Mazamas
Mt. Tabor Map and Compass Training Course

To do the course, you'll need:

1. Printout of the course map (at web link at bottom of page)
2. Printout of the course notes (you're reading them =^)
3. Compass (ideally with a baseplate and adjustable declination)
4. Pencil or pen

The skills you'll learn in this field exercise include:

A. Maps – Contours, Scale, Declination and UTM grid
B. Maps – Sense of direction and Orienting your map
C. Maps - UTM grid coordinates
D. Compass –Direction and bearings
E. Compass - Shooting and following a bearing
F. Map and Compass – Measuring a bearing between points on the map
G. Compass - Following a bearing in low visibility or past an obstruction by leapfrogging

A - Map skills: Contours, Scale, Declination and UTM

The course begins at Point 1 on the map, on the east side of Reservoir 6. Are you there?

1 - What's the date engraved on one of the steps? _____
History: The Mt. Tabor reservoirs supply much of the drinking water for Portland. They were competed in . . . you guessed it, 1911. The water originates in the Bull Run watershed, on the west slopes of Mt. Hood. (The other numbered reservoirs are in other locations around Portland, hence the strange numbering system.)

First, take a look at your map. When using any map, it's good practice to get familiar with the contour interval, index contour interval, scale, declination and UTM grid interval before you begin your trip. So, let's do it. This will take just a few minutes.

The contour interval, usually printed on topo maps, tells you the vertical distance between each individual contour line.
2 – What is the contour interval of your map? _____ feet.

An index contour is a contour line printed in a heavier line weight (aka bold) that has an elevation value printed somewhere on it. These index lines allow you to determine elevation.
3 - How much vertical distance is represented by each index contour on your map?
_____ feet

All maps should have some indication of scale. Almost always you'll have a scale bar, and sometimes a ratio scale as well, like 1:24,000, 1:50,000, etc. This map has just a simple scale

bar. It's useful to figure out how far in feet one inch on the map represents. Put the inch rule on the baseplate of your compass (if it has one; if not, use cm) on the bar scale printed on the lower left corner of the map. (Another reason why you need a compass with a baseplate.) Come up with an approximate value for what one inch on the map equals in feet. (Jot it down on your map, under the scale bar, for future reference.)
4 - What is the scale of your map? 1 inch (cm) on your map equals about _____ feet.

Declination is the difference in degrees between the geographic North Pole and magnetic north. This value changes depending where on earth you are, and a little bit with time (old maps may have a slightly different declination). The declination of your local area should be printed on any topographic map. This number is used to adjust the declination on your compass so you can read true north bearings.
5 - What is the declination of your map? _____ degrees east.
Your compass should be adjusted to this setting already. Please do it now if it's not. (You were a smart navigator and bought a compass with adjustable declination, right?)

You'll notice a UTM grid printed on the map as well. Normally on a smaller scale map (that shows a larger area) a UTM grid is printed every 1 km, or 1,000 meters. Here, it's different, because this is such a large scale map (that shows a small area.)
6 – How far apart are the UTM grid lines printed on your map?_____ meters
(Navigation tip: Once you know the distance of each side of the square of a UTM grid, it can help you to quickly estimate distances. In this case, count squares and multiply by 100 meters to estimate the distance between points. Yes, you do have to "think metric" for this to work!)

We've been standing around long enough, so let's get warmed up. From here, we're going to walk to Point 2. But, before you leave, use your map to answer these questions. Determining elevation and distance are the two most common uses for topo maps, so we'll get a lot of practice in these two areas today. (Hint: if your compass has string/cord attached, use it along with the scale bar on your map to determine distances.)
7 – What is the elevation of Point 1? about _____ feet
8 - How far away is Point 2 from Point 1? about _____ feet

Walk from point 1 to point 2, the bay/myrtle tree on the SW grassy edge of Reservoir 5.

~~~~~~

B – Map skills: General "sense of direction" and Orienting the map

Are you at Point 2? Good. Take a gentle pinch of the leaves of the tree next to you, and smell your fingers. It's *Umbellularia californica*, (Oregon Myrtle, or Bay tree). A leaf can be added to your next stew, but go easy - these are much stronger in flavor than the bay leaves you buy in the spice aisle. (It's also called the headache tree. Crush a leaf in your hands and take a big sniff if you **really** want to find out why.)
~~~~~~

Before you get out your compass, try this.
9 - Do you have a good sense of where N, S, E and W are? Try pointing to these directions. Think of why you know this (or don't know, as the case may be). Some people have a good "internal compass" and others do not. If you're not sure of your major directions, have faith - it's a skill that can be learned.

A typical first step in using a map in the field is to orient the map. That is, you align the map to the features you're actually looking at. If you're facing north, the north end of the map should be farthest away from you. Most of the time you know what direction you're facing, and orienting can be done without using the compass. But if you have no idea what direction you're facing, you need to use the compass to orient the map to north. (Note: for this to work, you need to have the declination properly set on your compass as in question #5.)

10 – Follow these steps to orient your map to true north using your compass:

1. Rotate your compass dial so North is at the "direction of travel" arrow.
2. Put the left edge of your compass baseplate on the left edge of the map.
3. Holding them together with one hand, slowly turn your whole body until the red end of the magnetic needle is "boxed" inside the red part of the orienting arrow.

The map, along with the compass and you, should now be facing geographic (not magnetic) north.

Reality check time. Look at the map, and look at the terrain around you. The map shows a road running roughly N-S just to your west (left), and the reservoir east (right) of you. Can you see these features on the ground?

11 - What general direction (N, S, NE, SW, etc,) is it from Point 2 to Point 3? _____

12 – Between Point 2 and Point 3 is a summit, indicated by a closed circle contour line. Is this summit the highest point in Mt. Tabor park? Circle one: Y / N

Now walk to Point 3, which is the row of 5 large Douglas Fir trees, about 100 feet south of the south side of Reservoir 1.

C - Map skills: UTM grid coordinates

Are you now at point 3, the row of five big Douglas fir trees? Good. Here, we'll learn about UTM coordinates.

UTM (Universal Transverse Mercator, in case you really cared) is the preferred method of specifying your precise location for land navigation. It's much easier to use than latitude and longitude (which everyone has heard of, but hardly anyone really knows how to actually use for actual navigation! Lat/long can specify a location just as precisely, but it's measured in minutes and seconds - far harder to figure out than UTM.)

Why are UTM coordinates useful? Even if you don't use a Global Positioning System (GPS) unit, UTM coordinates can be handy, as they allow you to precisely and easily specify any location (+/-100 meters) anywhere on earth.

Consider these situations:

1 – In town, your friend gives you the UTM coordinates for a great secret campsite. You mark it on your map so you can find it on your upcoming trip to the same area.

2 – Your climbing partner has suffered a severe injury, and you need help to evacuate him. You hike out with a first aid report form, including the UTM coordinates of the accident site so the rescue team can easily locate your partner.

UTM Tips: Tip #1: Northing values increase as you go north, and Easting values increase as you go east. Tip #2: The answer to question #6 will help you here.

Using the UTM grid printed on your map, answer the next 4 questions. Round off to the nearest 10 meters; your answer should end in a zero.

13 – Point 3, your present location Easting _____ Northing _____

14 – The summit of Mt. Tabor Easting _____ Northing _____

15 - If you went to this UTM coordinate, would your feet be: a)wet or b)dry?_____
Easting 531**550** Northing 5039**820**

16 – In what quadrant of the map is this UTM coordinate? (NE, NW, SE, SW)? (circle one)
Easting 531**410** Northing 5040**470**

See how easy it is to use the UTM coordinate system?

17 – What is the elevation of point 3? _____ feet

18 – What is the elevation gain between point 3 and point 4? _____ feet

From Point 3, walk to Point 4 near the top of Mt Tabor (a statue). The best route up heads east from Point 3 about 200 feet, then up a trail. As you're walking, note the terrain the trail is on and look at the contours on the map.

19 – Does the trail ascend a valley or a spur (aka ridge)? _____

20 – Do the contours on the map point downhill or uphill on this section of trail?
_____

Contour reading tip: Contours representing a spur/ridge always point downhill. Contours showing a valley/gully always point uphill.

D - Compass skills: Direction and Bearings

Are you at the statue at point 4? Good. (The blackberries along the trail you took to get here are yummy in August.)

Statue history: Harvey Scott was editor of the Oregonian newspaper for nearly 4 decades in the late 1800s. Gutzon Borglum sculpted this piece in the early 1930s. You may have heard of his better-known work: Mt. Rushmore, in the Black Hills of South Dakota.

The correlation between directions (N, S, SE, etc.) and numerical compass bearings (0 degrees, 180 degrees, 135 degrees, respectively) are indicated on your compass dial. The bearing (or more technically speaking, an azimuth) is simply a direction given numerically in degrees from 0 (North) to 360. Look at your compass dial to answer the following questions.

21 - What is the bearing for South? _____ degrees
22 - What is the bearing for East? _____degrees
23 - What is the bearing for SW? _____degrees
24 - What is the direction for the bearing 270°? _____
25 - What is the direction for the bearing 135°? _____

From Point 4, stroll over to point 5: the most northern of 4 benches facing west, near the Mt. Tabor summit.

E - Compass skills: Shooting and Following a Bearing

Are you at Point 5? Great! If it's a clear day, enjoy the vista west toward downtown Portland.
26 –What animal is on the plaque at the base of your bench? _____
27 - What is your elevation? _____ **feet**
28 – What is the distance between Point 5 and Point 4? about _____ **feet**

Here at Point 5, we'll learn how to take a bearing in the field with your compass. You may have a general sense that taking a bearing with a compass is one of its main uses, but why would you do this?. There are two man reasons for taking a compass bearing in the field: 1) when you want to actually follow the bearing, or 2) when you want to plot the bearing on a map. We'll look at the first case today, as it's much more common. Consider this scenario:

From your high camp in clear afternoon weather, you can see that your preferred route to the summit tomorrow leads from your camp across a series of snowfields to a low pass about a mile away, and then up a ridgeline to the summit. From camp, you take a compass bearing to the pass. The next morning when you leave camp, the cloud ceiling has dropped and visibility is just a few hundred feet. No worries! Your climbing team follows the bearing you took the previous day (using the "leapfrog" method, described below), reaches the pass, and continues on upward

to the summit. (Note: It is rare in the mountains to be able to travel in a straight line for any significant distance.)

How to take a bearing with a compass *that does not have a sighting mirror*
(Before you do this, be sure your compass declination is properly set.)
1 – Face the object to which you want to take a bearing.
2 - Making sure the direction of travel arrow is pointing away from you, place the end of the compass near your belly button. (This allows you to look straight down on the arrow to get an accurate reading.)
3 – Holding the baseplate of the compass steady, slowly turn rotate the compass housing until the red north half of the magnetic needle is "boxed" inside the red north half of the orienting arrow.
4 – The bearing to your object can now be read at the "read bearing here" marker/triangle on your compass baseplate.

Standing at Point 5, you should be able to see these features. Take a bearing on each one, and write them here.
29 – KOIN building downtown (rust-colored hi-rise, green pyramid roof) _____degrees
30 – Green metal cell tower (to your north) _____ degrees
31 – The statue at point 4 (squint through the trees) _____ degrees

Now, let's learn how to follow a bearing. It's pretty easy!

How to follow a bearing
1 – Turn the rotating housing on your compass to the desired bearing.
2 – Making sure the direction of travel arrow is pointing away from you, hold the end of the compass near your belly button.
3 – Rotate your entire body until the red north end of the magnetic needle is "boxed" inside the red north orienting arrow.
4 – You are now facing the direction of the bearing. Look up and make note of an object (tree, rock, etc.) on your bearing line that you can clearly see, ideally fairly far away (100-300 meters). Remember this point. Put your compass away and walk toward this point. When you get to this point, repeat steps 2, 3 and 4.

32 - A short "triangle" exercise on following bearings:
Start at the northern edge of the bench (with the animal plaque) at Point 5.

- Walk 40 paces on a bearing of 45 degrees.
- Walk 40 paces on a bearing of 165 degrees.
- Walk 40 paces on a bearing of 285 degrees.

You should have walked a triangle, ending up where you started.

Break time? A drinking fountain and bathrooms are nearby. It's almost time to walk to Point 6, but first, we'll learn about measuring a bearing from the map for use in the field.

F - Map and Compass – Measuring a bearing between points on a map

When would you have to do this? Consider this scenario:
You've made camp at a trail junction. The map shows that there is a small lake about a half mile away. This appears to be the only nearby source of water for your camp. The terrain is moderate and tree cover is sparse, so it appears that straight-line travel will be feasible to get to the lake. Using the map, you determine the bearing from your camp to the lake, then you follow this bearing to the lake to get water.

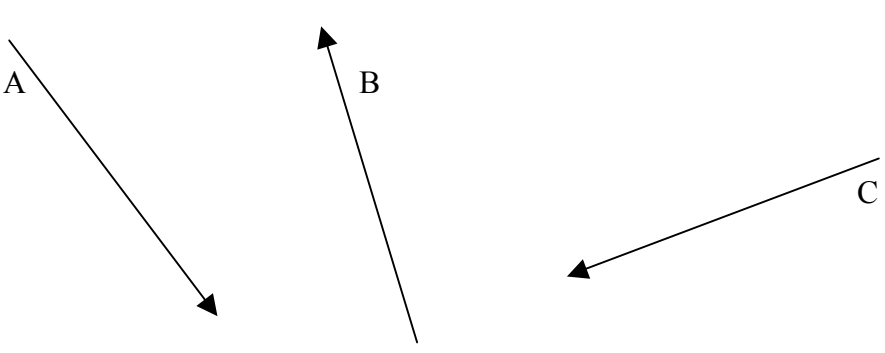
How to measure a bearing between points on the map
1 – Using one edge of the compass baseplate, put one part of the edge on your present location and another part of the same edge on your objective. (Think of using the edge of the baseplate as a ruler to simply draw a straight line between the two points.) Be sure the direction of travel arrow is pointing toward your objective.
2 – Rotate the compass dial so North is pointing to the north edge of your map. To make this as precise as possible, align the meridian lines on your compass housing with the UTM grids, which point to north.
Important: Completely ignore both the magnetic compass needle AND the orienting arrow that's pointing to 17 degrees for this exercise, as you're essentially using your compass as a protractor.
3 - Read the bearing.

Look at the arrows marked A, B and C below. First, estimate what the bearings will be. (Round off your answer to the nearest 10 degrees – your answer should end in a zero.)
Hint: Look back at Questions 21-25 if you need a refresher. Looking at a map and quickly estimating an approximate bearing before you actually get out the compass to measure it can be a good reality check.

33 – Estimated bearing of:
A_____ degrees **B**_____ degrees **C**_____ degrees

Then, with your compass, determine the actual bearings for each of these lines. (Fold over the edge of the sheet of paper to make a "North line" on which to align your compass.)

34 - Actual bearing of:
A_____ degrees **B**_____ degrees **C**_____ degrees



Now, let's put it together with the map.

35 - What is the bearing from Point 5 to Point 6? _____ degrees

36 – Does it look feasible to walk on a direct bearing from Point 5 to Point 6? Y / N

As we discussed before, it's often not possible to walk very far on a precise, straight line in the backcountry. However, getting a bearing from a map can give you a general starting direction. It's often "good enough" to then follow the path of least resistance through the terrain, staying more or less on the correct bearing.

Starting off using the bearing you calculated in Question 35, walk to Point 6 – the "summit" of the Mt. Tabor volcano. (You should be looking down at the basketball court and amphitheater)

G – Compass - Following a bearing in low visibility or past an obstruction by leapfrogging

Are you at Point 6? Congrats, you just summitted an Oregon volcano! (No, you probably shouldn't put this peak on your climbing resume.) Some geology trivia from Portland Parks: Mt. Tabor makes Portland one of only two cities in the continental U.S. to have an extinct volcano within its boundaries; the other city is Bend, Oregon. The volcanic features of Mt Tabor became known in 1912, years after it became a public park. The volcanic cinders discovered in the park were later utilized in surfacing the park's roads.

To travel from Point 6 to Point 7, let's put together all the map skills you've learned today.

37 - What is the elevation of point 6? _____ feet

38 - What is the elevation of point 7? _____ feet

39 - What is the elevation difference between Point 6 and Point 7? _____feet

40 - About halfway between Point 6 and Point 7, you see contours pointing uphill. Does this indicate a spur or a valley? _____

41 - What general direction do you need to travel between Point 6 and Point 7? (such as NE, SW, W, E, etc) _____

Just by looking at the map, guess the approximate bearing between Point 6 and Point 7.
42 - Your guess at the approx. bearing between Point 6 and Point 7: _____ deg.

43 - Actual bearing from Point 6 to Point 7: (measure this from your map) _____ **deg.**

Following a bearing in low visibility

When following a bearing in terrain with limited visibility, like trees or a snowfield in a whiteout, you need to choose intermediate points between you and your objective. (We touched on this before at question 32, following a bearing.) Dial in your bearing, look up, and choose an object on the bearing like a tree, rock, bush, etc. Then, put away your compass and walk to it. When you get there, find another object on the same bearing, walk to it, etc.

If you're on an open snowfield in a whiteout, the technique is roughly the same. But here, you'll need to send someone on your climbing team out along the bearing. When they are just about to go out of sight, yell for them to stop. Call to them to go left or right to be aligned with your bearing. Then you and the rest of your team walk to that person, then send them out again, and repeat. This method is known as leapfrogging.

To get to Point 7, use the leapfrog method if you are doing this exercise with a partner(s), or the "tree to tree" method if you are doing the course by yourself.

Proceed to Point 7, the end of SE Main Street.

~~~~~~

Congratulations, you've completed the navigation course. We hope you've had fun, learned a few Tabor tidbits, and most important, honed your map and compass skills.

Please let us know what you thought of this course, and if you have any ideas to enhance it. Please email your comments to the Mazamas Mountaineering Center (MMC): adventure@mazamas.org

Thanks,
The Mazamas
~~~~~~

ANSWER KEY

Note: Answers are fairly approximate. If your elevations are within +/- 20 feet and degree measurements within +/- 4 degrees, you're doing fine.

1. 1911
2. 10 feet
3. 50 feet
4. 1 inch = @400 feet
5. 17 degrees east
6. 100 meters
7. about 310 feet
8. about 510 feet
9. n/a
10. n/a
11. SE
12. no
13. easting = 531740 northing = 5039520
14. easting = 531790 northing = 5040010
15. wet
16. NW quadrant
17. 400 feet
18. about 220 feet
19. spur
20. downhill
21. 180 degrees
22. 90 degrees
23. 225 degrees
24. west
25. SE
26. squirrel
27. 630 feet
28. about 490 feet
29. about 270 degrees
30. about 346 degrees
31. about 142 degrees
32. n/a
33. estimate, no answer
34. A) about 140 degrees B) about 350 degrees C) about 250 degrees
35. about 314 degrees
36. not really - bathroom and trees obstruct a direct line
37. 530 feet
38. 340 feet
39. 190 feet
40. valley
41. SW
42. estimate, no answer
43. 212 degrees