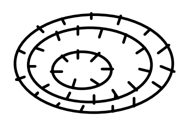
Name: ___________________________

Lab 11: Topographic and Geologic Maps

Topographic maps (often called "topo maps") represent the three-dimensional landscape on a two-dimensional sheet. Topography – the elevation of Earth's surface – is represented on a topo map by contour lines. The elevation change between each line (the contour interval) varies from map to map, but each map will have only one contour interval, which is listed on the map. Contours obey the following rules:

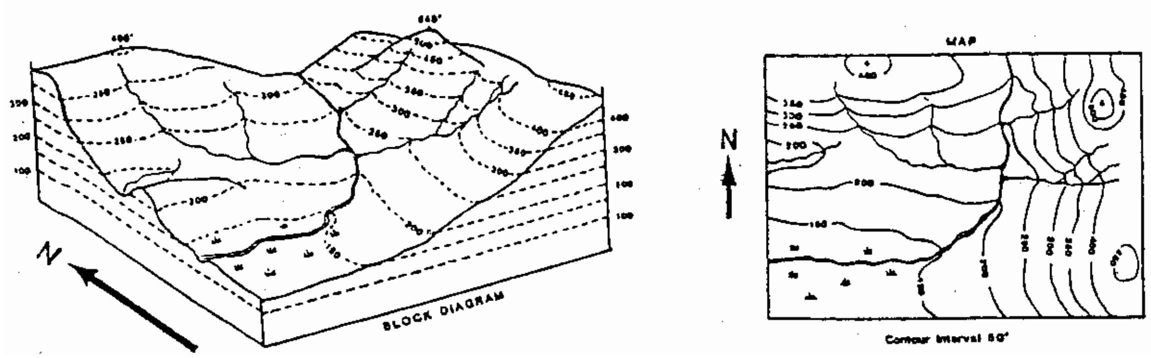
(1) Contour lines connect points of equal elevation.
(2) Contour lines do not cross.
(3) A contour line never branches.
(4) The spacing of contour lines is related to the steepness of a slope: Widely spaced contours characterize gentle slopes and closely spaced contours indicate steep slopes.
(5) A hill is represented by a concentric series of closed contours.
(6) A closed depression is represented by a concentric series of closed contours that have hachure marks ("tick marks") on the downhill side.



(7) Contour lines in valleys form "V" shapes which point uphill.

For convenience, topo maps, like other types of maps, show a scaled-down version of the surface. Each map typically shows two types of scales on the map: a numerical scale and a bar scale. Numerical scales are given as representative fractions, or ratios. For example, on a 1:24,000 map one inch on the map represents 24,000 inches on the ground. This is true of any unit, so one centimeter on the map represents 24,000 cm on the ground. Bar scales measure distance by displaying a simple line or bar with represented distances in feet, miles, and/or kilometers printed along it.

The location of a U.S. Geological Survey (USGS) topo map is shown in a number of ways. Each map is assigned a name; the county or counties included in the map area are listed, and frequently the location of the map within the state is shown on an index map on the same sheet. The corners of the map and other important locations on it are marked with latitude and longitude, given in degrees. Latitude is the number of degrees north or south of the equator. Longitude is the number of degrees east or west of the prime meridian (through Greenwich, England). Each degree (°) of latitude or longitude is divided into 60 minutes ('), and each minute is divided into 60 seconds ("). This classroom is at 47°39'16" N and 122°18'32" W.



Topographic Cross-sections

When looking at a topo map, one is seeing the landscape from directly above (often referred to as “map view”). Sometimes it is useful to visualize how the landscape would look in profile. Constructing a topographic cross-section accomplishes this, as it shows the topography one would encounter while traversing a straight line between two points. A profile is said to be unexaggerated if the horizontal and vertical scales are the same, but to emphasize the differences in relief in a comparatively flat area, the vertical scale may be expanded relative to the horizontal scale, producing a cross-section with vertical exaggeration. Vertical exaggeration is given by:

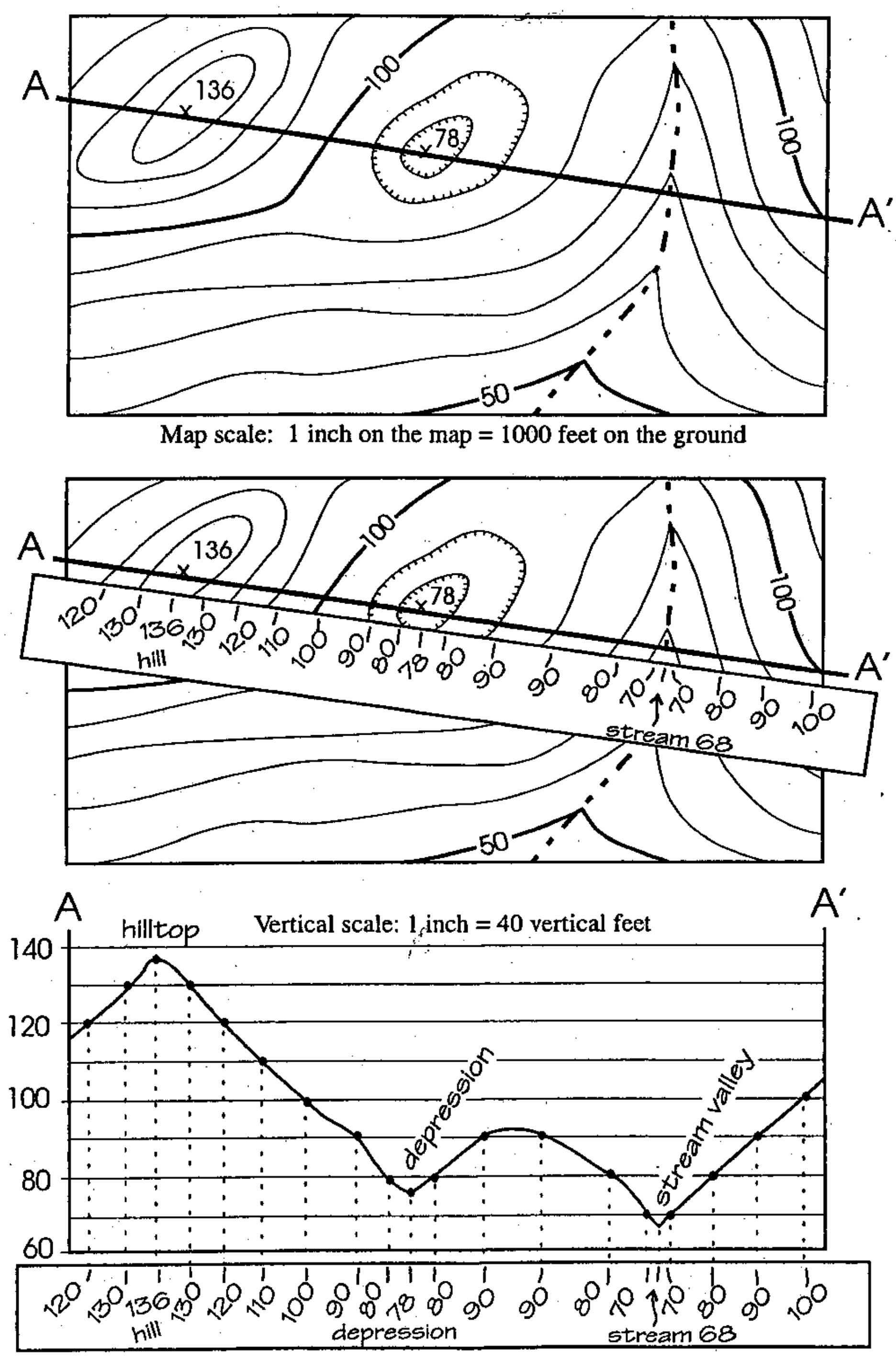
$$E = H/V$$

where E is the vertical exaggeration, H is the denominator of the horizontal scale fraction, and V is the denominator of the vertical scale fraction.

One efficient way to construct topographic cross-sections is the following:

1. Lay a strip of blank paper along the line to be profiled.
2. Mark on the edge of the paper the endpoints of the profile line and the exact place that each contour, stream, and hilltop crosses the profile line. Where contour lines are closely spaced, it is sufficient to label just the index contours (every fifth contour, drawn bold on topo maps). Double-check yourself every five lines or so.
3. Label each mark with the contour elevation or other feature it represents.
4. Determine the total relief of the profile line. Relief is the difference in elevation between the highest and lowest points.
5. Prepare a vertical scale on a sheet of graph paper or lined paper based on the relief. Label the horizontal lines on this sheet to correspond to the elevation of each index contour line
6. Write down the vertical exaggeration of your profile. Compare what an inch represents on each of your axes using the equation given above. Be sure to exaggerate only when needed for clarity.
7. Place the plain paper with labeled marks at the bottom (or top) of the profile paper and carefully project each contour onto the horizontal line of the same elevation.
8. Connect all of the points with a smooth line. Mark streams, peaks, benchmarks (points of exact elevation, as surveyed), etc.
9. Check that the profile matches the general topography along your transect line.

This method is illustrated below, showing a profile from points A to A´. The second endpoint is pronounced “A prime” and a point labeled A´´ would be pronounced “A double prime.”



Drawing a profile. Notice the tick marks along some contours indicating a closed depression. The vertical exaggeration of this profile is 25x.

Geologic Maps

Geologic maps generally contain the standard topographic information, further overlain by the geology of the area represented by colors, patterns, and symbols. Geologic cross-sections may also be provided. It is crucial to read carefully the legends, explanations, and other information given on each geologic map in order to interpret these appropriately. The standard symbols for designating the ages of rock units on geologic maps are given below. Geologic maps are often compilations of detailed information gleaned from many individual expeditions over many years. Interpretations may be from a field area of less than a square mile, or tens (or more) square miles. Even the most comprehensive, detailed field mapping consists of only a sampling of the rocks in the mapped area. Remapping or reinterpretation is commonplace, so a geologic map only represents the best interpretations and inferences at a given time.

Era	Period	Symbol
Cenozoic	Quaternary	Q
	Tertiary	T
Mesozoic	Cretaceous	K
	Jurassic	J
	Triassic	TR
Paleozoic	Permian	P
	Pennsylvanian	IP
	Mississippian	M
	Devonian	D
	Silurian	S
	Ordovician	O
	Cambrian	Є
Precambrian		pЄ

Geologic periods and their standard map symbols.

Part 1. Topographic Maps

Use the "Mount St. Helens Quadrangle, Washington, 7.5 Minute Series (Topographic)" map for these questions:

1. What is the scale of this map? Given this, one map inch equals how many real miles?

2. Locate/determine the following information:

    a. Calculate the map dimensions, in degrees, minutes and seconds:

        latitude:

        longitude:

    b. Contour interval, in feet:

    c. Compiled from aerial photos taken in what year, and field checked in what year:

3. Describe the summit of Butte Camp Dome in terms of:

    Latitude: ___________ Longitude: ___________ Elevation: ___________

4. Why is a 7.5-minute quadrangle <u>called</u> a 7.5-minute quadrangle?

5. Would a 7.5-minute quadrangle map from Alaska be wider or narrower than a 7.5-minute quadrangle map from Washington? Why?

6. What is the actual distance, in miles, between the summit of Butte Camp Dome and the center of the lava dome in Mt St. Helens? Be as precise as possible.

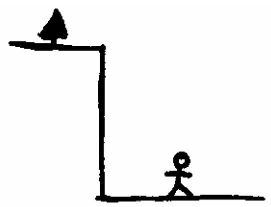
7. What is the elevation of Mt. St. Helens and where is this highest point located relative to the crater?

8. Is the south flank of Mt. St. Helens: A) constant in slope from top to bottom, B) steeper on the top than the bottom, or C) steeper at the bottom than the top? Explain your reasoning.

9. Can contour lines cross one another? What would this represent?

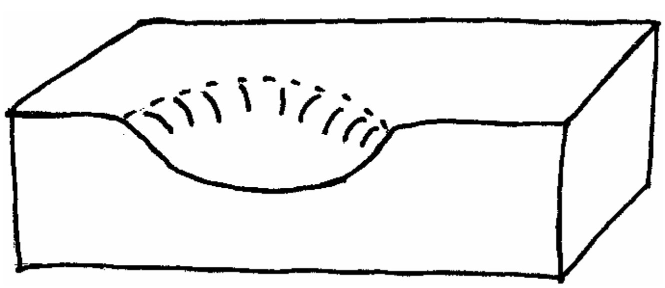
10. Sketch contours which express the following features (use five contours per sketch):

a. A steep cliff above a nearly flat plain:

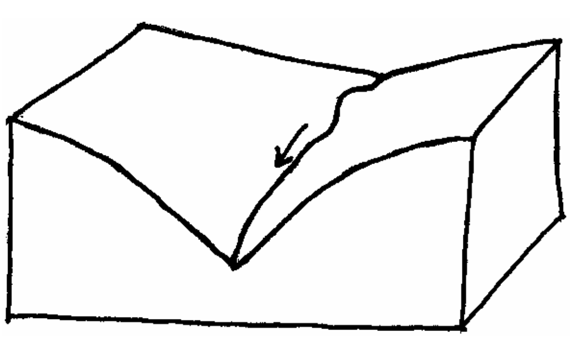


b. A rounded hill:

c. A closed depression:



d. A stream and stream valley (indicate direction of stream flow):



Part 2. Topographic Cross-Section

Pair up with someone to construct cross-sections from A to A´ and B to B´ (one each) on the Yosemite Valley map. Use the provided graph paper. Answer the following question once you have completed both sections:

11. Rivers typically carve valleys which have gently-sloping walls and narrow floors, known as "V-shaped" valleys, whereas glaciers carve valleys with steep walls and wide, flat floors known as "U-shaped" valleys. Classify the two cross-sections and indicate what this implies about the former extent of glaciation at Yosemite.

Part 3. Geologic Maps

Use the “Geologic Map and Section of Mount Rainier National Park, Washington” map for these questions:

12. How is the legend of this map arranged, in terms of its age relationships?

13. What are the numeric scale and contour interval of this map?

14. Is this map larger- or smaller-scale than the map of St. Helens?

15. What geologic unit underlies Mt. Rainier? Give its name, symbol, age, and a brief description of rock type.

16. What are the oldest and youngest units *shown on the cross-section*?

    Oldest:

    Youngest:

17. What type of rock is shown in white?

18. Which compass direction is Kautz Creek flowing? How can you tell?

19. What unit is represented by the sky blue color? What unit is represented by Td? Why are both colors <u>and</u> symbols used throughout the map to indicate such units?

20. Mt. Rainier is known for its “inverted topography” in which former low-lying features now stand in prominent relief. An example is Rampart Ridge, which is made of a series of eruptive flows that filled a former valley.

    a. How do the contours indicate that Rampart Ridge is a ridge?

    b. Of what unit is Rampart Ridge composed? What units are immediately beneath

    c. Describe the likely durability of these units and explain why it is reasonable to infer that the ridge was formed by the rapid erosion of the former valley walls that confined the original flow, leaving only the flow itself.