

Encyclopedic Entry

compass

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A [compass](#) is a [device](#) that [indicates direction](#). It is one of the most important [instruments](#) for [navigation](#).

Magnetic compasses are the most well known type of compass. They have become so popular that the term “compass” almost always refers a magnetic compass. While the design and construction of this type of compass has changed [significantly](#) over the centuries, the [concept](#) of how it works has remained the same. Magnetic compasses consist of a magnetized needle that is allowed to [rotate](#) so it lines up with the Earth's [magnetic field](#). The ends point to what are known as magnetic north and magnetic south.

Scientists and historians don't know when the [principles](#) behind magnetic compasses were discovered. Ancient Greeks understood magnetism. As early as 2,000 years ago, Chinese scientists may have known that rubbing an [iron](#) bar (such as a needle) with a naturally occurring [magnet](#), called a [lodestone](#), would temporarily [magnetize](#) the needle so that it would point north and south.

Very early compasses were made of a magnetized needle attached to a piece of wood or cork that floated freely in a dish of water. As the needle would settle, the marked end would point toward magnetic north.

As [engineers](#) and scientists learned more about magnetism, the compass needle was mounted and placed in the middle of a card that showed the [cardinal directions](#)—north, south, east, and west. A spearhead and the letter T, which stood for the Latin name of the North Wind, *Tramontana*, signified north. This combination [evolved](#) into a [fleur-de-lis](#) design, which can still be seen today. All 32 points of direction were eventually added to the [compass card](#).

Historians think China may have been the first [civilization](#) to develop a magnetic compass that could be used for navigation. Chinese scientists may have developed navigational compasses as early as the 11th or 12th century. Western Europeans soon followed at the end of the 12th century.

In their earliest use, compasses were likely used as backups for when the sun, stars, or other [landmarks](#) could not be seen. Eventually, as compasses became more [reliable](#) and more explorers understood how to read them, the devices became a [critical](#) navigational tool.

Adjustments and Adaptations

By the 15th century, explorers realized that the “north” indicated by a compass was not the same as Earth's true geographic north. This [discrepancy](#) between magnetic north and true north is called variation (by [mariners](#) or [pilots](#)) or [magnetic declination](#) (by land navigators) and varies depending on location. Variation is not significant when using magnetic compasses near the [Equator](#), but closer to the North and South Poles, the difference is much greater and can lead someone many kilometers off-course. Navigators must adjust their compass readings to account for variation.

Other [adaptations](#) have been made to magnetic compasses over time, especially for their use in [marine](#) navigation. When ships evolved from being made of wood to being made of iron and [steel](#), the magnetism of the ship affected compass readings. This difference is called [deviation](#). Adjustments such as placing soft iron balls (called [Kelvin spheres](#)) and bar magnets (called [Flinders bars](#)) near the compass helped increase the [accuracy](#) of the readings. Deviation must also be taken

into account on [aircraft](#) using compasses, due to the metal in the construction of an airplane.

Magnetic compasses come in many forms. The most basic are portable compasses for use on casual hikes. Magnetic compasses can have additional features, such as magnifiers for use with maps, a [prism](#) or a mirror that allows you to see the [landscape](#) as you follow the compass reading, or markings in Braille for the visually impaired. The most complicated compasses are [complex](#) devices on ships or planes that can [calculate](#) and adjust for motion, variation, and deviation.

Other Types of Compasses

Some compasses do not use Earth's magnetism to indicate direction. The gyrocompass, invented in the early 20th century, uses a spinning [gyroscope](#) to follow Earth's [axis of rotation](#) to point to true north. Since magnetic north is not measured, variation is not an issue. Once the gyroscope begins spinning, motion will not disturb it. This type of compass is often used on ships and aircraft.

A solar compass uses the sun as a navigational tool. The most common method is to use a compass card and the angle of the shadow of the sun to indicate direction.

Even without a compass card, there are techniques that use the sun as a compass. One method is to make a shadow stick. A shadow stick is a stick placed upright in the ground. Pebbles placed around the stick, and a piece of string to track the shadow of the sun across the sky, help a navigator determine the directions of east and west.

Another type of solar compass is an old-fashioned analog (not digital) watch. Using the watch's hands and the position of the sun, it is possible to determine north or south. Simply hold the watch parallel to the ground (in your hand) and point the hour hand in the direction of the sun. Find the angle between the hour hand and the 12 o'clock mark. This is the north-south line. In the [Southern Hemisphere](#), north will be the direction closer to the sun. In the [Northern Hemisphere](#), north will be the direction further from the sun.

Receivers from the [global positioning system \(GPS\)](#) have begun to take the place of compasses. A [GPS receiver](#) [coordinates](#) with [satellites](#) orbiting the Earth and [monitoring stations](#) on Earth to pinpoint the receiver's location. GPS receivers can [plot latitude](#), [longitude](#), and [altitude](#) on a map. Unless large objects block signals, readings are usually accurate to within about 15 meters (50 feet).

Despite advancements with GPS, the compass is still a valuable tool. Many airplanes and ships still use highly advanced compasses as navigational instruments. For [casual observation](#)—for navigators on foot or in a small boat—a pocket compass or a basic compass mounted on a [dashboard](#) remains a practical and [portable](#) tool.

VOCABULARY

Term	Part of Speech	Definition
accuracy	<i>noun</i>	condition of being exact or correct.
adaptation	<i>noun</i>	a modification of an organism or its parts that makes it more fit for existence. An adaptation is passed from generation to generation.
aircraft	<i>noun</i>	vehicle able to travel and operate above the ground.
altitude	<i>noun</i>	the distance above sea level.
axis of rotation	<i>noun</i>	single axis or line around which a body rotates or spins.
calculate	<i>verb</i>	to reach a conclusion by mathematical or logical methods.
cardinal direction	<i>noun</i>	one of the four main points of a compass: north, east, south, west.
casual observation	<i>noun</i>	something that is seen, heard, touched, smelled, or tasted without being studied in depth.

civilization	<i>noun</i>	complex way of life that developed as humans began to develop urban settlements.
compass	<i>noun</i>	instrument used to tell direction.
compass card	<i>noun</i>	freely rotating circular card with magnets attached to its underside, its face marked with up to 32 compass points, degrees clockwise from north, or both.
complex	<i>adjective</i>	complicated.
concept	<i>noun</i>	idea.
consist	<i>verb</i>	to be made of.
coordinate	<i>verb</i>	to work together or organize for a specific goal.
critical	<i>adjective</i>	very important.
deviation	<i>noun</i>	error of a magnetic compass due to the effect of local magnetism, such as materials used in the construction of a ship or aircraft.
device	<i>noun</i>	tool or piece of machinery.
direction	<i>noun</i>	the way in which somebody or something goes, points, or faces.
discrepancy	<i>noun</i>	difference or conflict in sets of data.
engineer	<i>noun</i>	person who plans the building of things, such as structures (construction engineer) or substances (chemical engineer).
Equator	<i>noun</i>	imaginary line around the Earth, another planet, or star running east-west, 0 degrees latitude.
evolve	<i>verb</i>	to develop new characteristics based on adaptation and natural selection.
explorer	<i>noun</i>	person who studies unknown areas.
fleur-de-lis	<i>noun</i>	stylized design, often associated with France or French royalty, representing three petals of a flowering iris encircled by a band.
Flinders bar	<i>noun</i>	bar of soft iron, mounted vertically beneath a magnetic compass to compensate for vertical magnetic currents.
Global Positioning System (GPS)	<i>noun</i>	system of satellites and receiving devices used to determine the location of something on Earth.
GPS receiver	<i>noun</i>	device that gets radio signals from satellites in orbit above Earth in order to calculate a precise location.
gyroscope	<i>noun</i>	device consisting of a rotating wheel mounted so that its axis can turn freely in any direction, and capable of maintaining the same absolute direction in spite of movements of the mountings and surrounding parts.
indicate	<i>verb</i>	to display or show.
instrument	<i>noun</i>	tool.
iron	<i>noun</i>	chemical element with the symbol Fe.
Kelvin sphere	<i>noun</i>	one of two iron balls placed next to a magnetic compass to compensate for horizontal magnetic currents. Also called a Kelvin ball or navigator's ball.
landmark	<i>noun</i>	a prominent feature that guides in navigation or marks a site.

landscape	<i>noun</i>	the geographic features of a region.
Latin	<i>noun</i>	language of ancient Rome and the Roman Empire.
latitude	<i>noun</i>	distance north or south of the Equator, measured in degrees.
lodestone	<i>noun</i>	natural magnet.
longitude	<i>noun</i>	distance east or west of the prime meridian, measured in degrees.
magnet	<i>noun</i>	material that has the ability to physically attract other substances.
magnetic declination	<i>noun</i>	difference between a local magnetic field, or the direction a compass points, and true north, or the direction of the geographic North Pole.
magnetic field	<i>noun</i>	area around and affected by a magnet or charged particle.
magnetic north	<i>adjective</i>	direction that all compass needles point.
magnetize	<i>verb</i>	to turn something into a magnet.
map	<i>noun</i>	symbolic representation of selected characteristics of a place, usually drawn on a flat surface.
marine	<i>adjective</i>	having to do with the ocean.
mariner	<i>noun</i>	sailor.
monitoring station	<i>noun</i>	facility with instruments and tools for measuring and keeping track of conditions in an area.
navigation	<i>noun</i>	art and science of determining an object's position, course, and distance traveled.
Northern Hemisphere	<i>noun</i>	half of the Earth between the North Pole and the Equator.
orbit	<i>verb</i>	to move in a circular pattern around a more massive object.
pilot	<i>noun</i>	person who steers a ship or aircraft.
plot	<i>verb</i>	to form a path based on calculations.
portable	<i>adjective</i>	able to be easily transported from one place to another.
principle	<i>noun</i>	rule or standard.
prism	<i>noun</i>	device for distributing light into different colors of the spectrum.
reliable	<i>adjective</i>	dependable or consistent.
rotate	<i>verb</i>	to turn around a center point or axis.
satellite	<i>noun</i>	object that orbits around something else. Satellites can be natural, like moons, or made by people.
significant	<i>adjective</i>	important or impressive.
Southern Hemisphere	<i>noun</i>	half of the Earth between the South Pole and the Equator.
steel	<i>noun</i>	metal made of the elements iron and carbon.
true north	<i>noun</i>	direction of the geographic North Pole.

For Further Exploration

Articles & Profiles

- Royal Museums Greenwich: The Magnetic Compass

Worksheets & Handouts

- National Geographic Maps: Basic Map & GPS Skills

Video

- Ordnance Survey UK: How to Use a Compass

Websites

- Natural Resources Canada: Using a Compass



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