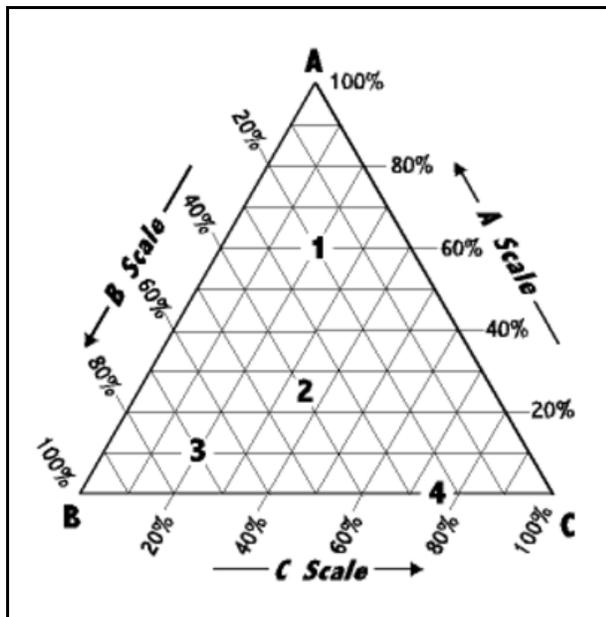


Jefferson's experimental vegetable garden (seen in the images below) lies just below Mulberry Row at Thomas Jefferson's Monticello. Mulberry Row was the industrial center of Jefferson's 5000 acre plantation where dozens of slaves lived and worked. In total, there were over 600 slaves that Jefferson owned throughout his lifetime. These slaves were responsible for most of the labor at Monticello, including the removal of large parts of the mountaintop for both the house and the vegetable garden.

Ternary Graph

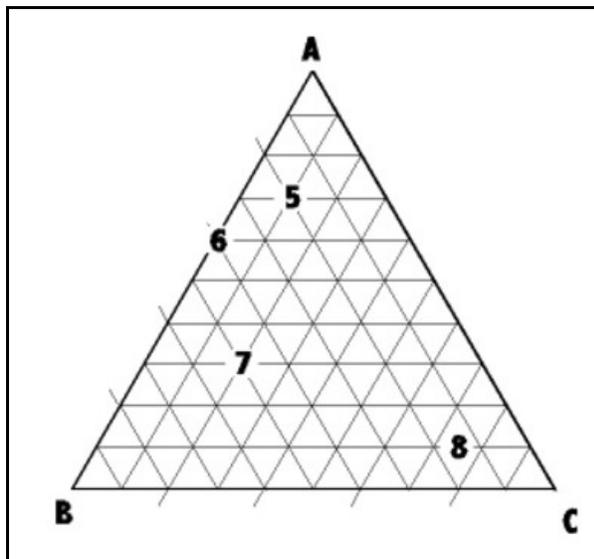
(from <http://csmres.jmu.edu/geollab/Fichter/SedRx/readternary.html#test>)

A ternary graph is a triangle with each side representing one of the three main components of the whole. The three sides will sum to 100% (or 1). They are commonly used in geology and soil science to graphically (visually) compare the composition of samples.



The ternary graph can be read counter clockwise, as seen here (use the orientation of the axes numbers as a guide).. The composition of data points 1-4 is given below.

- 1: 60% A, 20% B, 20% C = 100%
- 2: 25% A, 40% B, 35% C = 100%
- 3: 10% A, 70% B, 20% C = 100%
- 4: 0% A, 25% B, 75% C = 100%



It is not uncommon for ternary graphs to be without axis labels. Remember that the axis will range from 0-100%. Try to determine the composition of data points 5-8.

5: A **70%** B **20%** C **10%**

6: A _____ B _____ C _____

7: A _____ B _____ C _____

8: A _____ B _____ C _____

Climate is perhaps the biggest influence on soil color. Below are some broad trends in climate and soil color.

Climatic conditions	Soil Colors
Cold, wet areas (tundra)	Black, dark brown and gray
Wetlands (anaerobic conditions)	Gray, blue, green
Desert	Red, yellow/tan, white
Tropical	Bright red, orange and brown

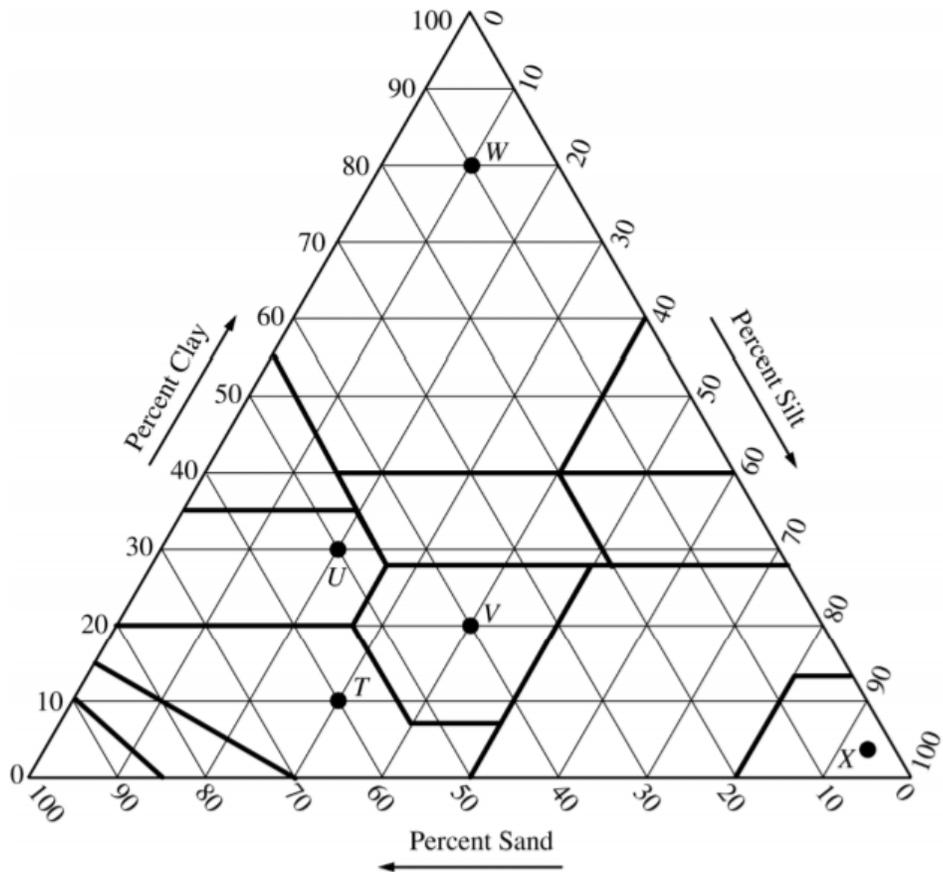
(from <https://www.sciencedaily.com/releases/2016/09/160901125646.htm>)

At Monticello, the soil is a bright red clay known as the Davidson clay. The bedrock beneath the soil is greenstone, which is comprised mainly of Fe (iron), Ca (calcium), and Mg (magnesium). As the greenstone decomposes (breaks down due to exposure to water and air), the iron in the greenstone oxidizes and turns the whole rock yellow and red. Chemical and mechanical weathering continue until the rock is broken down completely, and it becomes a red clay. This clay is rich in the nutrients necessary to grow crops.

Using the blank ternary graph to the right, plot the samples below using their chemical composition.. Remember to label each axis with an element.

- 1: 50% Fe, 30% Ca, 20% Mg = 100%
- 2: 15% Fe, 40% Ca, 45% Mg = 100%
- 3: 20% Fe, 20% Ca, 60% Mg = 100%

2016 AP Environmental Science Exam: Ternary Graph Practice



22. What are the proportions of sand, silt, and clay for the soil at point *T*?

	% Sand	% Silt	% Clay
(A)	75	20	5
(B)	70	20	10
(C)	65	25	10
(D)	60	30	10
(E)	55	30	15

23. Which soil composition would be the best choice for lining a landfill?

- (A) Point *T*
- (B) Point *U*
- (C) Point *V*
- (D) Point *W*
- (E) Point *X*

Trigonometry Red Soil & Dimensional Analysis Name:

Jefferson's experimental vegetable garden (seen in the images below) lies just below Mulberry Row at Thomas Jefferson's Monticello. Mulberry Row was the industrial center of Jefferson's 5000 acre plantation where dozens of slaves lived and worked. In total, there were over 600 slaves that Jefferson owned throughout his lifetime. These slaves were responsible for most of the labor at Monticello, including the removal of large parts of the mountaintop for both the house and the vegetable garden.

The Experimental Vegetable Garden at Monticello

Source:

https://www.monticello.org/sites/default/files/styles/body_image/public/uploaded-content-images/aerial-site-DJI0061-3v1.jpg?itok=ogqHqHIP



Experimental Vegetable Garden seen in the yellow rectangle.

Source:

<https://www.monticello.org/sites/default/files/uploaded-content-images/veggiemap.jpg>



QUESTIONS: Show all work in the spaces provided.

1. Seven slaves worked for three years to level the land for Jefferson's experimental vegetable garden. On March 31, 1774, Jefferson writes, "...laid off ground to be levelled for a future garden. the upper side is 44f. below the upper edge..." ([Jefferson's Garden Book, page 50](#)). Eventually, the garden would be 1000 feet by 80 feet by 44 feet deep, as seen in the yellow rectangle above. What was the total volume of dirt the slaves removed to create Jefferson's vegetable garden?

2. If an Olympic size swimming pool holds 88,000 cubic feet of water, essentially how many of these pools did these seven slaves dig over the course of those three years?

3. Approximately how many cubic feet of dirt did each slave remove per workday (generally the slaves worked Monday to Saturday). *Note: it is likely that there was not equal amount soil removed throughout the different seasons.*

ANSWERS

1. Volume = $44 \times 1000 \times 80 = 3,520,000$ cubic feet

2. $3,520,000$ cubic feet / $88,000$ cubic feet = 40 Olympic sized swimming pools

3. $3,520,000$ ft³ per 3 slaves per 3 years = $391,111.11$ ft³ per slave per year.

Slaves worked 6 days a week (Mon-Sat) for 52 weeks a year: $52 \times 6 = 312$ days a year.

$391,111.11$ ft³ per slave per year / 312 work days per year = 1253.56 ft³ of dirt removed per day.