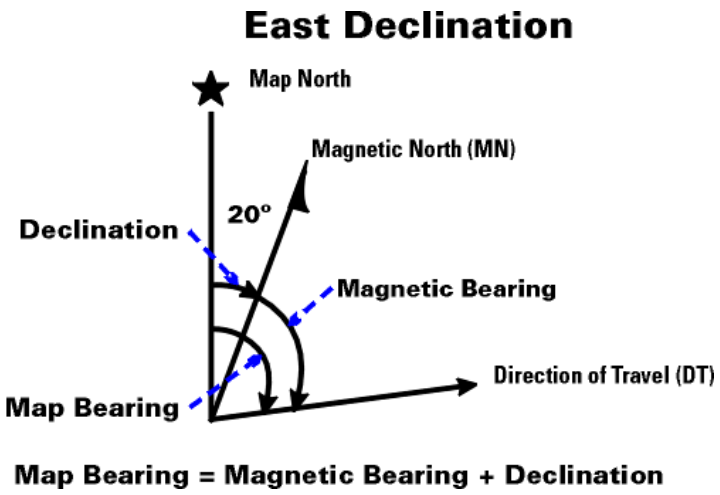


East Declination:

If your declination is East then magnetic north is greater than true north the map bearing is greater than the magnetic bearing. You need to make the two worlds equivalent by adding or subtracting the declination. This is illustrated in Table 6.2 and Figure 6.8a.

- **Map Bearing to Magnetic Bearing:** If you are taking a bearing from one point on your map to another point on the map with respect to true north, then you are working with the map bearing. Now you want to figure out where your position is in the magnetic bearing. In order to transfer this information back to your magnetic bearing you need to subtract the declination from your map bearing compass bearing to create the proper magnetic bearing bearing. **Map bearing - Declination = Magnetic Bearing.**

- **Magnetic Bearing to Map Bearing:** If you use your compass to take a bearing from your current position to a point on the landscape, then you are working with the magnetic bearing. Now you want to figure out where your position is on the map. In order to transfer this information back to your map you need to add the declination from your magnetic bearing compass bearing to create the proper map bearing. **Magnetic bearing + Declination = Map Bearing.**



If the declination is...	Then...	Map Bearing to Magnetic Bearing	Magnetic Bearing to Map Bearing
West	Magnetic North < True North Map Bearing is < the Magnetic Bearing	Map Bearing + Declination = Magnetic Bearing.	Magnetic Bearing - Declination = Map Bearing.
East	Magnetic North > True North Map Bearing is > the Magnetic Bearing	Map Bearing - Declination = Magnetic Bearing.	Magnetic Bearing + Declination = Map Bearing.

Materials from http://www.princeton.edu/~oa/manual/mapcompass.shtml