ESS 110: Introduction to Geology **Name:** ____________________________
Dr. Christopher Woltemade
Topographic Maps Lab **Section:** ___________________________

Introduction

Topography means "the shape of the land" and thus topographic maps illustrate the scale, width, length, and height of land surface features. Topographic maps also show a number of cultural features (land survey system, roads, houses, schools, etc.). Topographic maps are extensively used in the Earth sciences to evaluate locations, landform types, elevations, characteristics of streamflow, and other physical data. Topographic maps are also useful for such purposes as planning a backpacking trip or bicycle route, orienteering, or evaluating real estate.

The purpose of this laboratory is for you to become familiar with the fundamentals of topographic map interpretation. When you are finished, you should be comfortable working with the concepts of scale, location (latitude and longitude), elevations and contour lines. You should be able to identify the direction and steepness of land slope and visualize the form of the land.

Materials

USGS Shippensburg 7.5 minute quadrangle (topographic map), ruler, paper, pencil, calculator.

Map names

Topographic maps are named after a prominent town or physical feature that appears on the map. The names of adjacent maps (or quadrangles) are printed at each corner of the map and along each side, to allow you to easily determine other maps in the area that you may need.

(1) What is the name of the map with which you are working (look in the upper, right-hand corner)?

(2) What is the name of the adjoining map to the northeast? (Note that the 8 surrounding maps (N, S, E, W, NE, NW, SE, SW) are labeled in the margin.)

Map series, latitude and longitude

The map series (type of map) is described by how large an area the map covers in latitude and longitude. Latitude and longitude are expressed in degrees (°) - latitude extends from 0° at the equator to 90° north or south at the north and south poles, respectively. Longitude is based on a 0° line, the *prime meridian,* that runs north-south from the north pole, through Greenwich, England, to the south pole. Longitude is measured in degrees up to 180° east or west away from the prime meridian. Fractions of a degree are expressed in minutes (') and seconds (") - there are 60 minutes per degree and 60 seconds per minute. So, for example, a location half way between 40° and 41° north would be 40 degrees 30 minutes north, written as 40° 30' 00" north. Common coverages for U.S. Geological Survey maps are 7.5 minutes (covering 7.5 minutes latitude by 7.5 minutes longitude), 15 minutes (older maps, now discontinued), and 1 degree (lat.) by 2 degrees (long.).

(3) Which series is the map with which you are working?

(4) How much *area* is covered by a 15 minute map relative to a 7.5 minute map? (Hint: Think *area*, not *distance,* and draw a figure of a 7.5 minute map contained within a 15 minute map. How many 7.5 minute maps would it take to cover the same area as a 15 minute map?)

(5) What is the latitude of the northern edge of the map, to the nearest second?

(6) What is the longitude of the eastern edge of the map, to the nearest second?

(7) What is the latitude and longitude of the center of the map, to the nearest second? (You don't need to measure this, just calculate it.)

(8) What is the latitude of "Interchange 9" (now Exit 24) on I-81, to the nearest minute?

<u>Scale</u>

Scale expresses the relationship between distances on the map and corresponding distances on the ground (in the "real world"). Topographic maps include both a ratio scale and a graphical scale. Ratio or fractional scales have no units associated, because the *same units* must be used on both sides of the ratio (or fraction). For example a scale of 1:10,000 indicates that one inch on the map corresponds to 10,000 inches on the ground or, alternatively, one millimeter on the map corresponds to 10,000 millimeters (or 10 meters) on the ground.

For the following questions, calculate answers using the numerical scale rather than estimating based on the bar scale.)

(9) What is the fractional or ratio scale of the Shippensburg quad with which you are working?

(10) One *inch* on the map represents how many *inches* on the ground?
How many *feet* on the ground does that represent?

(11) One *mile* (5280 feet) on the ground covers how many *inches* on the map?

(12) One *square mile* on the ground is represented by how many *square inches* on the map? (Remember you are working with squared units here!)

(13) Locate Interstate 81 at the southern border of the map. Measure the map distance from the southern border to Interchange 9 (now called Exit 24—measure to the center of the interchange). How long is this stretch of road in miles?

(14) How many miles are covered by the width of the map along the south edge?

(15) Given your answer from (14), how many miles does one degree of longitude cover? (Note that the map covers 7.5′ of longitude, a fraction of one degree.)

<u>Contour lines</u>

A *contour line* on the map (shown in brown) connects points of equal elevation above or below a reference plane (usually mean sea level, MSL). These lines allow us (with some training) to visualize the shape of the land; that is, topography. The contour interval is the vertical difference in elevation between adjacent contour lines (e.g. if the contour interval is 20 feet, lines might correspond to 420', 440', 460', etc.). Index contours may be shown with a heavier brown line and are labeled with the corresponding elevation. Some general rules for contour lines follow:

- A contour line connects points of equal elevation.
- A contour line never branches or splits.
- Steep slopes are shown by closely spaced contours, flat areas are shown with widely spaced contours (a completely flat area would not have any contours).
- Contour lines never cross, except to show an overhanging cliff, where hidden contours are dashed. Contour lines merge only to show a vertical cliff.
- Hills are represented by a concentric series of closed contour lines.
- A closed depression (basin) is shown by concentric contour lines with hachures on the downhill side.
- Where contour lines cross a stream or a dry stream channel, they form a "V" that points *upstream.*

Relief refers to the difference in elevation between two points. *Total relief* is the difference between the highest and lowest points in an area (or on a map), while *local relief* refers to the difference in elevation between two nearby points (e.g. a hilltop and nearby valley).

(16) What is the contour interval on your map?

(17) What is the difference in elevation between index contours?

(18) How can you tell an area that is relatively flat? Name such an area.

(19) How can you tell an area that has a steep slope? Name such an area.

(20) Estimate the elevation of the following features. Be careful – take time interpreting the contours. You should express your answers as at 10-foot range.

The extreme SE corner of the map = _______________

The summit of Timber Hill = _______________

The confluence of Muddy Run and Conodoguinet Creek = _______________

The confluence of Middle Spring Creek and Conodoguinet Creek = _____________

Shearer Hall = _______________

(21) In which direction is Burd Run flowing? How do you know this?

(22) What are the highest and lowest points on the map? What is the total relief? Show how you calculated this.

(23) There is a depression (closed contour with hachures) located in the southeastern corner of the map (about 1.5 inches north of the southern edge, about 1.5 inches SE of I-81 Interchange 9). Estimate the lowest elevation within the depression that shows multiple depression contours.

(24) Draw a contour map with a contour interval of 20 feet based on the points below. You will have to estimate the elevations between the known points. Label each of your lines with the elevation.

[See lab handout for base map]

(25) Drawing a topographic profile. Topographic maps depict the earth as viewed from above. If you need to see a side-view of the elevations and slopes in an area, this can be accomplished by constructing a topographic profile. First, draw a line on the map along which the profile is to be constructed - for this exercise, use the "profile" line on the contour map you created. Lay a piece of scratch paper with its edge along this line. On the scratch paper, mark the edges of the map and each place where a contour line intersects the profile line. Note the elevation of each line as well as the location of streams. Use the blank graph below to construct your profile. Lay your scratch paper marked with elevations along the profile base. Wherever you have marked a contour line on the edge of the paper, place a dot directly above the mark at the elevation on the vertical scale corresponding to that of the contour line. When all contours have been transferred, connect the dots with a smooth line to produce the side-view, drawing in hills and valleys between the points of known elevation. Keep all features within the appropriate contour interval based on the topographic map. The landforms will be vertically exaggerated (steeper than actual) due to the different horizontal and vertical scales on the graph.

[See lab handout for profile graph]