Let the Sun Shine

Name _____ Date _____ Per. _____

If you think about the time that the sun rises and sets each day, there are various changes that occur during a year. These changes vary depending on the latitude of that location. If you have been in Seattle or Canada in the summer you might notice that the sun does not set until after 10:00 PM. On the other hand, if you have spent time in Mexico City, the daylight hours do not vary much during the year.

This activity will have you explore daylight hours for various locations around the world. You will record hours of daylight for 12 different times during a year and fit these data points to a cosine curve.

Each member of your group will be recording and graphing the daylight hours for a different location. You will compare certain aspects of each graph and make some conjectures about the amount of daylight in different locations around the world.

http://www.exptech.com/sunrise.htm

Each member of the group should choose a group to take their city from, in other words, one group member should have A, another B, and so on. Once the group letter is chosen, that member can select any city in the group. The idea is for each group choice to be represented by the four students. (The four cities in each group choice have approximately the same latitude and all are in the northern hemisphere)

Group A	Group B	Group C	Group D
Anchorage, Alaska	Portland, Maine	Atlanta, Georgia	Dar Es Salaam, Tanzania
Helsinki, Finland	Madrid, Spain	San Diego, California	Bogota, Colombia
Reykjavik, Iceland	Istanbul, Turkey	Shanghai, China	Panama City, Panama
Oslo, Norway	Portland, Oregon	Cairo, Egypt	Lagos, Nigeria

Some of the cities will be found under WORLD CAPITALS, others under WORLD CITIES, and the same goes for the U.S. Cities.

Complete the table below with the information from your city. You will enter this data into the calculator later, graph the data, and find the algebraic model.

Your City _____

Latitude _____ Longitude _____

Day #		Hours of Daylight	Day #		Hours of Daylight
June 21	**0**		January 15	**208**	
August 15	**55**		February 28	**252**	
September 21	**92**		March 21	**273**	
October 30	**131**		April 30	**313**	
November 15	**147**		May 31	**344**	
December 21	**183**		June 21	**365**	

Now that you have your data points in the table above, it is time to enter the data into the lists on your calculator. If you are finished with the computer, please quit out of the Internet browser.

1. Enter the data into two lists, L_1 and L_2. June 21st is the longest day of the year and that is where your graph will begin, therefore June 21st will be position zero. These numbers represent the values on the horizontal axis, **days since June 21**, ENTER these numbers to enter into L_1. Enter the hours of daylight time in decimal form into L_2.

2. Turn on your STATPLOT for those lists. Press WINDOW and enter values to produce a viewing window that will show one complete year of daylight time. (This is your practical domain and range).Write those values below:

   x-min _____ x-max _____ y-min_____ y-max_____

3. TRACE along your plot. What do the x-values represent? _____

4. What do the y-values represent? _____

5. What is the maximum daylight time for your city? _____

6. What are the other maximum times for the other members in your group?
   _____ _____ _____

7. Which location in your group has the longest day (largest amount of daylight time)?
   _____

8. Which location in your group has the shortest day? _____

9. Which day number is the longest? _____ Is the is the same for all locations? Why or why not?
   _____

10. Explain the relationship between a location's latitude and the amount of daylight hours it has?

11. If a location has approximately 12 hours of daylight each day, every day, where would it be located?

12. Can a location have 24 hours of daylight? Explain.

13. Can you find such a location and explain if and when it would have about 24 hours of daylight?

13. Does this location ever have 0 hours of daylight? Explain if and when that would happen.

14. hat type of function do you think would best model this data? _____
    Why?
    _____

15. The next step is selecting the "parent" function to model the data. In this lesson you will fit the data to the Cosine family of functions. To review the parts of the cosine family, fill in what each of the variables A, B, and C represent.

    A _____ B _____ C_____

16. Press Y_1 and enter A cos B(x+ C). The plan is to find each value, store it in, then graph it. Let's start with A, the amplitude of the function.

    Compute the amplitude and store this value in for A on the calculator. A = _____.

17. Did you get the same values as the other members of your group? _____ Why or why not?

_____

18. The location with the greatest amplitude in your group is _____.

19. The location with the least amplitude in your group is _____.

20. You already know that the length of one cycle is 365. The fundamental period of cosine is 2π. If you divide 2π by 365 you will obtain what portion of the graph you will see in 2π. Store that value you in for B. B = _____.

21. Before we worry about the vertical shift (C), turn on Y_1 and press ZoomStat to view the graph. If you do not see anything but the plot, you must make an adjustment to the vertical shift. Change your WINDOW to show a y-min of –10. When you return to the graph window you will see where the function is. Try storing difference values in for C until you have the correct value. Press ZoomStat again to view the graph and the correct function.

C = _____.

22. Write your complete equation using the values for the four variables:

y = _____

23. Go back to the WINDOW and change x-max to 730. This is model two years. Press GRAPH.

24. Press 2^{nd} TRACE and then VALUE. Ask for the 500^{th} day since June 21^{st}? How many hours of daylight are on that day? _____

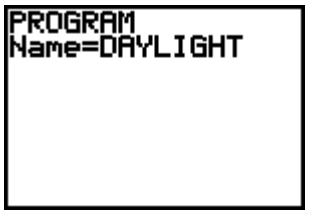
25. Is amplitude the only value that is different with respect to the equations in your group? Why or why not?

26. Type into Y_2 and Y_3 the equations from your other group member. View your graph with the three equations. List some of the similarities and differences they have? Make sure you include any points that **all** the graphs might have and **WHY**.

Similarities Differences

You want to save L_1 and L_2 which contain the data. All you need is a 2-line program. Follow the simple steps below to create this program. You can then delete or overwrite the lists since the data will be saved somewhere else. The screenshots below will take you through each step.

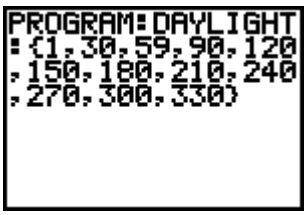
Press PRGM



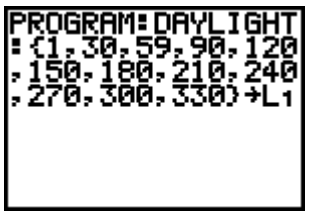
Choose NEW and type in the name of the program. You will already be in ALPHA mode.

Press ENTER when finished with the name of the program.

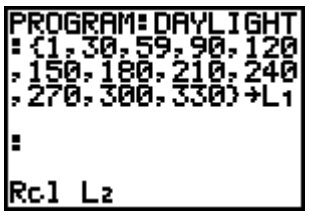
Press 2nd STO will bring up the RCL (recall) command, then type L_1.



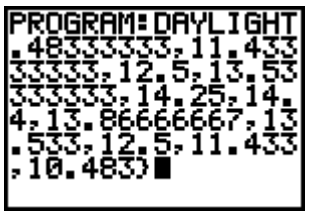
Press ENTER and the data from L_1 will be displayed.



Immediately store to list 1 by pressing the STO key and choosing L_1. Press ENTER when finished.



Repeat the process for the next list.



When you are finished with both lists, press 2nd QUIT and you have now created a program with the two data lists.

To have these lists appear in the List Editor, simply run the program.