Geographic and magnetic north

Geographic north and south poles are determined by the earth’s spin. They are the locations on earth through which the axis of the earth’s spin passes. Magnetic north is determined by the direction a compass points.

Magnetic variance

Magnetic variance, or declination, is the difference between geographic north and magnetic north. As shown in the picture below, the angle between these locations depends on where on the earth the observer is located. In the picture below, observers in the lighthouse would measure a fourteen degree difference between geographic and magnetic north.

One of the interesting applications of magnetic variations is the problem of navigation. There is greater magnetic variance near the poles. As a result, at locations close to the poles, compass readings are not very valuable unless one knows the exact declination.
Wandering magnetic north

Magnetic north can wander. Typically, the location of magnetic north makes an ellipse-like shape throughout the day. Changes such as this are influenced by the sun. On “disturbed days,” days when the sun impacts the magnetic field around the earth significantly, the ellipse is larger than on “undisturbed days.” In the picture below, the star shows the average location of magnetic north. The inner ellipse shows the path of magnetic north on an undisturbed day. The outer ellipse shows the locations of magnetic north on a disturbed day.

For more information . . .

1) [http://home.att.net/~agligani/navigation/magnetic.htm](http://home.att.net/~agligani/navigation/magnetic.htm)
This website explains the difference between geographic and magnetic north and suggests methods for correcting for compass error. The picture above including a light house was taken from this website. Caution: one of the mnemonics is a bit risqué!

2) [http://www.geolab.nrcan.gc.ca/geomag/e_nmpole.html](http://www.geolab.nrcan.gc.ca/geomag/e_nmpole.html)
This website explains changes in the location of magnetic north. The picture above showing the location of magnetic north on a quiet and disturbed day was taken from this website. One of the best pictures on the website tracks the changes in the location of magnetic north from 1831-1994.

3) [http://www.geolab.nrcan.gc.ca/geomag/e_magdec.html](http://www.geolab.nrcan.gc.ca/geomag/e_magdec.html)
Another reference explaining areas of compass unreliability and relationship to the north magnetic pole and magnetic declination.