Teacher's Guide

The Sunspot Cycle

Objective

The student will create a list and construct a graph of the number of sunspots using both technology and paper. The student will explore patterns in the data and locate the maximum and minimum.

Materials

— Graph paper
— Ruler
— Colored pencils
—Sunspot data table

Optional:
—Teacher notes on the graphing calculator.
—Graphing calculator.
TI-83 used in the examples

Procedure

1) Divide the students into groups and assign a time period from the data table that each group will graph. Some possible lengths are the 1900s, 1800s; every 50 years; a column of the table (be aware that assigning less than 50 data points will prevent pattern recognition).

2) Use the graphing calculators, the students will input their data. They will use the trace key to explore the graph of their data while they look for a pattern or observation. Allow each group to report on their findings. They may or may not agree on a pattern within the groups as well as within the classroom as a whole.

3) Students will then construct the graph of the table on graph paper. Some possible options here are to have students each construct the graph, have each group use their assigned data and put the results of the class as a whole on the wall, or have the groups do a graph of the entire data. Be sure to agree upon a consistent scale for ease of construction and display

4) Discuss the results of the entire sunspot table as a whole. Look for patterns such as maximum and minimum.

5) Students then predict when the next maximum will occur. Students will then construct what the graph would look like if this pattern continued on through the year 2099.

What is a sunspot?

A sunspot is a region on the sun that can be seen as a small dark spot through a telescope. Since their discovery by Galileo in 1609, astronomers have learned that they are regions, about the size of the Earth, where powerful magnetic fields are concentrated. Often the site of solar flares and other storm activity, these spots are dark because the temperature of the solar gases inside them is about 2000 C cooler than the rest of the sun (5500 C). They appear black because they emit less light than the sun. In fact, if the were suspended in the night sky, they would glow a bright red color and be brighter than the full moon. The sunspot cycle has been seen since about 1670 and has a period of about 11 years. Before 1670, no such cycles were seen and this time also corresponded to the 'Little Ice Age' in Europe. Scientists now think that solar activity influences the Earth's weather in some way.

Key Terminology:

Maximum: A large number of sunspots in a particular cycle.

Minimum: A small number of sunspots in a particular cycle.

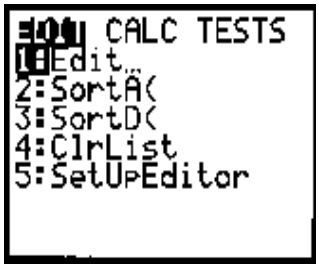
Sunspot: A dark spot on the Sun indicating a cooler temperature.

Teacher Notes for the Graphing Calculator

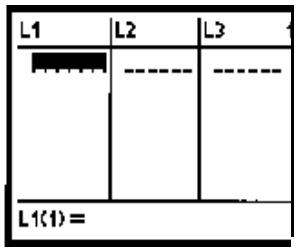
The commands for the calculator are given in bold print below the window you will see in the right-hand screen. Read the setup guide at the end of this section under 'How to insure success.'

When choosing the group data assignments, the best situation may be to assign the 1700's, 1800's and 1900's, or a minimum of 50 data points to permit pattern recognition.

Entering data into the list will consist of the following key strokes :

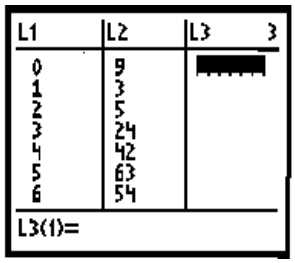


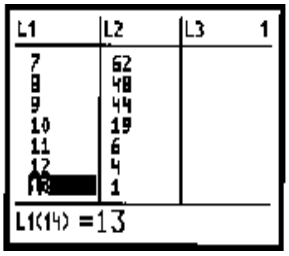
STAT



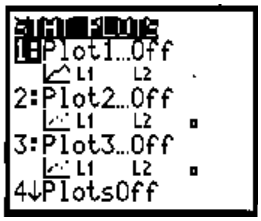
ENTER

This will put you at the window to input data for the year in list 1, and the data for the sunspot number in list 2. Screen images for the list beginning in 1900 are shown. The L1 data (year) was entered using only one or two digits for simplicity and to save time. This is acceptable since the scales on the axis are not displayed by the graphing calculator.





After the data has been entered into the lists, the stat plots will need to be turned on. To turn the plots on, use the right-hand key strokes. Note, turn on the second window to the right by using the arrow keys to place the cursor over each of the darkened items shown, and hittin **ENTER.**

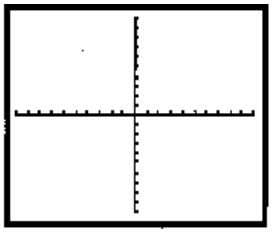


2ND Y=

ENTER

Note: When selecting the type of graph, the student may want to pick the first plot. When they do so, the result is a plot of the individual data points. The second type shows the data as a set of connected points. The second type of graph is best for this example because it shows a continuous cycle. Students need to be aware that the data is continuous.

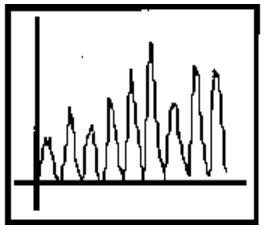
When the students hit the graph key, they may not see any data. They may see a graph of four quadrants with a small display of data.



GRAPH

In order to get the correct window for the statistics plots, students will need to zoom the window:

ZOOM



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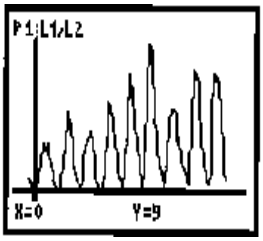
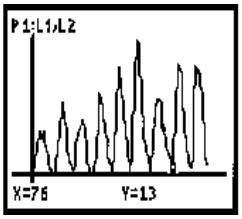
In order to check for pattern recognition and to trace the sunspot cycle maxima and minima, the students need to trace the cycle by using the left and right arrow keys to move along the graph. Some examples of the screen when using the **TRACE** command are shown to the right. When using the TRACE key, the students are able to see the year displayed from L1 and the number of sunspots from L2.

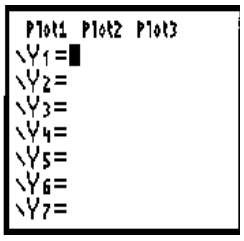




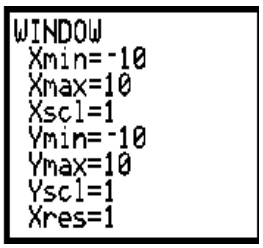
How to insure success for beginners

Before starting the activity with the students, have them insure that the following settings are in place on their calculators.

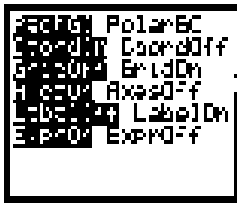
MODE



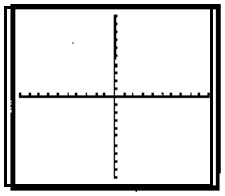
Y=



WINDOW

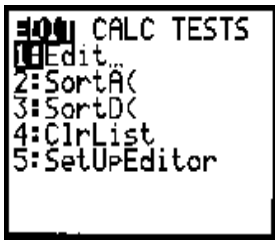


2ND ZOOM



GRAPH

To insure that the lists are cleared beforehand:



STAT

Then select 'ClrList' and use the keystrokes: 2**ND 1, 2ND 2, ENTER, CLEAR.** You can now begin the activity.

The Sunspot Cycle Data Table

The following numbers give the maximum sunspots counted during each year from telescopic observations on the ground. They are listed by year 'yr' and by the corresponding number seen 'N'. Example, for 1880 there were N = 32 sunspots counted.

Year....N	Year....N	Year...N	Year...N	Year.....N
1700... 5	**1760...63**	**1820...16**	**1880...32**	**1940...68**
1702...16	**1762...61**	**1822...4**	**1882...60**	**1942...31**
1704...36	**1764...36**	**1824...9**	**1884...64**	**1944...10**
1706...29	**1766...11**	**1826...36**	**1886...25**	**1946...93**
1708...10	**1768...70**	**1828...64**	**1888...7**	**1948...136**
1710... 3	**1770...101**	**1830...71**	**1890...7**	**1950...84**
1712... 0	**1772...67**	**1832...28**	**1892...73**	**1952...31**
1714...11	**1774... 31**	**1834...13**	**1894...78**	**1954...4**
1716...47	**1776...20**	**1836...121**	**1896...42**	**1956...142**
1718...60	**1778...154**	**1838...103**	**1898...27**	**1958...185**
1720...28	**1780...85**	**1840...65**	**1900...9**	**1960...112**
1722...22	**1782...38**	**1842...24**	**1902...5**	**1962...38**
1724...21	**1784...10**	**1844...15**	**1904...42**	**1964...10**
1726...78	**1786...83**	**1846...61**	**1906...54**	**1966...47**
1728...103	**1788...131**	**1848...125**	**1908...48**	**1968...106**
1730...47	**1790...90**	**1850...67**	**1910...19**	**1970...104**
1732...11	**1792...60**	**1852...54**	**1912...4**	**1972...69**
1734...16	**1794...41**	**1854...20**	**1914...10**	**1974...34**
1736...70	**1796...16**	**1856...4**	**1916...57**	**1976...13**
1738...111	**1798...4**	**1858...59**	**1918...81**	**1978...92**
1740...73	**1800...14**	**1860...96**	**1920...38**	**1980...154**
1742...20	**1802...45**	**1862...59**	**1922...14**	**1982...116**
1744... 5	**1804...48**	**1864...47**	**1924...17**	**1984...46**
1746...22	**1806...28**	**1866...16**	**1926...64**	**1986...14**
1748...60	**1808...8**	**1868...38**	**1928...78**	**1988...98**
1749...81	**1809...3**	**1869...74**	**1929...65**	**1989...154**
1750...83	**1810...0**	**1870...139**	**1930...36**	**1990...146**
1752...48	**1812...5**	**1872...102**	**1932...11**	**1992...94**
1754...12	**1814...14**	**1874...45**	**1934...9**	**1994...30**
1756...10	**1816...46**	**1876...11**	**1936...80**	
1758...48	**1818...30**	**1878... 3**	**1938...110**	

Name _____

Date_____