

IMPORTANT: Please refer to the Preface for Topographic Map Activities for preliminary instructions and information common to all Topographic Map Activities in the series.

Topographic Map Activity 7 - Distance Between Two Points (Revision 07-28-20)

Objective: To calculate the distance in miles from the SR 159 turn-off into Red Rock Canyon National Conservation Area (NCA) to the summit of Turtlehead Mountain (as the crow flies).

Background: A Topographic Map can be used to find the distance between any two points on the map. One way, is to *measure* the distance. The distance can be measured using the scale bar at the bottom of the map, like a ruler, or by using the Geospatial Distance Tool included with the map. Another way, is to *calculate* the distance using the Pythagorean Theorem (high school math <https://youtu.be/AA6RfgP-AHU>). The haversine formula is a more complicated method for calculating the shortest distance between two points on the surface of a sphere.

Activity: In this activity, we will *calculate* the distance between two points.

Step 1. Open the [La Madre Mountain](#) Topo Map (if you previously saved it on your computer then you do not need to download it again).

Step 2. Once the map opens, ensure that all layers are being shown (refer to instructions in Preface for assistance).

Step 3. Scroll and zoom in to find the point for the SR 159 turn-off into the Red Rock Canyon NCA.

Step 4. At the top of your screen, select Tools > Measure > Geospatial Location Tool. Using your mouse, position the cursor at the SR 159 turn-off point. In the lower right hand portion of your screen, record the latitude and longitude for this point (record four places after the decimal point). [Answer](#)

Step 5. Scroll and zoom in to find the summit of Turtlehead Mountain (you may have to exit from the Geospatial Location Tool to scroll and zoom). After locating the summit, ensure the Geospatial Location Tool is on and position your cursor in the center of the contour circle for the summit. Record the latitude and longitude for this point (record four places after the decimal point). [Answer](#)

Step 6. Calculate the difference in latitude between these two points. [Answer](#)

Step 7. Convert this difference in degrees to distance in miles (note that a full degree of latitude is 69.06 miles, and stays nearly constant everywhere on the earth). [Answer](#)

Step 8. Calculate the difference in longitude between these two points. [Answer](#)

Step 9. Convert this difference in degrees to distance in miles. A full degree of longitude at 36.1562° latitude (the average for the latitudes for our two points) is 55.8487 miles. We learned how to calculate the distance for a degree of longitude at a given latitude in Topographic Map Activity #). [Answer](#)

Step 10. Calculate the *direct* distance in miles between these two points on a map (whenever the two points have either the exact same latitude or the exact same longitude use the answer in Step 7 or Step 9, whichever applies, here and skip to Step 11). Use the Pythagorean Theorem to calculate the hypotenuse of a right triangle, where 1 leg (a) of the triangle is the distance north-south and the other leg (b) of the triangle is the distance east-west (round numbers to 4 places after decimal point). $Distance = \sqrt{a^2 + b^2}$ [Answer](#)

Step 11. This is our last step! Since a Topographic Map provides elevation, we are working in 3-dimensional space. Use the Pythagorean Theorem again with the answer in Step 10 above as leg (a) and the elevation change (in miles) as leg (b) (round numbers to 4 places after decimal point). [Answer](#)

With the elevation component we could not have done it using the scale at the bottom of the map. However, try the Geospatial Distance Tool included with the map and check the answer. When you visit Red Rock Canyon NCA, and turn off SR 159, look for Turtle Head Mountain. Use the fact that it is 3.6795 miles away (including elevation change) to calibrate your eyesight.

Check the answer with online distance calculator (use negative values for south and west coordinates; no elevation) <https://www.vcalc.com/wiki/vCalc/Haversine+-+Distance>

[Feedback](#)

Answers (AS stands for answer step):

AS4 36.1317° N 115.4214° W

AS5 36.1807° N 115.4457° W

AS6 $36.1807^\circ - 36.1317^\circ = .049^\circ$

AS7 $.049 \cdot 69.06^\circ = 3.38394$ miles north

AS8 $115.4457^\circ - 115.4214^\circ = .0243^\circ$

AS9 $.0243 \cdot 55.8487 = 1.3571234$ west

AS10 Distance = $\sqrt{a^2 + b^2} = \sqrt{(3.3839)^2 + (1.3571)^2} = 3.6459$ miles

AS11 Distance = $\sqrt{a^2 + b^2} = \sqrt{(3.6459)^2 + (.4962)^2} = 3.6795$ miles