Name: _____

LAB: Sunspot Analysis

Adapted from Exploration in Earth Science, The Physical Setting, United Publishing Company, Inc.

INTRODUCTION: Photographs of the Sun show dark areas on its surface. These spots are believed to be due to solar storms - areas of cooler gases on the surface. The number and pattern of these spots change with time.

When data collected over many years are graphed, a pattern emerges. This picture-like representation makes it easier to see relationships that are not obvious from a column of numbers.

OBJECTIVE: You will see how graphing a natural phenomenon can aid in predicting future events.

VOCABULARY:

Event:

Independent Variable:

Dependant Variable:

Cyclic:

Extrapolate:

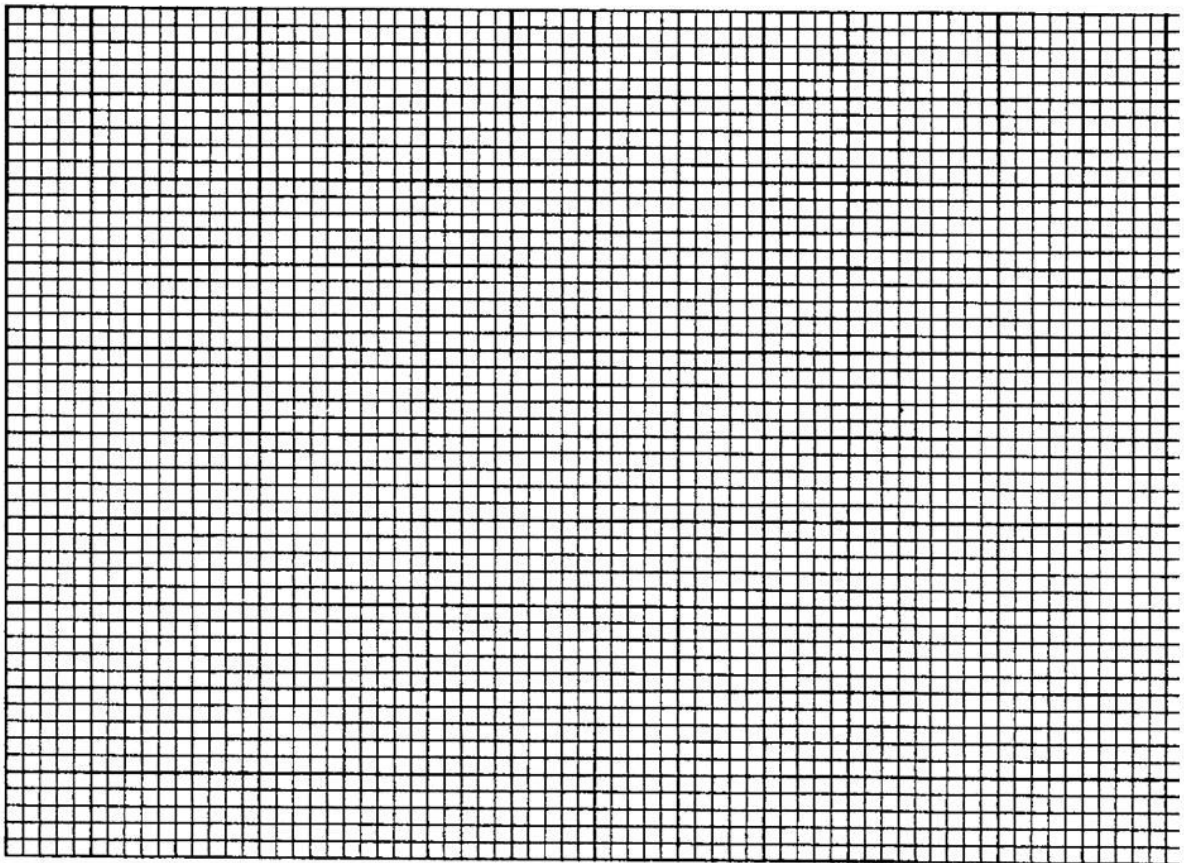
PROCEDURE:

1. Using the data from the table, determine which variable is the independent and which is the dependant variable. Make an appropriate scale for each based on the data given. Label each graph axis completely
2. Using the data given, graph the number of sunspots in the years from 1950 to 2004.

AVERAGE ANNUAL SUNSPOT NUMBERS

YEAR	NUMBER OF SUNSPOTS	YEAR	NUMBER OF SUNSPOTS
1950	84	1978	93
1951	69	1979	155
1952	30	1980	146
1953	13	1981	134
1954	4	1982	116
1955	38	1983	72
1956	141	1984	46
1957	176	1985	18
1958	185	1986	13
1959	158	1987	29
1960	112	1988	50
1961	54	1989	145
1962	38	1990	155
1963	28	1991	150
1964	10	1992	94
1965	15	1993	55
1966	47	1994	30
1967	94	1995	18
1968	106	1996	7
1969	105	1997	21
1970	105	1998	64
1971	67	1999	93
1972	69	2000	120
1973	38	2001	111
1974	34	2002	104
1975	16	2003	64
1976	13	2004	44 (est)
1977	27		

AVERAGE ANNUAL SUNSPOT NUMBERS



Discussion Questions: Answer using data from the lab and in complete thoughts.

1. Describe the pattern shown on this graph.

2. Each peack on this graph represents a sunspot maximum. In which years do the maxima occur?

3. When did the last maximum occur?

4. What is the average time span (to the nearest tenth of a year) between maxima? *Hint: determine how many years between each maxima, add those all up, and divide by the number of time spans (one complete cycle)* Show your work.

5. What is the average time span (to the nearest tenth of a year) between minima? *Hint: look at the previous problem.* Show your work.

6. What is the average time for one complete sunspot cycle?

7. Predict when the next maxima will occur after the last one plotted on your graph. Use your answers to questions 3, 4 and 6 to assist you on this question.

8. Predict when the next minima will occur after the last one plotted on your graph. Use your answers to questions 5 and 6 to assist you on this question.

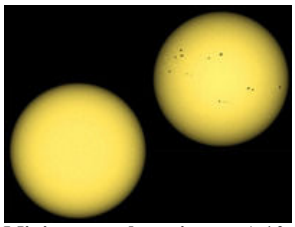
9. Extrapolate from this graph at its present rate to determine approximately how many sunspots will occur in the year that you will graduate from high school. *First, determine the year you will graduate, then show the extrapolation on the graph to determine the number of sunspots*.

CONCLUSION: How does graphing show us that some natural phenomena may be predictable?

Reading Comprehension Read the portion of the article on the Sunspot Cycle below and answer the following questions based on the reading. Use complete sentences

End of the Sunspot Cycle?

by Richard A. Kerr on 14 June 2011, 6:06 PM



Minimum and maximum. A 10-year prediction has the sun devoid of sunspots when it should be covered with them.
Credit: Image courtesy of SwRI

Things may be about to get very dull on the sun. Three different measurements of solar activity, reported by scientists at a press conference today, suggest that the next 11-year-long solar cycle will be far quieter than the current one. In fact, it may not happen at all: Sunspots, the enormous magnetic storms that erupt on the sun's surface as the cycle builds, might disappear entirely for the first time in approximately 400 years.

If the reported trends continue—a big if, other researchers note—a hibernating sun would have only a slight cooling effect on climate. But solar storms hurtling toward Earth that can disrupt satellites, power grids, and other electronics, would be much subdued, giving scientists a chance to study the sun in a phase unseen in modern times. For centuries, solar activity has been swinging from solar maximum (lots of dark sunspots, solar flares, and massive ejections of plasma, some aimed at Earth) to a far quieter solar minimum every 11 years or so. The current solar cycle, dubbed number 24 (it's the 24th solar cycle since 1755, when sunspot activity began being recorded), has just gotten off to a late, slow start in the past year as more sunspots appear.

At the press conference, held at the annual meeting of the Solar Physics Division of the American Astronomical Society in Las Cruces, New Mexico, three scientists gave a forecast of sorts for the next solar cycle, number 25. "Cycle 24 may be the last normal one for some time," said solar physicist Frank Hill of the National Solar Observatory (NSO) in Tucson, Arizona, "and the next one, cycle 25, may not happen. The solar cycle may be going into hiatus, like a TV show." Hill and colleagues reported on a jet-stream-like flow within the sun that they have been monitoring since 1995 using "helioseismology," the study of sun-wide oscillations of the solar surface. They expected the next cycle's jet to appear in 2008 or 2009, but it's still a no-show.

Another still-missing harbinger of the next solar cycle is the rapid march of magnetic activity toward the poles in the sun's very hot but faint gaseous corona high above the visible surface. Richard Altrock of NSO in Sunspot, New Mexico, showed a 40-year record that suggested this "rush to the poles" is far behind schedule in the current cycle. That might mean that this cycle will not clear the decks, magnetically speaking, to make room for the next cycle. In that case, "it's not clear what would happen" in the next cycle, Altrock said.

And Matthew Penn of NSO in Tucson and colleagues reported a trend in the intensity of the magnetic field of sunspots as gauged using a ground-based telescope during 13 years. The stronger a spot's magnetic field, the darker the spot. Below a certain field strength, a spot will fade away. Penn finds that the typical field strength of spots began declining in the past cycle and continues to decline in this cycle. Assuming the trend continues, the maximum of the current cycle would have half as many sunspots as the previous cycle did, and the next cycle would have no spots at all, he said.

Taken together, the scientists say, the three trends suggest that no visible solar cycle will begin at the next expected start time, around 2020. Such a gap last happened during the Maunder Minimum 400 years ago. But other researchers are cool to the idea. Solar physicist Mausumi Dikpati of the National Center for Atmospheric Research in Boulder, Colorado, notes that success forecasting solar activity a few years out has been modest at best; forecasting a decade or two out would be even trickier. "The data is very limited as yet, only one or two cycles," she says, making prediction difficult.

Dikpati and space physicist Yi-Ming Wang of the Naval Research Laboratory (NRL) in Washington, D.C., also interpret some of the physics underlying the three observed trends differently from the three forecasters. In their alternative interpretations, the trends are of little help in forecasting. All in all, writes space physicist Judith Lean of NRL in an e-mail, the understanding of the sun's behavior "is so uncertain that projections far into the future are more or less speculation."

1. Using the information from the article, sketch a graph to represent sunspot activity (the x-axis will be the # of years, the y-axis will be activity from high to low)

2. When did sunspot activity begin being recorded and which “cycle” are we currently in?

3. What are two pieces of evidence that the next susnspot cycle may not occur?

4. How could Earth be affected by a period of no sunspot activity?