Name(s): _____ Per: _____

Investigation of Daylight Hours Throughout the Year Using Trig Functions

A table for the amount of daylight on the first of each month for three locations is shared below.

Helena, MT (46.5891° N, 112.0391° W)

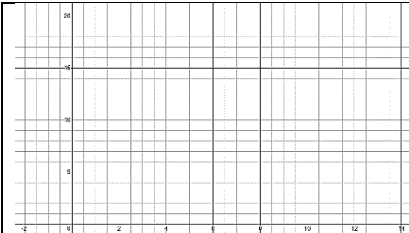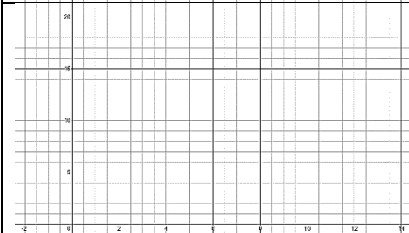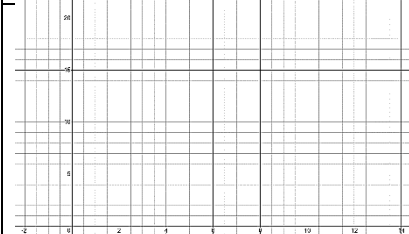| Month	Jan	Feb	March	April	May	June	July	Aug	Sept	Oct	Nov	Dec
Daylight	8 hr 39 m	9 hr 38 m	11 hr 6 m	12 hr 49 m	14 hr 23 m	15 hr 34 m	15 hr 46 m	14 hr 50 m	13 hr 19 m	11 hr 42 m	10 hr 3 m	8 hr 52 m
Hours	8.650											

Phoenix, Az (33.4484° N, 112.0740° W)

Month	Jan	Feb	March	April	May	June	July	Aug	Sept	Oct	Nov	Dec
Daylight	9 hr 59 m	10 hr 34 m	11 hr 28 m	12 hr 33 m	13 hr 31 m	14 hr 14 m	14 hr 20 m	13 hr 47 m	12 hr 52 m	11 hr 51 m	10 hr 49 m	10 hr 6 m
Hours	9.983											

Yakima, Wa (46.6021° N, 120.5059° W)

Month	Jan	Feb	March	April	May	June	July	Aug	Sept	Oct	Nov	Dec
Daylight	8 hr 37 m	9 hr 37 m	11 hr 5 m	12 hr 50 m	14 hr 24 m	15 hr 36 m	15 hr 47 m	14 hr 52 m	13 hr 20 m	11 hr 42 m	10 hr 2 m	8 hr 51 m
Hours	8.617											

1. Convert all the time measurements from hours & minutes to just hours and put them in the 3rd row of each table (round to the nearest thousandths). The first one for each city has already been done for you.
2. For each city, plot the 12 points using the month as the x-coordinate and the hours as the y-coordinate. January's measurement for Helena then would be (1, 8.650).

Sine equation for Helena:

Cosine equation for Helena:

Sine equation for Phoenix:

Cosine equation for Phoenix:

Sine equation for Yakima:

Cosine equation for Yakima:

3. Go into Desmos, make a table for each city (you can add a table by first clicking on the plus sign). And it will plot the points for you. Adjust your window to be like the one in the graphs above.

4. Get a sine equation for each of the cities by typing in the following in an empty cell. Helena's is done as the example below. The only difference for Phoenix is you would use x_2 and y_2. It will output the values of a, b, c, and d for you. Then, record the equation for each in the table above. *Round to two decimal places.

$$y_1 \sim a \sin\left(bx_1 + c\right) + d$$

5. Repeat step 4 but get a cosine equation for each of the cities.

6. What is the period for each of the cities? What do you notice? Why does that make sense scientifically?

7. What is the amplitude for each of the cities? What do you notice? Why does that make sense scientifically?

8. When you did a cosine equation for each of the cities which of the parameters (a,b,c,d) changed and which stayed the same? If they changed, state by how much. Explain why each makes sense.

9. Mark where each of the three cities are on the map.

10. Using the map to justify, what did you notice about Helena and Yakima's points, graphs, and equations. Why is this so?

11. Was the same true for Helena and Phoenix since they have the same longitude location (112° W)? Why so?