

Laboratory 6: Topographic Maps

Part 1: Construct a topographic map of the Egyptian Pyramid of Khafre

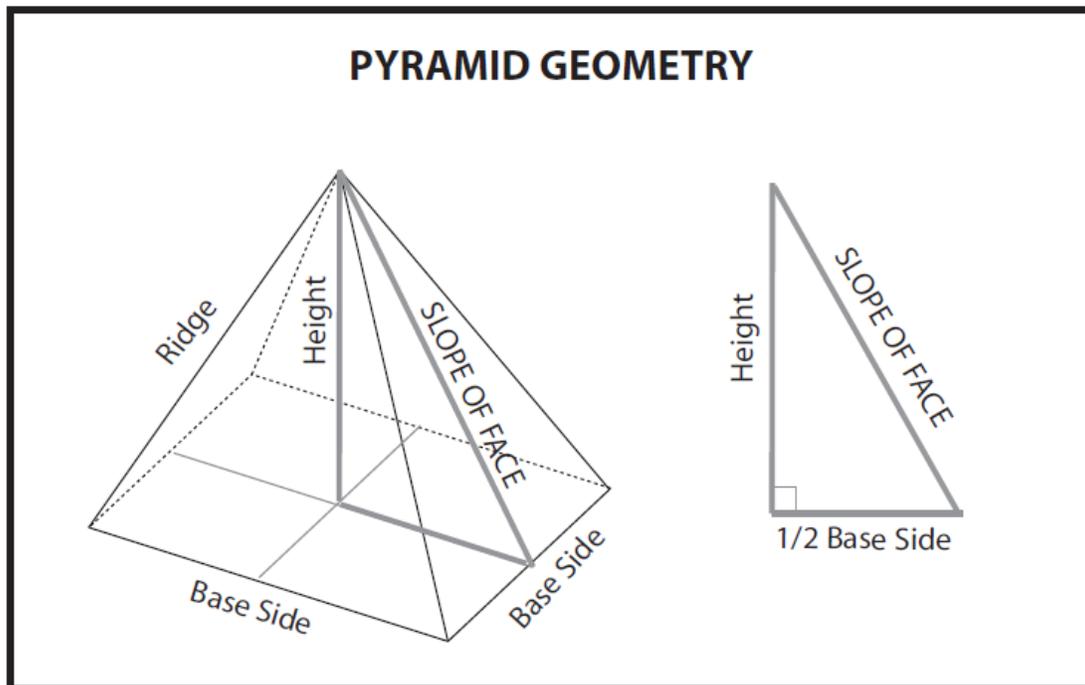
A **topographic map** is a two-dimensional representation of a three-dimensional space. Topographic maps use **contour lines**, lines of equal elevation, to represent the vertical dimension (height) of the landscape. The Pyramid of Khafre is the second largest of the Ancient Egyptian Pyramids of Giza and the tomb of the pharaoh Khafre. Today the lab table supports a scaled model of the Pyramid of Khafre. Follow the steps below to create a topographic map of the model pyramid on the lab table. Use the graph paper on the following page to make your map.

1. First determine the dimensions of the pyramid by measuring the following pyramid features in inches:

a. Base Side = _____ **36** _____ inches (1 pt)

- b. Use a **vertically oriented** ruler to measure the height.

Height = _____ **24** _____ inches (1 pt)



2. Use the geometry of the pyramid to calculate the slope of the pyramid's face.

Slope of pyramid face = _____ **1.33** _____ (1 pt)

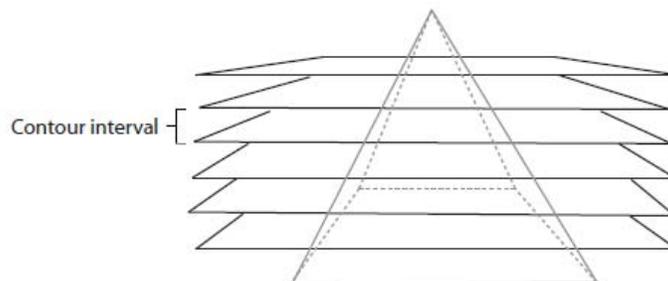
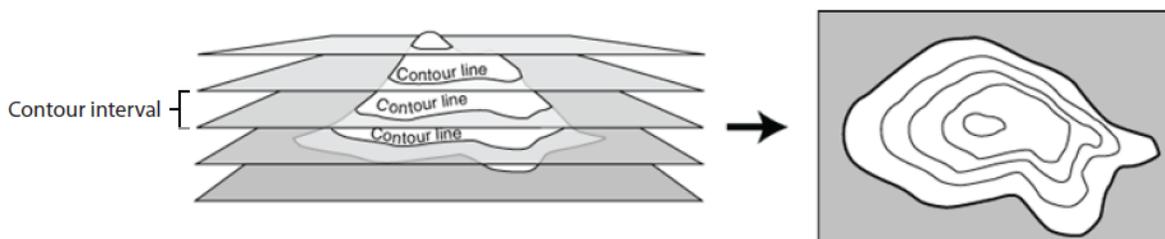
- Now begin constructing a topographic map of the pyramid. Your paper is smaller than the base of the pyramid so you will need to create a scale in order to create your map. One of any unit of measurement on your map is equal to some number of that same unit of measurement in real life. For example, in a map with a scale of 1:24,000 one inch would equal 24,000 inches in real life. You have been measuring the dimensions of your pyramid so let's think about inches to construct a map scale. How many inches on your map represent inches in real life? (*Hint: your map is smaller than the pyramid so one inch on your map needs to represent several inches in real life*)

Scale \longrightarrow number of units on map : number of units in real life

1 inch : _____ **6 works well (can vary)** _____ inches (1 pt)

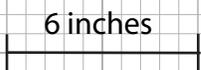
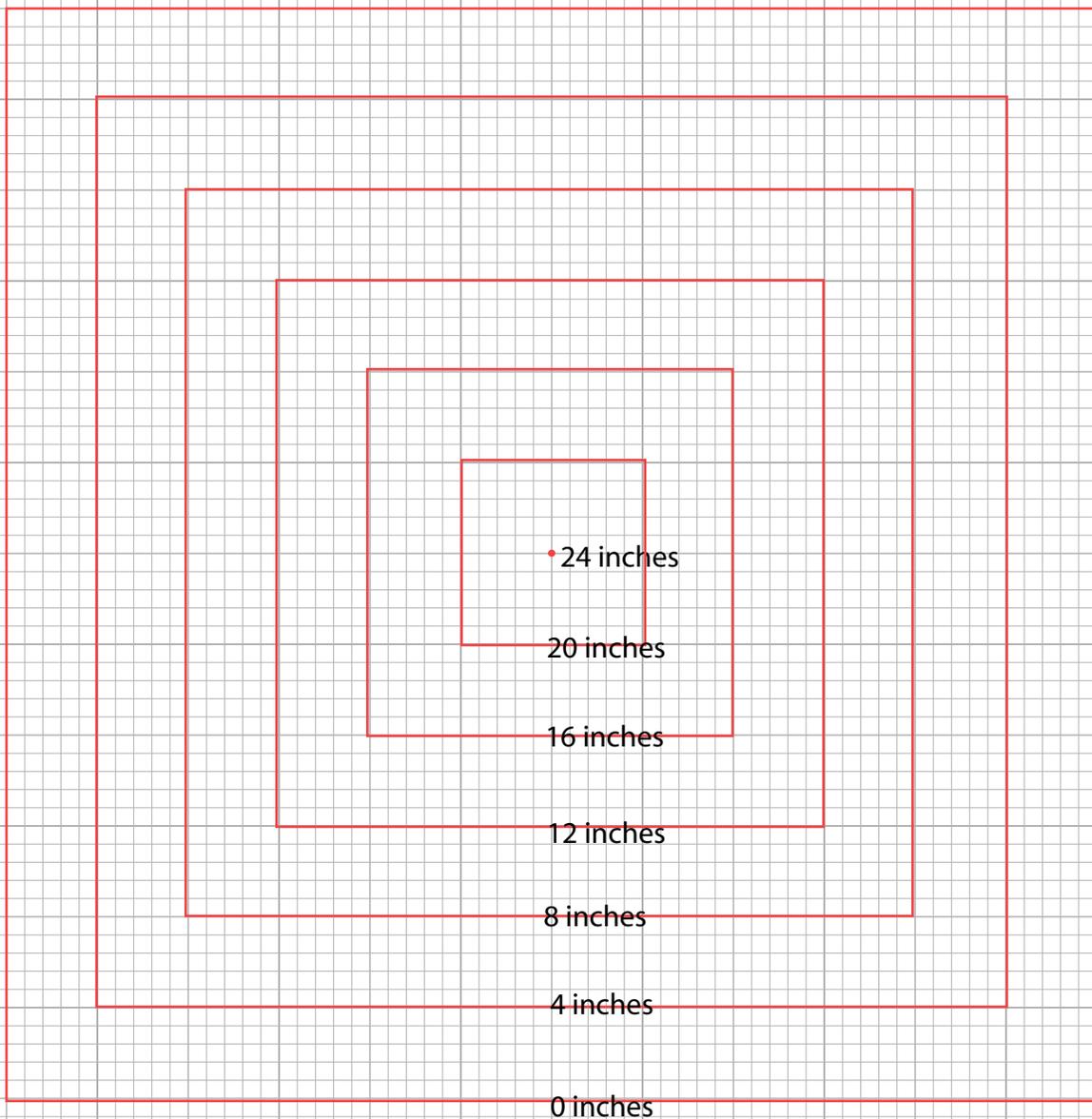
Draw a scale bar that matches your scale on the map. (1 pt)

- Using a ruler and the graph paper, draw the base of the pyramid **to scale** using the dimensions you measured in question 1a. Pyramids have a square base, so all the base sides will be the same length (1 pt)
- Find the middle of the square using the geometry of the base of the pyramid. Mark the middle with a point and label the point with the maximum elevation (or height) of the pyramid you measured. (1 pt)
- Contour lines are lines on a map that represent points of equal elevation in the landscape. For example, if you climbed half-way up the pyramid and then traversed around the pyramid while maintaining the same elevation and dragging a paint brush behind you....you would draw one contour line on the pyramid. The stacks of horizontal paper below cuts the mountain at equal intervals of elevation. The intersection between the landscape and the horizontal paper marks the location of the contour lines on a two-dimensional map. Now draw contour lines on your map to represent the pyramid in three-dimensions on your map. **Use a contour interval of 4 inches.** (5 pts)



- All good maps have a title, north arrow, and scale. Make sure these things are on your map! The windows in the geology lab face towards the west. (3 pts)

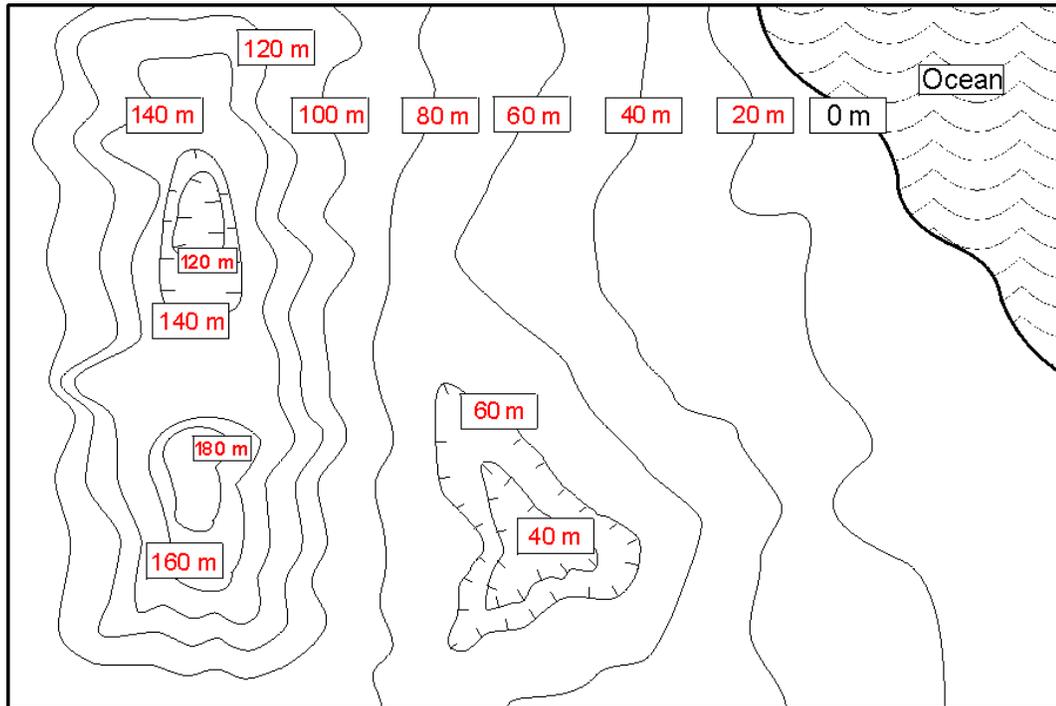
Topographic Map of the Pyramid of Khafre



1 inch on map = 6 inches in real life

Part 2: Understanding Topographic Maps

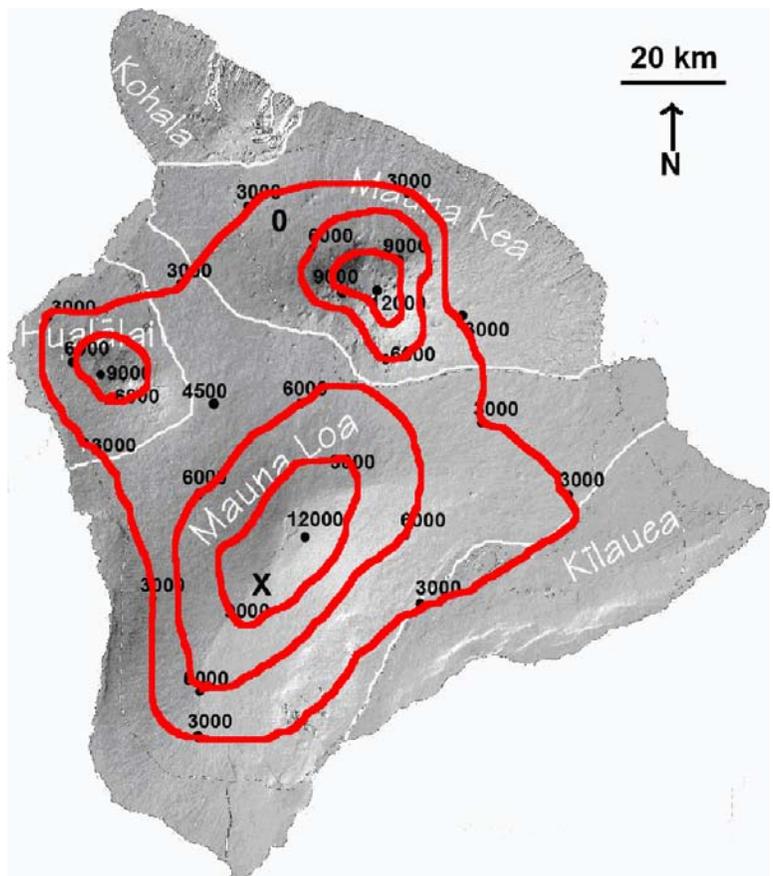
8. Label the elevation of the contours on the map below. Watch out for depressions with repeated contours! (13 pts)



9. The shaded relief map to the right provides elevation measurements across Mount Mauna Loa, an active Hawaiian volcanic island. Using a 3000 m contour interval, draw and label the contour lines across the island. Sea level elevation = 0 m. Don't forget about the rule of V's! (2 pts)

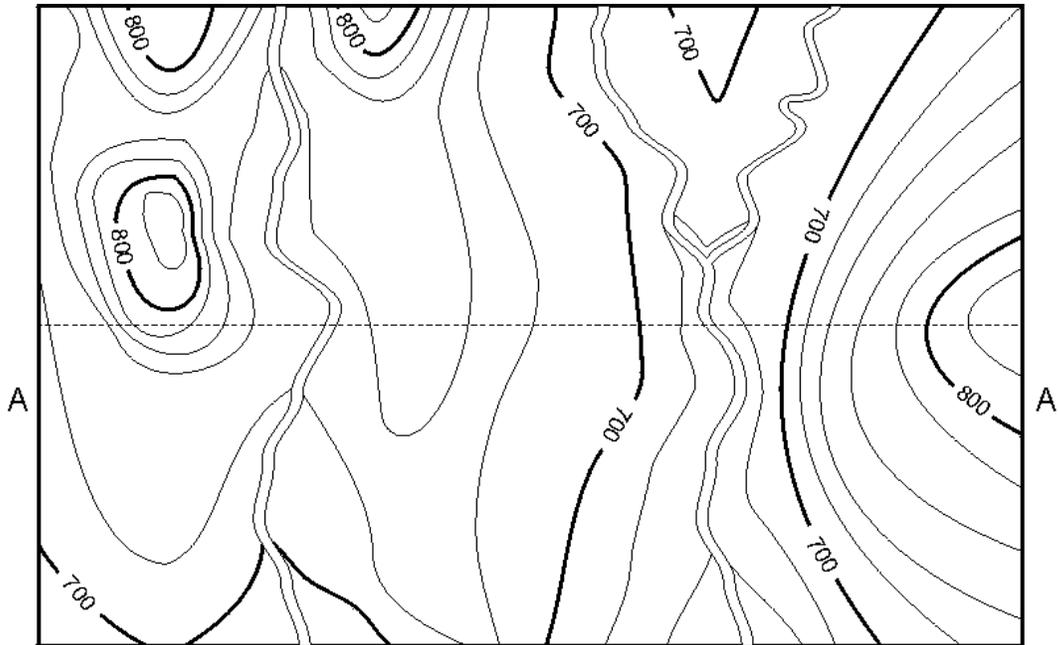
Estimate the elevation of location X by interpolating between the contour lines.

X = 10000 m (2 pts)

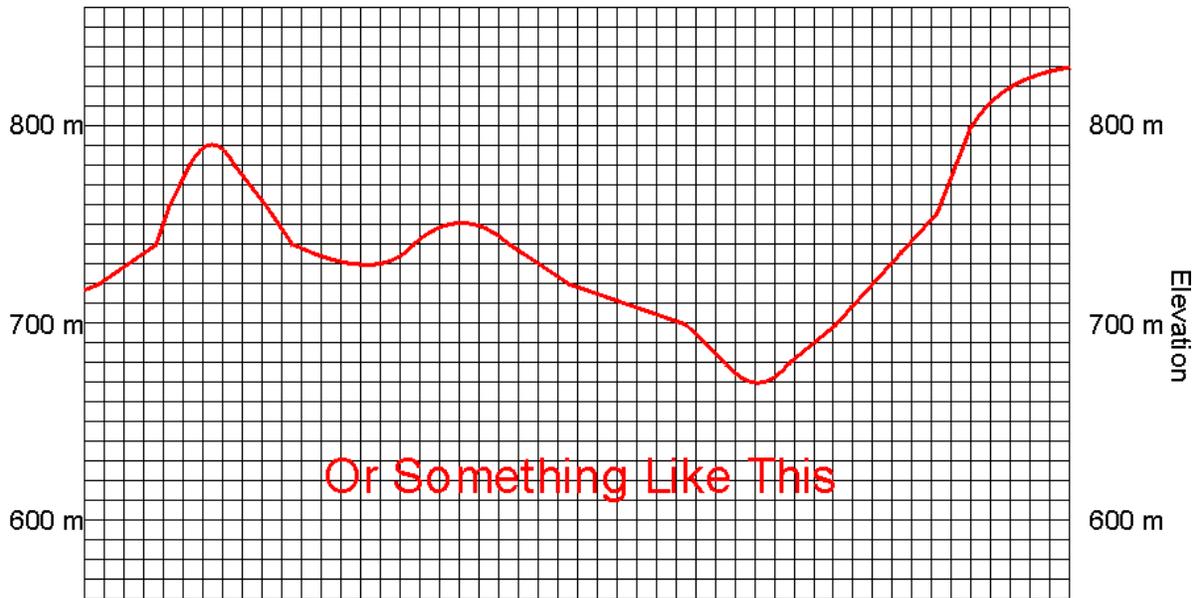


(Shaded relief model and elevations across Mauna Loa from Temple University www.temple.edu/geology)

10. Using the topographic map below, construct a topographic profile from A to A'. Fold your paper along. Use page 189 in your lab book to help you. (10 pts)



Contour Interval = 20m Scale: 1 inch = 1000 m



On the profile you just created: (1 point each)

a. What is the horizontal scale in meters/inch? 1000 m/inch

b. What is the vertical scale in meters/inch? 100 m/inch

c. What is the vertical exaggeration? $1000/100 = 10$

Part 3: Topography of Mt. Saint Helens

For this section, examine the topographic map of Mt. Saint Helens! All of the information in this section is written somewhere on the map so it should be relatively easy to find (1 pt each)

Part I: Basic Topographic Map Features

1. What is the name of this quadrangle?

Mt. St. Helens

2. What part of Washington State is this quadrangle in?

SW

3. Is this a 7 ½ or a 15 minute quadrangle?

7 ½

4. What is the difference in area between a 7 ½ and a 15 minute quadrangle?

15 minute covers 4 times more area.

5. What is the ratio scale of this map?

1:24,000

6. How many meters in real life does 1 cm on the map equal?

1 cm on the map = 240 meters in real life

7. What is the magnetic declination in the area of this map?

18 degrees East

8. If you wanted to hike eastward past the limit of this map, which quadrangle would you need a map of?

Smith Creek Butte

9. Benchmarks are locations of known location and elevation. Benchmarks are shown on the topographic map by an x symbol followed by the elevation value. Calculate the total relief shown on the topographic map using the benchmarks.

Total relief = 8333-2422=5911 ft

Part II: Using Topographic Maps for Measurement and Navigation

Now that you understand the basics, try and find your way around the map.

10. What is the distance in meters between the northern and southern peaks at Butte Camp Dome? (1 pt)

_____ **600** _____ m

11. If you hiked east along the Muddy River, would you be traveling uphill or downhill? (1 pt)

Downhill

12. What is the horseshoe-shaped structure in the center of the map? (1 pt) **The crater (rim)**

13. What is the small (about one inch) feature in the center of this horseshoe-shaped structure? (1 pt)

The lava dome

14. What feature is located at the northern opening of this horseshoe-shaped structure? What do you think caused this? (2 points)

The breach, caused by an eruption blowing the entire north face off.

15. Where is the majority of the vegetation located on this map? Why? (1 pt)

In the south, because it didn't have a mountain dropped on it.

16. What low-relief feature is located to the north of Sasquatch steps (in the N area of the map)? (2 pts)

Pumice Plains

- a. How do you think it got this name? (2 pts)

It's made of pumice and it's flat.

- b. Where do you think these rocks originated? (2 pts)

In the 1980 eruption

- c. Would you expect rocks on this map to be mainly **igneous**, sedimentary or metamorphic? (2 pts)

17. If you wanted to hike to the lava dome to roast marshmallows, what would be the easiest direction to hike from? Why? (3 pts)

The north, it isn't as steep a climb

18. You are standing at the lava dome and want navigate to the following locations using your map and compass. What is the compass bearing from the lava dome to the following locations? Choose either the azimuthal or quadrant method to represent your bearing in degrees.

- a. Crescent Ridge? 270/ W90 (2 pts)
- b. Redrock Pass? 210/ S30W (2 pts)
- c. Forsyth Glacier? 45/ N45E (2 pts)

19. Look at the glaciers on the map. (2 points each)

- a. What feature is present at the base of most glaciers?
Streams
- b. Why is this feature present?
Melt water drainage

20. Locate the Shoestring Glacier. (4 pts)

- a. What is the length of the glacier in km? 2.25 km
- b. What is the relief of the glacier in ft? (~8000 - ~4600) = ~3400 ft
- c. What is the relief of the glacier in meters (1 m = 3.28 ft)? ~1037 m
- d. What is the gradient of the glacier in m/km? ~450 m/km

21. Locate the Tallus Glacier. (4 pts)

- a. What is the length of the glacier in km? ~1.0 km
- b. What is the relief of the glacier in ft? (~7560 - ~5720) = ~1840 ft
- c. What is the relief of the glacier in meters (1 m = 3.28 ft)? ~560 m
- d. What is the gradient of the glacier in m/km? ~560 m/k

Part 4: Topographic Deformation and Evolution of Mt. Saint Helens

Use these sets of digital topographic data from the USGS to construct a timeline describing the how recent volcanic events changed the topography of Mt. Saint Helens. Make sure to describe in detail the 1980 eruption and the recent lava dome formation. (10 pts)

1. USGS shaded digital relief models of Mt. Saint Helens from Pre-1980, 1980, 2003, 2007
2. USGS shaded digital relief models of Mt. Saint Helens Lava Dome
3. USGS Mt. Saint Helens Eruption Fact Sheet
4. 3D Anaglyph image of Mt. Saint Helens after the 1980 eruption
5. Mt. Saint Helens Topographic Map

TIMELINE OF RECENT VOLCANIC ACTIVITY AND TOPOGRAPHIC DEFORMATION AT MOUNT SAINT HELENS

