How to use a compass

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Using the compass alone

This is a very easy lesson, and I would say, not sufficient for those who would like to travel safely in unfamiliar terrain.

N

W

E

S

The first thing you need to learn, are the directions. North, South, East and West. Look at the figure and learn how they are. North is the most important.

There are several kinds of compasses, one kind to attach to the map, one kind to attach to your thumb. The thumb-compass is used mostly by orienteers who just want to run fast, and this is the kind of compass I normally use.

But not in this tutorial. I would recommend the third kind of compass. Let's take a look at it:
You see this red and black arrow? We call it the compass needle. Well, on some compasses it might be red and white for instance, but the point is, **the red part of it is always pointing towards the earth's magnetic north pole.** Got that? That's basically what you need to know. It's as simple as that. But if you don't want to go north, but a different direction? Hang on and I'll tell you.

You've got this turnable thing on your compass. We call it the Compass housing. On the edge of the compass housing, you will probably have a scale. From 0 to 360 or from 0 to 400. Those are the degrees or the azimuth (or you may also call it the bearing in some contexts). And you should have the letters N, S, W and E for North, South, West and East. If you want to go in a direction between two of these, you would combine them. If you would like to go in a direction just between North and West, you simply say: "I would like to go Northwest ".

![Diagram showing compass needle and directions](image1)

Let's use that as an example: You want to go northwest. What you do, is that you find out where on the compass housing northwest is. Then you turn the compass housing so that northwest on the housing comes exactly there where the large direction of travel-arrow meets the housing.

![Diagram showing compass needle and northwest direction](image2)

Hold the compass in your hand. And you'll have to hold it quite flat, so that the compass needle can turn. Then turn yourself, your hand, the entire compass, just make sure the compass housing doesn't turn, and turn it until the compass needle is aligned with the lines inside the compass housing.

![Warning icon](image3)

Now, time to **be careful!** It is extremely important that the red, north part of the compass needle points at north in the compass housing. If south points at north, you would walk off in the exact opposite direction.
of what you want! And it's a very common mistake among beginners. So always take a second look to make sure you did it right!

A second problem might be local magnetic attractions. If you are carrying something of iron or something like that, it might disturb the arrow. Even a staple in your map might be a problem. Make sure there is nothing of the sort around. There is a possibility for magnetic attractions in the soil as well, "magnetic deviation", but they are rarely seen. Might occur if you're in a mining district.

When you are sure you've got it right, walk off in the direction the direction of travel-arrow is pointing. To avoid getting off the course, make sure to look at the compass quite frequently, say every hundred meters at least.
But you shouldn't stare down on the compass. Once you have the direction, aim on some point in the distance, and go there. But this gets more important when you use a map.

There is something you should look for to avoid going in the opposite direction: The Sun. At noon, the sun is roughly in South (or in the north on the southern hemisphere), so if you are heading north and have the sun in your face, it should ring a bell.

When do you need this technique?
If you are out there without a map, and you don't know where you are, but you know that there is a road, trail, stream, river or something long and big you can't miss if you go in the right direction. And you know in what direction you must go to get there, at least approximately what direction.
Then all you need to do, is to turn the compass housing, so that the direction you want to go in, is where the direction of travel-arrow meets the housing. And follow the above steps.
But why isn't this sufficient? It is not very accurate. You are going in the right direction, and you won't go around in circles, but you're very lucky if you hit a small spot this way. And that's why I'm not talking about declination here. And because that is something connected with the use of maps. But if you have a mental image of the map and know what it is, do think about it. But I think you won't be able to be so accurate so the declination won't make a difference.

If you are taking a long hike in unfamiliar terrain, you should always carry a good map that covers the terrain. Especially if you are leaving the trail. It is in this interaction between the map and a compass, that the compass becomes really valuable.

**Using the compass in interaction with a map**

This is the important lesson, and you should learn it well.
It's when you use both compass and map the compass is really good, and you will be able to navigate safely and accurately in terrain you've never been before without following trails. But it'll take some training and experience, though.

I am not covering map reading here, guess you would have to consult other sources for that, but the lesson will be useful if you have a sense of what a map says.

First, a quick summary of what you will learn in this lesson:

1. Align the edge of the compass with the starting and finishing point.
2. Rotate the compass housing until the orienting arrow and lines point N on the map.
3. Rotate the map and compass together until the red end of the compass needle points north.
4. Follow the direction of travel arrow on the compass, keeping the needle aligned with the orienting arrow on the housing.

Here is our compass again:

![Compass Diagram]

The principles are much the same as in lesson 1 but this time, you are using the map to tell you which way is correct instead of your intuition.

Take a map. In our first example, we look at a map made for orienteering, and it is very detailed. Well, not really. We look at a fictitious map I drew myself, but never mind. To the point.
You want to go from the trail-crossing at A, to the rock at B. Of course, to use this method successfully, you’ll have to know you really are at A.
What you do, is that you put your compass on the map so that the edge of the compass is at A. The edge you must be using, is the edge that is parallel to the direction of travel arrow. And then, put B somewhere along the same edge, like it is on the drawing. Of course, you could use the direction arrow itself, or one of the parallel lines, but usually, it's more convenient to use the edge. At this point, some instructors say that you should use a pencil and draw a line along your course. I would recommend against it. First, it takes a lot of time, but offers no enhancement in accuracy of the method. Second, if you have wet weather, it may destroy your map, or if it is windy, you may loose it. You should keep your map (preferably in a sealed) transparent plastic bag, and if it is windy, tied up, so it can't blow away. But most important is that any drawings may hide important details on the map.

Time to be careful again! The edge of the compass, or rather the direction arrow, must point from A to B! And again, if you do t his wrong, you'll walk off in the exact opposite direction of what you want. So take a second look. Beginners often make this mistake as well.
Keep the compass steady on the map. What you are going to do next is that you are going to align the orienting lines and the orienting arrow with the meridian lines of the map. The lines on the map going north, that is. While you have the edge of the compass carefully aligned from A to B, turn the compass housing so that the orienting lines in the compass housing are aligned with the meridian lines on the map. During this process, you don't mind what happens to the compass needle.

There are a number of serious mistakes that can be made here. Let's take the problem with going in the opposite direction first. **Be absolutely certain** that you know where north is on the map, and be sure that the orienting arrow is pointing towards the north on the map. Normally, north will be up on the map. The possible mistake is to let the orienting arrow point towards the south on the map. And then, keep an eye on the the edge of the compass. If the edge isn't going along the line from A to B when you have finished turning the compass housing, you will have an error in your direction, and it can take you off your course.
When you are sure you have the compass housing right, you may take the compass away from the map. And now, you can in fact read the azimuth off the housing, from where the housing meets the direction arrow.

**Be sure that the housing doesn't turn, before you reach your target B!**

The final step is similar to what you did in lesson 1.

Hold the compass in your hand. And now you'll have to hold it quite flat, so that the compass needle can turn. Then turn yourself, your hand, the entire compass, just make sure the compass housing doesn't turn, and turn it until the compass needle is aligned with the lines inside the compass housing.

The mistake is again to let the compass needle point towards the south. The red part of the compass needle must point at north in the compass housing, or you'll go in the opposite direction.

It's time to walk off. But to do that with optimal accuracy, you'll have to do that in a special way as well. Hold the compass in your hand, with the needle well aligned with the orienting arrow.

Then aim, as careful as you can, in the direction the direction of travel-arrow is pointing. Fix your eye on some special feature in the terrain as far as you can see in the direction. Then go there. Be sure as you go that the compass housing doesn't turn.

If you're in a dense forest, you might need to aim several times. Hopefully, you will reach your target B when you do this.
At this time, you may want to go out and do some training, so you could check out some suggested exercises.

Unfortunately, sometimes, for some quite often, it is even more complicated. There is something called magnetic declination. And then, for hiking, you wouldn't use orienteering maps.

Magnetic Declination

Unfortunately, sometimes, for some quite often, it is even more complicated. There is something called magnetic declination. You see, the compass is pointing towards the magnetic northpole, and the map is pointing toward s the geographic northpole, and that is not the same place.

![Diagram of Magnetic North, Grid North, and Geographic North](image)

To make things even more complicated, there is on most hiking-maps something (that is very useful) called the UTM-grid. This grid doesn't have a real north pole, but in most cases, the lines are not too far away from the other norths. Since this grid covers the map, it is convenient to use as meridians. On most orienteering maps (newer than the early 70's), this is corrected, so you won't have to worry about it. But on topographic maps, this is a problem.

First, you'll have to know how large the declination is, in degrees. This depends on where on the earth you are. So you will have to find out before you leave home. Or somewhere on the map, it says something about it. One thing you have to remember in some areas, the declination changes significantly, so you'll need to know what it is this year.

If you are using a map with a "UTM-grid", you want to know how this grid differs from the magnetic pole. When you are taking out a course, you will do that more or less as described in lesson 2, but this time, you must also look out so that you don't align the orienting lines with the grid lines pointing west or east, or south for that matter. When you have taken out a course like you've learned, you must add or subtract an angle, and that angle is the angle you found before you left home, the angle between the grid lines or meridians and the magnetic north.
The declination is given as e.g. "15 degrees east". When you look at the figure, you can pretend that plus is to the right, or east, and minus is to the left and west. Like a curved row of numbers. So when something is more than zero you'll subtract to get it back to zero. And if it is less, you'll add. So in this case you'll subtract 15 degrees to the azimuth, by turning the compass housing, according to the numbers on the housing. Now, finally, the direction of travel-arrow points in the direction you want to go. Again, be careful to aim at some distant object and off you go.

You may not need to find the declination before you leave home, actually. There is a fast and pretty good method to find the declination wherever you are. This method has also the advantage that corrects for local conditions that may be present (I am thankful towards Jim Cross who pointed this out to me). This is what you do:

1. Determine by map inspection the grid azimuth from your location to a known, visible, distant point. The further away, the more accurate it gets. This means you have to know where you are, and be pretty sure about one other feature in the terrain.
2. Sight on that distant point with the compass and note the magnetic azimuth. You do that by turning the compass housing so that it is aligned with the needle. You may now read the number from the housing where it meets the base of the direction of travel-arrow.
3. Compare the two azimuths. The difference is the declination.
4. Update as necessary. You shouldn't need to do this very often, unless you travel in a terrain with lots of mineral deposits.

There are a few riddles and rhymes to help you remember whether you should add or subtract. I don't know them. If you live in an area where you don't go far for it to change between east and west, it is so small you wouldn't need to worry about it anyway. So it's best to just remember whether you should add or subtract. Nevertheless, I have collected some of the rhymes people use.

Uncertainty

You can't always expect to hit exactly what you are looking for. In fact, you must expect to get a little off course.
How much you get off course depends very often on the things around you. How dense the forest is, fog, visibility is a keyword. And of course, it depends on how accurate you are. You do make things better by being careful when you take out a course, and it is important to aim as far ahead as you can see.
In normal forest conditions we say that as a rule of thumb, the uncertainty is one tenth of the distance traveled. So if it is like in the figure, you go 200 meters on course, it is possible that you end up a little off course, 20 meters or so. If you’re looking for something smaller than 20 meters across, there is a chance you’ll miss. If you want to hit that rock in our example you'll need to keep the eyes open!

In the open mountain areas, things are of course a lot easier when you can see far ahead of you.

This was the last of the lessons you should know. But more lessons are upcoming. Now it is time to log out and get into the backyard, and then backcountry. Try it out! That is after all, the only way to learn this properly. **Good Luck!**

I said navigating in the mountains is easier. Well that is until the fog comes. Fog can make orienteering in the mountains and in the forest extremely difficult, and therefore, it can also be dangerous to the unexperienced.

**How to navigate in foggy conditions**

Fog makes things difficult, and in some situations dangerous. When you hike, you will probably some day experience these difficulties, and you’d better be prepared.

The fog can come creeping very fast. I have myself experienced from clear view to dense fog in 10 seconds. How fast this goes, depends on where you are.

In normal summer conditions without snow, it is often not much of a problem. Unless you are supposed to find a hut or something. The ground provides normally so much contrast, you could do the aiming I have written about in [lesson 2](#). Just be very careful and accurate. Perhaps you also might use some of the advice given later.

Winter conditions can make things a lot worse, when there is snow on the ground. The fog is white (or grey), the snow is also white. You may get a condition we call a "white-out". It's too late to read the terrain, and then the map isn't of much use. You can't see anything anyway. You have no choice but to put blind faith in your compass. I hope you knew where you were, because you need to take out a good compass course, like described in the other lessons.

If you are skiing, you should tie your compass to your arm or something, so you can look at it for every step you take. A rubberband is good. Check for more or less every step you take that the compass needle is aligned with the orienting lines. But if it is cold, make sure it doesn't affect circulation of blood in your arm, because that will make you freeze. If you are going on an expedition where you expect conditions like this, you should perhaps consider a arrangement to attach to your chest.

Let's consider a method to enhance the accuracy in conditions when you can't aim at anything.
If you are three persons in a row, like on the figure, and the last one carries a compass (of course, it is better that all three carry a compass, but the last one has command), he or she will see if you get off course because one of those in front of him or her will not be covered by the person in front. On the figure, the situation to the left is ok. The person on top is heading forward and but he sees only the person in front of him or her. In the situation to the right, it's time to stop. The last person can see the backs of both of them in front, and they are about to leave their course.

The further apart you go, the more accurate this method is, but it is also very important to have good contact. Sometimes the conditions get so bad there is no way to maintain contact, and then, the method may fail.

There is also another method for two people, where the lead person goes out on a compass azimuth, as far as the visibility will allow. The person behind stands still and watches the lead person, telling them if they are in the correct line or not. Once they have moved correctly into line they then stand still and the back person joins them. They then have their turn to move out ahead on the azimuth, and the whole cycle repeats. The problem with this method is when the visibility is very bad, the lead person can't go more that a few meters, and it would be dangerous to lose each other.

Finally, I'd like to comment on something that is seen in many standard texts on mountaineering navigation: You are commonly taught to use methods that use terrain features that are easily recognizable but far away. In my opinion, such methods are of little use, unless you require surveyor's accuracy in knowing where you are (hikers rarely do). As long as the weather is good, navigation is fairly easy and you'll naturally use these features as part of a more general approach. However, when the visibility is poor, you can't see these far-away-features and this makes the methods involving them rather useless. Therefore, focus your training in navigation on using features in your vicinity.
Cartography conventions help people make sense of a map immediately, which makes it easier to find their way.

Suppose you decide to make a trek to the North Pole. You can't catch a plane there. So instead, you pull out your compass, watch the needle swing northward and plot a path, right? Wrong. To get to the North Pole, or true north, just following your compass needle won't work.

If you want to get from a point at the bottom of a map to one at the top, you need to head true north. True north is a geographical direction represented on maps.
and globes by lines of longitude. Each line of longitude begins and ends at the Earth's poles and represents direct north and south travel.

Compasses, on the other hand, direct you to magnetic north, a point in the arctic regions of Canada that continually shifts location based on the activity of the Earth's magnetic fields. Fluid iron in the planet's core acts like a huge bar magnet, creating a relatively weak magnetic field. The force of that magnetic field has a horizontal component in the direction of magnetic north. A compass needle is magnetized and freely suspended to allow that horizontal force to pull it toward magnetic north as well.

But the Earth's magnet isn't perfectly aligned with the geographical poles. For that reason, there is a difference between true north on a map and the north indicated by your compass. That difference is called the magnetic declination and is measured by the angle between true north and magnetic north when plotted on a map.

Magnetic declinations vary from place to place, depending on the intensity of the Earth's magnetic fields. For instance, if you hold out a compass in New Zealand, magnetic north will be about 20 degrees east of true north, whereas the declination in Los Angeles is 12 degrees. Geographical lines do exist where true north and magnetic north are aligned, and these are called agonic lines. In North America, one currently runs through the panhandle of Florida up to the Great Lakes and into the Arctic Ocean.

Given these irregularities, how will you ever reach the North Pole or a true north destination? Read on to find out how you can do it -- any time of day and with man-made and natural navigation tools.

Finding True North with Navigation Tools

One of the simplest ways to find true north is with a Global Positioning System (GPS). A GPS recognizes your location by compiling the location information provided by multiple satellites that orbit the Earth. If you have one, you can select a 'true north' setting on your GPS, enter your destination, and it takes care of the rest.
Some cell phones are also equipped with compass capabilities. The Verizon Navigator, for example, comes with GPS hardware installed. These types of phones are becoming increasingly popular, particularly in Japan, where some models allow users to point them toward a destination, and the phone returns literally step-by-step directions. There are also free compass programs that you can download from the Internet to your phone. The compass will come into action when you point the phone in the direction of the sun. For a more traditional approach to navigation, let's look at the compass.

![compass diagram]

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Adjust your compass to find true north.

To find true north, you need to know your local declination value, or the angle difference between true north and magnetic north, discussed earlier. That information will either be listed in your map's legend or you can find it online at government Web sites, such as the National Geophysical Data Center. Why go to all this trouble? Even a 1 degree difference in true north and magnetic north can land you up to 920 feet (280 meters) off-course [source: Curtis].
You can adjust your compass to find true north.

There are a few options for adjusting your compass to true north. First, be sure to know whether the declination number is positive or negative, which is determined by whether you are east or west of the agonic line. If you are east of the line, it will be negative, meaning you turn the ring clockwise; west of it is positive, meaning you turn the ring counterclockwise.

Some compasses allow you to manually adjust the needle to compensate for the declination. Otherwise, you can use the bezel ring on a compass to set the magnetic declination by turning the ring until the orienting arrow points to your declination value. Then, hold the compass in your hand. When the needle and orienting arrow line up, the direction of travel arrow on the base will point true north. You can also accomplish this by aligning the orienting arrow and the direction of travel arrow. Then, hold out your compass and turn your body until the needle points to your declination. The orienting arrow and direction of travel arrow indicate true north.

Finding True North with the Sun

If you're lost during the day somewhere without a map, compass or GPS handy, the best method to find your direction is to look up. The movement of the sun can illuminate your way true north. But to use this solar guide, you'll need to remember a few important things. In the Northern Hemisphere, the sun always rises in the east and sets in the west. At noon, it looms in the middle of the horizon and directly south. That means when you're facing the sun at noon, walking directly toward it will take you south. Walking with the sun at your back means you're heading north. The opposite is true in the Southern Hemisphere.
If it isn't noon, and you want to find your directions during daylight, an analogue watch with minute and hour hands can serve as a substitute compass. First, make sure the watch displays the correct time. Then, point the hour hand at the sun. Next, holding the watch in place, imagine an angle formed by the hour hand and a line from the 12 o'clock position to the center of the watch. Then draw an imaginary line bisecting that angle. That line indicates south in the Northern Hemisphere. During daylight saving time, create the angle from the one o'clock position instead of the 12 o'clock position.

In the Southern Hemisphere, point the 12 at the sun, instead of the hour hand. Then, form an imaginary angle between the hour hand and a line from the 12 to the center of the watch. The line bisecting that angle represents north.

Don't have a watch? No problem. As long as you know the correct time, you can draw out your own clock on a paper and use it the same way.
You can use a stick and the shadows from the sun to find approximate true north.

For another way to get your bearings, find a stick and a large sunny spot on the ground. For this approach, remember that when the sun casts shadows, those shadows are in the opposite direction as its position in the sky. That means when the sun is in the eastern sky, its shadows will point toward the west.

That said, grab a stick, preferably about a yard (1 meter) high, and stab it in the ground in a sunny area so that you can see its shadow. Use a rock or other sharp
object and mark the tip of that shadow on the ground. Since the sun's shadows move from west to east during the day, this first point stands for west.

Catnap for 15 minutes or so, then mark where the stick's shadow has moved. Now you should have two spots in the dirt: The first spot represents the west and the second spot represents the east. If you draw a line between those two spots, you have a general idea of your east-west line. From there, you can draw your north-south line at a 90-degree angle to the east-west line.

Although these aren't precise directional guides, there are other clues in nature to help orient you toward true north:

- **Moss on trees** -- Although common convention holds that moss grows on the north side of trees, that isn't always the case. However, in the Northern Hemisphere, moss on the south side of trees will be thicker and greener because that side often gets more sun.
- **Trees** -- The bark may be duller and branches more extended to the sky on the north side of trees because it doesn't receive as much sun.
- **Melting snow** -- Snow may melt faster on the warmer southern side of rock faces or mountains.
- **Ant hills** -- Ants often build their nests on the south or southeastern side of trees where it is warmer.

OK. So we know how to find true north in the daylight. But what about when it's dark? Read on to the next page to learn how to find true north by the moon and stars.

Chris Cheadle/Getty Images
In the Northern Hemisphere, moss on the southern side of trees is usually greener.
Sources