Wysham & Babcock 2008

This hand out was designed and put together to help instructors and students understand the basic concepts of topographic map reading that should be covered at the high school level. There are many more concepts that can be covered but this only sets the ground work for the map reading curriculum. It was put together in conjunctions with the AOFC map reading competitions. It is a combination of work done by Bill Wysham a long time forestry/natural resources instructor at Madras High School and Simon Babcock a recent addition to the Philomath High School Forestry/Natural Resources Program.

Map Reading Check Off List

- Latitude and Longitude - http://www.ghosttowns.com/topotmaps.html
- UTM's - http://www.maptools.com/UsingUTM/quickUTM.html
- Declination
- Distance
- Legal description
- Triangulation
- Contour lines
- Slope
- Area
- Standard conversions
- Standard symbols
- Numbering sections
- Direction from a point to another
- Aspect
- Hard question (distance to a point off the map)

Note:
All questions in the packet refer to the HEHE Butte Quadrangle Oregon-Wasco Co. 7.5 Series (Topographic)

Latitude and Longitude

What is it:

UTM's

What is it:

Declination

What is it:
The compass needle points to magnetic north. Maps and land surveys are made on the basis of true north. This is necessary because magnetic north is some fourteen hundred miles distant from true north. Since all maps are made on a true north bearing and the compass needle points to magnetic north, an adjustment must be made on the compass to compensate. This difference is known, as the angle of declination.
Source: "Map and Compass", United States Department of Agriculture, Forest Service Pacific Northwest Region, Portland Oregon, April 1965

Where to find it:
It is usually printed on the map to the left of the scale bar at the bottom of a USGS 7.5' quadrangle.
Source: "Introduction to Topographic Maps", Geospatial Training and Analysis Cooperative, April 7. 2008, http://geology.isu.edu/geostac/Field_Exercise/topomaps/magnetic_declination.htm

Question: What is the declination of this map (in degrees)? 20 ½ degrees

Distance

What does it mean
Ground distance can be determined from a map by the map scale. Scale is the relation between distance on the map and the actual distance on the ground. The representative fraction or RF expressed: 1:12,000 (or 1/12,000) means, 1 unit of distance on the map equals 12,000 of the same unites on the ground.
Source: "Map Reading",Oregon Department of Forestry, December 1993.

How to determine distance
One method is to hold the measuring devise up to the map scale and guesstimate the distance, works but will not win any points with accuracy. The second method uses the following formula GD=MDxMSR. (GD=ground distance, MD=map distance, MSR=Map scale reciprocal) For example you determine that the MP is 10 marks and the MSR is 24,00/1. by plugging the numbers into the formula you get GD=10x24,000. So the GD=240,000 marks. You can now convert that into any unit that you want as long as you know how many marks equals that unit.

Question: How many miles is it from Hehe Butte to the intersection of Badger Creek Access Road and U.S. Route 26? 1.04 miles (distance 166 marks; GD=MDxMSR; GD=166marksx1/24000; GD=3984000marks; using 60 scale 1ft=720marks so GD=3984000marks/720marks; GD=5533.33ft and divide that by how many ft in a mile 5280ft; gives you GD in miles)

Legal Description

What is it:

A starting point was needed in Oregon and Washington so a point called the Willamette Stone was positioned near Portland, Oregon. An east-west line was established from this stone and was called the Willamette Base Line. The north-south line was called the Willamette meridian.

In order to further subdivide this area, lines were run at six-mile intervals parallel to the meridian and range lines. The lines running east and west were called township lines and were numbered consecutively, north and south of the base line. The lines running north and south were called range lines and were numbered consecutively east and west of the base lines.

To further divide this grided land area, each square or township (6 miles on each side) was divided into 36 sections each 1 mile square. Each section contains 640 acres.

Sections are further subdivided as needed or location. One-fourth of a section is 160 acres. It can be taken one step further and divided into one fourth of one fourth of a sections which is 40 acres (commonly known as the back 40). A proper legal description starts with the smallest land unit on the left and ends with the largest land unit on the right (e.g. SW ¼, NW ¼, Sec 16, T4S, R7E, WM).

Source: "Map and Compass", United States Department of Agriculture, Forest Service Pacific Northwest Region, Portland Oregon, April 1965

Question: What is the legal description to the nearest 40 acres of Hehe Butte?

NE ¼, SW ¼, Sec 18, T7S, R11E, WM

Triangulation

what is it:

Suppose you're lost on a large, maze like lake, but you can recognize two or more topographical features off in the distance. Use a compass to find your position by "triangulation". Pick out a point on the horizon and shoot a magnetic bearing to the point. Now using a straight edge, draw your line. Repeat these steps with another land mark. Your location will be where the two lines intersect.

Source: "The Basic Essentials of Map&Compass", Cliff Jacobson, 1988

Question: You were out hunting with your friends and get separated. You need to radio your location to the rest of you group so that they can meet up with you. You pull out your compass and shoot a bearing to Hehe Butte 357degrees and a gravel pit at 247degrees. What is you location (legal description) to radio your group? NW ¼, NE ¼,Sec 31, T7S, R11E, WM

Contour Lines

What is it:
The ups and downs of an area-its mountains and hills, its valleys and plains-are shown on the topographic map by thin Brown lines called contour lines. While most of the other map symbols are self-evident, the contour lines will probably need some explanation. A contour line, by definition, is an imaginary line on the ground along which every point is at the same height above sea level.
Source: "Be Expert With Map & Compass The Complete Orienteering Handbook", Bjorn Kjellstrom, 1994

The bolder brown lines with the elevation value are the index contour lines and the thinner unlabeled brown lines are the intermediate contour lines. The contour interval is usually labeled under the map scale. The last thing that you need to understand about contour lines is that the closer they are the steeper the slope and therefor the further apart the lines the gentler the slope.

Question: What is the contour interval of this map? 20Ft

Slope

What is it:
You may remember back to the days of math class. Slope is given in the formula rise over run. Hint: make sure that you units are the same when you plug the values into this formula.

Question: What is the percent slope of the north side of Hehe Butte from the top to Warm Springs River? 20% (Hehe Butte is at 3090ft elevation and Warm Springs River is at 2540ft elevation; the difference is you rise which is 550ft; the run is the distance which is GD=MDxMSR; GD=82marksx24000; GD=1968000marks; using 60 scale there are 720 marks in 1ft; GD=1968000marks/720marks; GD=2733ft for you run; rise over run = 550ft/2733ft; slope =.20 and to make it a % you must multiply by 100 which gives you a slope of 20%.

Area

What is it:
This is used to determine the area of a fire, forest, property, etc. This is done by guesstimating but if you understand the area of a section and can break it down into smaller sections then one can increase there chances of guesstimating very closely the actual size.
You know that a section is 640 acres, ½ section is 320 acres, ¼ section is 160 acres, ½ of a ¼ section is 80 acres, ¼ of a ¼ section is 40 acres and so on.

Question: What is the area of the lake located at SW ¼, Sec 3, T7S, R11E, WM? 7.5acres (break it down into ¼, ¼, ¼, ¼ section which equals 2.5 acres and it would take three of them to cover the lake.

Standard Conversions

What is it:
The following is list of conversions that need to be memorized to be successful in converting units when map reading.

5,280 ft =1 mile
1 mile= 80 chains
1chain = 66 ft
1 acre = 43,560 SQ. FT.
1 Sec = 640 acres

Standard Symbols

What is it:
The following is a list of symbols commonly seen on a topographic map. Note that this is only some of the most commonly found symbols and not all of the USGS map symbols that can be encountered when reading a map.

1. inhabited building
2. campground
3. primary road
4. marsh land
5. cemetery
6. saddle
7. uninhabited building
8. depression
9. school
10. church
11. open area
12. wooded area
13. valley
14. intermittent stream
15. bridge
16. perennial stream
17. unimproved road
18. gravel pit
19. quarry
20. tanks
21. power lines
22. index contour line
23. spring
24. trail
25. intermediate contour line
26. railroad double track

27. mine tunnel
28. railroad single track
29. peak
30. ridge line

Numbering Sections

What is it:
Each section is marked by four lines creating a box with the section number located in the middle. Each section is 640 acres and has the dimensions of one mile by one mile. They are numbered in a snake like pattern starting with number one in the top left hand corner of the township and working left to right until you get to section number 6. The number pattern then drop down to the section below it and begins with section number 7 and goes left to right until you get to section number 12. It continues in this snake like pattern until you get to section 36 in the bottom left hand corner of the township in which the patter starts all over in the next township. On the map Hehe Butte Quadrangle start with the red section number 36 in the top left hand corner and go down one section to section number 1. Follow the snake like pattern of the section number system until you get to the section number 36 located right after the words Island Windmill. This exercise will hopefully give you the understanding of how the sections on a topographic map are numbered.

Direction From One Point to Another

What is it:
If you are using a map to navigate how to get from one point to another you need to understand how to understand how to determine the direction that you need to walk to get from one location to another. You do this by determining your starting point and use a compass to determine the direction that you need to walk. Draw a line that connects the two points and place your compass on the map (make sure that north on your compass is point north on the map) and calculate the direction to the point that you are trying to reach.

Question: You are starting at Island Windmill and want to get to the gravel pit. What direction would you walk (as a crow flies) to get to the gravel pit? 273 degrees

Aspect

What is it:
Aspect is the direction of a slope that faces down hill. Aspect is described in a direction N, NW, S, SE and so on.

Question: What is the aspect of the steepest slope on Hehe Butte?

Hard question (distance to a point off the map)

With the information provided in the sections above you should be able to determine the legal description, direction or question pertaining to a point off of the given map. It may require that you use your knowledge of number sections, grid system or basic map conversions to do this but it can be done. Just know that if a judge gives you a question like this that with the given information provided by the judge that you can determine the answer to the question that takes you off the map if you put together the information provided by the basic map concepts hand out.

Special Note******The information provided in this hand out is only the basic information that is provided by a topographic map and that there are lots of other details or investigative concepts that a judge may put on a map reading competitions. The is only the basic concepts and it is up to you to investigate all that a topographic map has to offer.********