Topographic Maps Lab

To represent mountain belts and landforms, geologists work extensively with maps. A very important type of map used for scientific, engineering, recreational and military purposes is the topographic map. Topographic maps depict the shape of the earth's surface by means of contour lines, lines of constant elevation. The purpose of this lab is to familiarize you in the use of such maps by having you construct one.

Materials and Preparation

This is a field lab and we will be outside most of the lab period, rain or shine. Please consider the weather before coming to lab and dress appropriately. We will spend much of the lab period walking around in a somewhat overgrown field. Sandals will not be a very comfortable choice for footwear; sneakers or light hiking boots will be fine.

Bring pencils, an eraser, and a **calculator** to lab with you. You will not need your text book. Before coming to lab, read through this lab description carefully.

An Introduction to Topographic Maps

To effectively use topographic maps there are several basic concepts you need to understand:

Map Scale: Maps are scaled−down representations of an area. This means that the distance between two points on a map corresponds to some true distance on the ground. The ratio of map distance to true distance is the map **scale**. Most people are familiar with a "scale bar." A scale bar is a line or bar on a map of some predetermined map length, for example 2 cm, which is labeled with the corresponding true distance, for example, 2 miles. Map scales can also be expressed as a ratio or fraction. Many topographic maps, for instance, have a scale of 1:24,000. This means that one cm on the map equals 24,000 cm on the ground, one foot on the map equals 24,000 feet on the ground, etc. The scale 1:24,000 can also be expressed as a decimal fraction, 1/24000 =0.000041666. While scale bars are handy for a rough approximation of lengths, fractional scales allow precise calculations of lengths. Two equations are particularly useful:

*True Distance = (Map Distance) * (Fractional Scale)*

Map Distance = (True Distance) / (Fractional Scale)

Note: These expressions assume that map and true distances are expressed in the same units! Thus if you measure map distance in cm and calculate true distance, the calculated distance will be in cm. If true distance is in miles and you calculate map distance, the calculated distance will be in miles.

Orientation: Most maps have a North arrow. When the map is "oriented" so that North arrow on the map points north, directions on the map are the same as directions on the ground and the map can be used for navigation. Besides North arrows, lines of longitude and latitude or other similar coordinate systems can be used to orient a map.

<u>Contour Lines</u>: Contour lines indicate the shape of the land surface, its topography. A contour line is the map trace of an imaginary line on the ground that has a particular elevation. One way of visualizing such a line is to imagine a shoreline. Bodies of standing water have level upper surfaces, thus their shore lines are traces on the ground surface of that particular elevation. Topographic maps have many contour lines, each adjacent line differing by a constant elevation difference, the **contour interval** (Figure 1).

Figure 1.

Contour lines follow some basic rules that are worth learning. If you understand contour lines, you should be able to explain why each of these rules is true:

The closer spaced contour lines are, the steeper the ground surface is.

Contour lines never cross

Contour lines never branch

Contour lines never change elevation

Contour lines never skip (e.g., you can never have the sequence of lines 10, 20, 40 without having 10, 20, 30, 40)

Contour lines always have an up side and a down side (all elevations on one side of the line are higher than the line, all elevations on the other side lower). The up and down sides never change along the length of the contour line.

Method

In this lab, you will be part of a team that will survey and construct a topographic profile, and then the class as a whole will pool their profiles and use them to generate a topographic map.

Procedure

You will work in groups of three to four. Each group will survey a topographic profile along a particular assigned line, and then the groups will share information to construct a topographic map of the entire area.

Making a Topographic Profile: Topographic profiles are scaled drawings that depict the elevation of the land surface along some particular line. Figure 2, for example, is a topographic profile that runs EW through the campus from the Barn to Seneca Lake.

To construct a profile, you need to be able to measure distances between points, and elevation differences between points on the surface.

Measuring distances is easy. Each pair of surveyors will be equipped with a length of cord that is exactly 5 meters long and they will determine the elevation every 5 meters along their line.

Measuring the elevations requires a bit more equipment. We will measure the elevation **differences** between adjacent points using a leveling technique. This technique is illustrated in Figure 3. An "Instrument Person" holds a sighting level to their eye, which allows them to sight along a level line. A "Rod Person" holds a graduated rod, which has been specially adjusted so that it has a zero mark at exactly the height of the instrument person’s eye. Thus, when the instrument person is standing on a spot that is at the same elevation as the spot where the rod is positioned (Figure 2a), the level line will intersect the rod at the zero position (zero difference in

Figure 2. A topographic map showing the HWS campus and two profiles along the same section line. The section line runs from A at Odell's Pond to B off South Main Street in Seneca Lake. The horizontal scale is fixed by the map scale of 1:12,000. Two different vertical scales are shown. The exaggerated profile corresponds to the scale on the left. On this scale the same distance that represents 1 foot on the horizontal scale would represent 20 feet on the vertical scale, thus the vertical exaggeration is 20 times (20X). The un−exaggerated profile corresponds to the scale on the right − which is the same as the horizontal scale along the bottom.

elevation). When the instrument person is standing on a spot with an elevation that is higher than the spot where the rod is positioned (Figure 2b), the level sight line will intersect the rod some positive number of graduations above the zero line on the rod (a positive difference in elevation). Similarly, if the rod position is at a higher elevation than the instrument person, then the level sight line will intersect the rod some number of graduations below the zero line (a negative difference in elevation).

Figure 3.

Making a topographic map: After group has completed their profile, we will share all the elevation data and draw a composite contour map of the area.

Leaving for the field.....

Before leaving for the field, make sure that your group has all of the gear that you will need:

- Level, rod, 5m cord
- Leveling worksheet
- Flagging
- Base map
- Pencils
- Calculator

Assignment

This is a group assignment. Each group should complete their topographic map drawing and labeling all the contour lines. Each group should also indicate on their map the line of their profile and attach it to the map. Completed maps due at the end of the lab period. Don’t forget to put all group members’ names on the completed map!

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Topographic Worksheet

Station #	**ROD** **RED −** **Meters** **BLACK +**	ELEVATION (meters) Add last station and rod reading
0 (Start)	−−−−−−−−−−−−−−−−−−−−−−−−−	Start = meters
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