Map and Compass

Maps

Information from the *Field Book for Canadian Scouting*

A topographic map shows details of a portion of the earth's surface drawn to scale on paper. The features shown fall into four main divisions:

- Water: including the sea, lakes, rivers, streams, ponds, marshes, swamps, glaciers and snowfields
- Relief: including mountains, hills, valleys, cliffs, slopes and depths.
- Culture: including cities, towns, villages, buildings, railways, highways and land boundaries
- Vegetation: including wooded areas, orchards, vineyards and cleared areas.

Map makers use colour to tell the difference between land and water, and forest and cleared land. **Contour Lines** tell the height of various areas about sea level. Blue horizontal grid lines are called "northings"; vertical ones are called "eastings." Both help pinpoint locations.

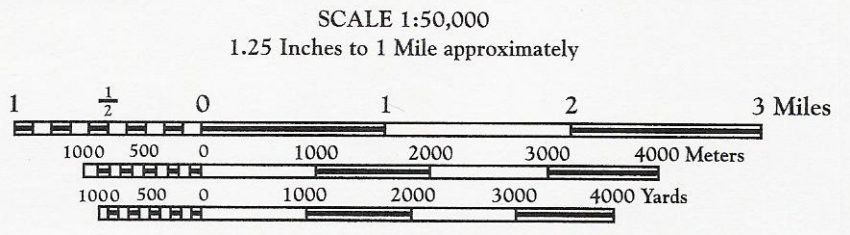
A map must be drawn to a uniform **scale** if it's going to truly represent the surface of the ground. Distances must all appear on the map in the same proportion, and the map user must know what that proportion is. Beginners need to understand scale well. If they don't, they could form wrong ideas about what the terrain actually looks like. They could judge size and distances on the map incorrectly and get into serious trouble.

Canadian maps, like those of other countries, show scale as the proportion of map distance to true distance. On maps with a scale of 1:250,000, one centimeter on the map represents 250,000 centimetres on the ground.

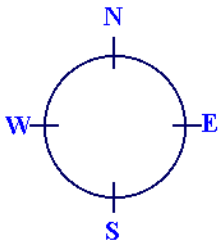
If all maps were drawn to the same scale, it would be easy to compare actual areas and distances on the ground. But maps have many different uses and so there are many different scales. Canadian topographic maps come in four scales:

1:25,000	(or 50 mm to the kilometre)
1:50,000	(or 20 mm to the kilometre)
1:125,000	(or 8 mm to the kilometre)
1:250,000	(or 4 mm to the kilometre)

All Canadian topographic maps include a graduated scale on each sheet. This scale usually shows the distance in both kilometres and miles. Many modern maps also give distance in metres and yards. The scale at the bottom of a topographic map demonstrates several ways to measure distances.



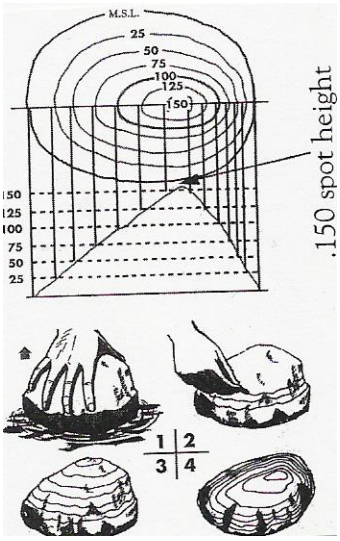
Direction



You'll usually find north at the top of the map, south at the bottom, east to the right, and west to the left. These are the "true" or astronomic" north, south, east, west. They are different from magnetic directions. A set of arrows on the map's border will show the difference in degrees between true directions and magnetic directions. This difference is called "magnetic declination."

Contours

A topographic map does not show landscape in the same way a photograph or a painting does. With practice, a map reader will be able to pick out small features, like streams or bridges, and learn to recognize symbols for many others which identify specific terrain. Hills and valleys are shown on the flat surface of a map by *brown* contour lines; these connect points of equal height throughout the area presented on the map. Lines are numbered to show the height of the ground in metres (or feet) above sea level. For example, a map reader following the course of a contour line would go neither uphill nor downhill but would stay on the same level.



The drawing illustrates an imaginary hill which rises from sea level to 150 m; this is how it would appear on a map and how it would appear in cross section. Where lines are far apart, the ground slopes gently. Where they lie close together, the hill is steep. When lines are crowded, they show a cliff.

At the top of a large hill, the map may show a number, called a "spot location," which represents the altitude of the crest.

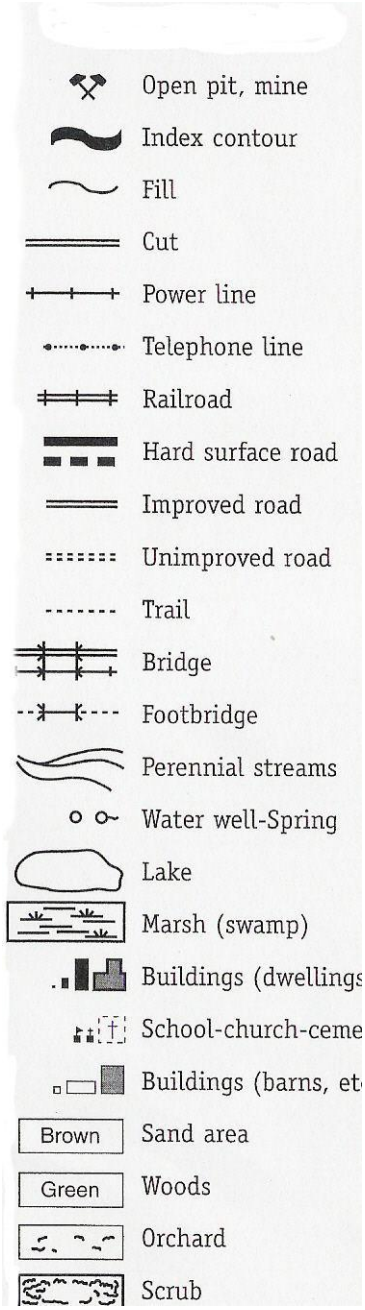
The vertical distance between contour lines is called the "vertical interval" or "contour interval." The horizontal distance between contours is called the "horizontal equivalent."

Ordering Maps

The best topographic maps for hiking have a scale of 1:50,000. These are available for your area. Of course you'll have to know the specific section of the country for which you want the map. These maps are available at many camping and "outdoor" stores.

(Note regarding SK sources – You can also purchase topographical maps from Information Services Corporation of Saskatchewan in Regina – see www.isc.ca)

Map Symbols



All maps have a reference that displays symbols and abbreviations. They may all appear in a margin of the map, or some may appear in the margin with the remainder on the back. These symbols tell details of the terrain and various features of the area.

The **colours** used are symbolic too. Everything in ***black*** indicates manufactured structures (roads, towns, bridges, boundaries and dams). Water, such as rivers, lakes and swamps, appears as ***blue***. Valleys, hills and mountains are in ***brown***. On some maps, woodland areas are shown in ***green*** and main highways in ***red***.

Orienting or Setting a Map

A map is "oriented" when it is placed to correspond in direction with the ground it represents. Map readers can tell in which direction they're facing by any of the following methods.

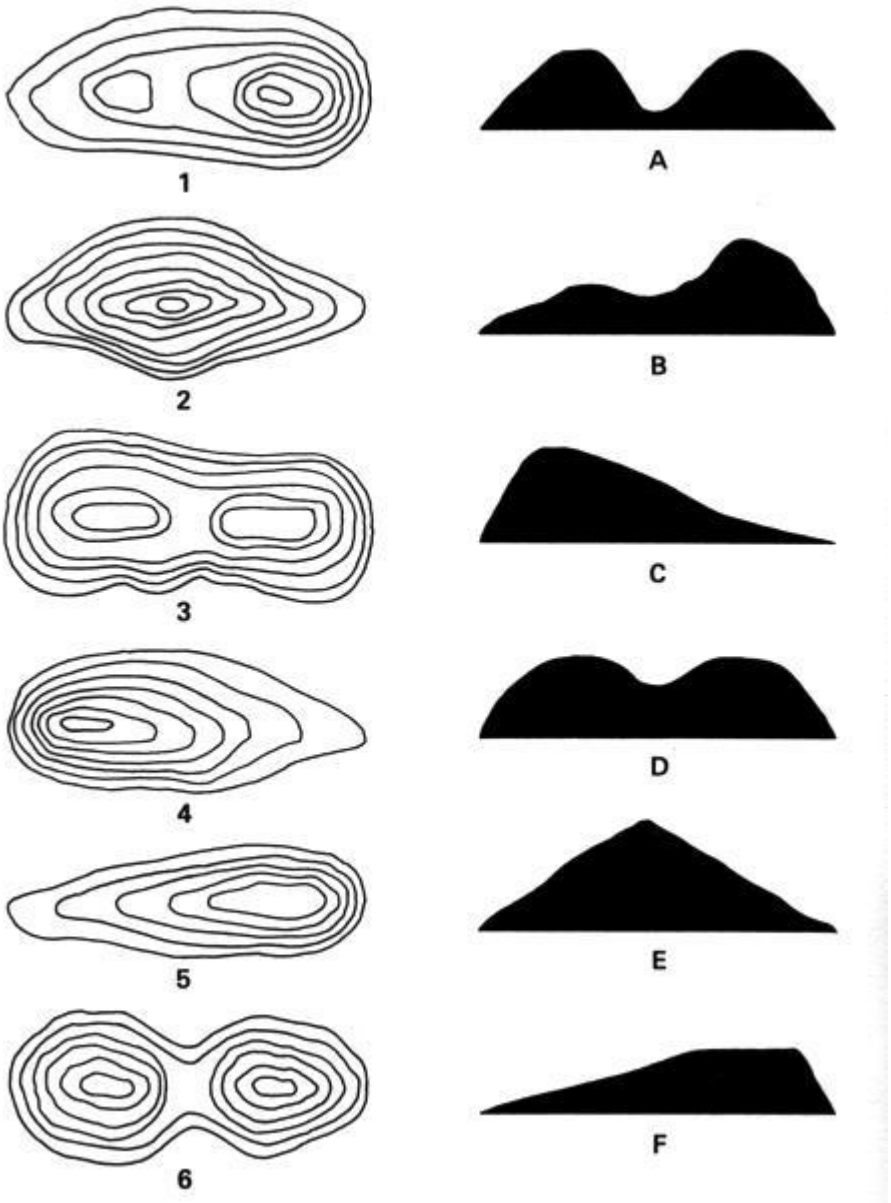
- □ *By the compass*.
- □ *By objects*. If you know your position on the map and can identify the position of some distant object, turn your map so the lines on the map between your position and the object point to the distant object.
- □ *By a watch and the sun*. In the northern hemisphere, if Daylight Saving Time is in effect, first set your watch back to Standard Time. Place the watch on something flat with the hour hand pointing toward the sun. True south is midway between the hour hand and the figure 12. True north is directly opposite. (This is a very rough way to check directions.)
- □ *By the North Star*. In latitudes below 60 degrees N, the bearing of the North Star (also called Polaris) is never more then 2° from true north.

Map Date

All maps show the date when they were prepared and printed. No map is ever truly up-to-date, for cities grow larger, new buildings are built, roads are widened, and new dams are created. Check your maps to make sure that they are the most current ones available.

Contour Exercise

Try this self-test. Match the contours on the left with the terrain on the right.



It is important to use all the information provided by the topo map in order to correctly identify the features. Note that the figures 1, 3 and 6 on the right above all have two peaks, but by using the shape of the contour lines and their relative elevations you can determine which contour figure goes with which side view. This becomes an important skill to learn when trying to identify features in the real world; matching figure 3 on a map with profile A in the real world would be a big mistake if you were counting on the identification to tell you where you are!

Answers:
1-B; 2-E, 3-D, 4-C, 5-F, 6-A

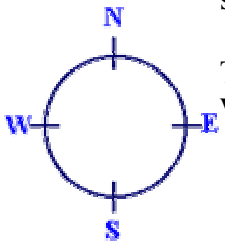
How to Use a Compass

Information from Kjetil Kjernsmo's Illustrated Guide on How to Use a Compass
www.learn-orienteering.org/old/

Lesson One:

Using the compass alone

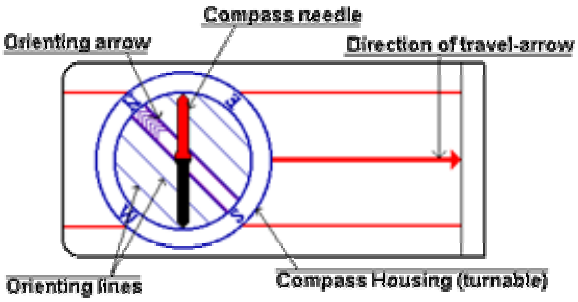
This is a very easy lesson, and I would say, not sufficient for those who would like to travel safely in unfamiliar terrain**.**



The first thing you need to learn, are the directions. **N**orth, **S**outh, **E**ast and **W**est. Look at the figure and learn how they are. *North is the most important.*

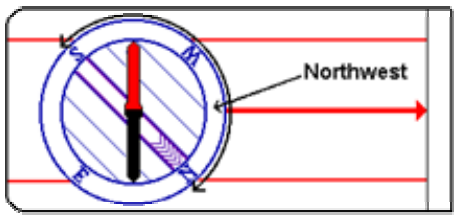
There are several kinds of compasses, one kind to attach to the map, one kind to attach to your thumb. The thumb-compass is used mostly by orienteers who just want to run fast, and this is the kind of compass I normally use - but not in this tutorial.

I would recommend the third kind of compass. Let's take a look at it:

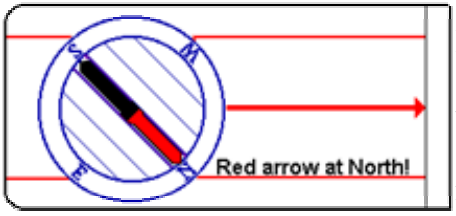


You see this red and black arrow? We call it the *compass needle*. Well, on some compasses it might be red and white for instance, but the point is, **the red part of it is always pointing towards the earth's magnetic north pole.** Got that? That's basically what you need to know. It's as simple as that.

What 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 **N**orth, **S**outh, **W**est and **E**ast. 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 ".



Example: You want to go northwest. What you do, is 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.



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.

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. *Always take a second look to make sure you did it right!*

A second problem might be local magnetic attractions. If you are carrying anything 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. Magnetic deviation 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* - every hundred meters at least.

You shouldn't stare down on the compass. Once you have the direction, aim on some point in the distance, and go there. 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 you can't miss if you go in the right direction. The trick is, you must know what direction you must go to get there, or 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. That's why I'm not talking about *declination* here. Declination is something connected with the use of maps. If you are taking a long hike in unfamiliar terrain, you should always carry a good map that covers the terrain. This is especially important if you are leaving the trail. It is in this interaction between the map and a compass, that the compass becomes really valuable.

Lesson Two:

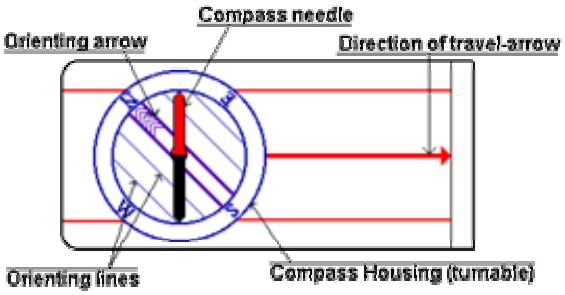
Using the compass in interaction with a map
This is the important lesson, and *you should learn it well.*
It's when you use both compass and map that the compass becomes really handy. You will be able to navigate safely and accurately in terrain you've never been before without following trails. It will take some training and experience, so be patient.

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:

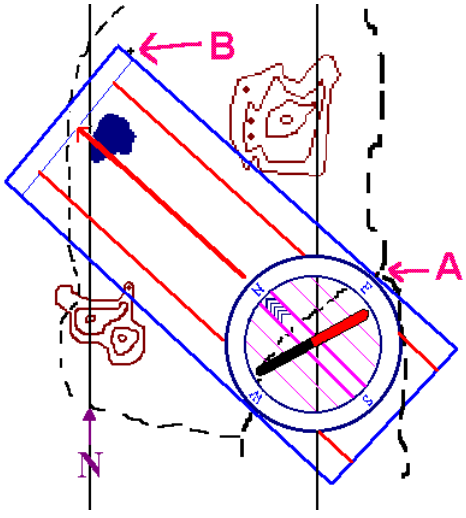
1. Align the edge of the compass with the starting and finishing point.
2. Rotate the compass housing until the orienting arrow and lines point N on the map.
3. Rotate the map and compass together until the red end of the compass needle points north.
4. Follow the direction of travel arrow on the compass,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

Here is our compass again:



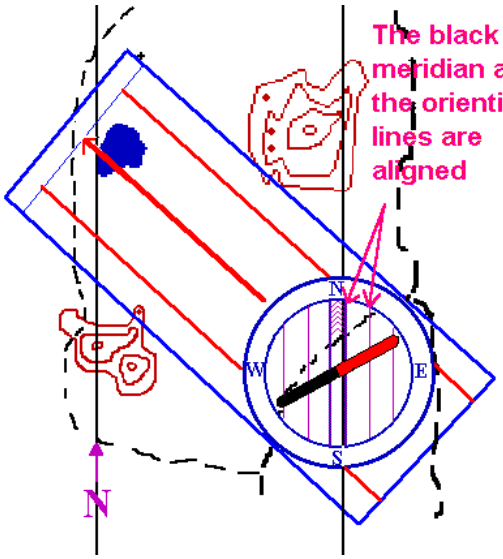
The principles are much the same as in Lesson One but this time, you are using the map to tell you which way is correct instead of your intuition.

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 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.



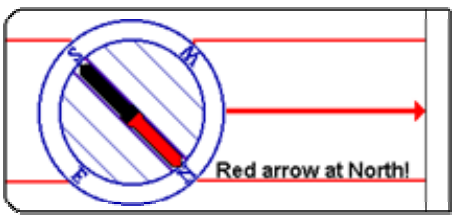
At this point, some instructors say that you should use a pencil and draw a line along your course. I would recommend against it. First, it takes a lot of time, but offers no enhancement in accuracy of the method. Second, if you have wet weather, it may destroy your map, or if it is windy, you may loose it. Most importantly, any drawings may hide important details on the map. You should keep your map in a transparent plastic bag (preferably sealed), and if it is windy, tied up, so it can't blow away.

Time to be careful again! The edge of the compass, or rather the direction arrow, must point from A to B! Again, if you do this wrong, you'll walk off in the exact opposite direction of what you want. *Always take a second look. Beginners often make this mistake.*



Keep the compass steady on the map. What you are going to do next is **align the orienting lines and the orienting arrow with the meridian lines of the map** (the lines on the map going north). 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 worry about 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. A possible mistake is to let the orienting arrow point towards the south on the map.

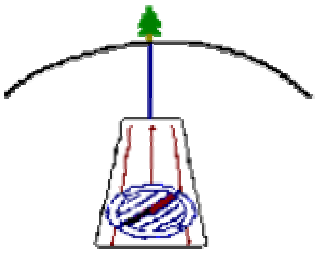
Keep an eye on the edge of the compass. If the edge isn't going along the line from A to B when you have finished turning the compass housing, you will have an error in your direction, and it can take you off your course.
When you are sure you have the compass housing right, you may take the compass 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 One. Hold the compass in your hand. You'll have to hold it quite flat, so 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.
Again, a common mistake is to let the compass needle point towards the south. The red part of the compass needle *must point to the 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. Aim *carefully* 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. As you are walking be sure 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.

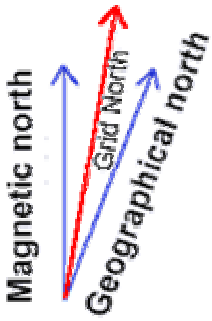


At this time, you may want to go out and do some training, so you could check out some suggested exercises (check out www.learn-orienteering.org/old/).

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

Lesson Three:

Magnetic Declination

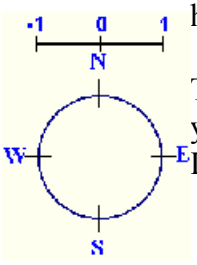


There is something called *magnetic declination*. You see, the compass is pointing towards the *magnetic* North Pole, and the map is pointing toward s the *geographic* North Pole, and that is not the same place. To make things even more complicated, on most hiking-maps there is something very useful 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 (since the early 1970'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, unless it is mentioned somewhere on the map. 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 more or less what is described in Lesson Two. 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. 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.

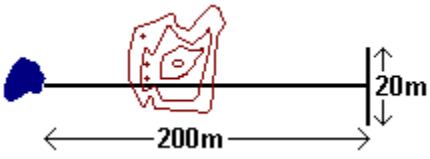
You may not need to find the declination before you leave home, actually. There is a fast and pretty good method to find the declination wherever you are. This method has also the advantage that corrects for local conditions that may be present (I am thankful towards Jim Cross who pointed this out to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

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. More lessons will be posted at www.learn-orienteering.org/old/. Now it is time to get outside into the backyard, and then backcountry. Try it out! That is after all, the only way to learn this properly.

Good Luck!