STARBASE Challenge: Solar Storms and Satellites

Satellite technology is everywhere! As of September 2019, there are over 2200 working satellites orbiting Earth. They represent over $160 billion in assets to the world's economy. In the United States alone, satellites and the many services they provide produce over $225 billion every year. But satellites do not work forever. For this challenge, you will learn more about satellites and solar events. You will decide for yourself whether or not the number of sunspots per year may impact the number of Low Earth Orbit (LEO) satellites that re-entered Earth's atmosphere by generating and analyzing line graphs.

Part 1: Satellite Basics

Use this resource to answer the following questions: Everything Revolves Around You: Crash Course Kids #22.1 or https://tinyurl.com/sbctsatellites

1. What is a satellite?

2. What are some of the different types of satellites?

3. Which type of satellite do you think is most important? Why?

4. How do factors like velocity and gravity decide whether or not a satellite will stay in its orbit?

Part 2: Solar Events

Use this resource to answer the following questions: The Sun: Crash Course Astronomy #10 or https://tinyurl.com/sbctsun

1. What process powers the sun?

2. How are magnetic fields created in the sun?

3. How are sunspots, solar flares, and coronal ejections similar? How are they different?

4. How does the Earth react to these solar events?

This challenge was inspired by Solar Storms and Satellite Orbit Decay from NASA's Space Math - 1.

Part 3: Graphing and Patterns

The table below gives the number of LEO satellites that re-entered Earth's atmosphere, and the average sunspot number, for each year since 1969.

A Table of the Average Number of Sunspots and LEO satellite Re-entries From 1969 - 2004

Year	Sunspots	Satellites
1969	105	26
1970	107	25
1971	66	19
1972	67	12
1973	37	14
1974	32	21
1975	14	15
1976	12	16
1977	26	18
1978	87	33
1979	145	42
1980	149	41
1981	146	32
1982	115	19
1983	65	28
1984	43	14
1985	16	17
1986	11	16
1987	29	13
1988	101	33
1989	162	45
1990	145	30
1991	144	40
1992	93	41
1993	54	28
1994	31	17
1995	18	20
1996	8	22
1997	20	21
1998	62	30
1999	96	25
2000	124	37
2001	123	41
2002	109	38
2003	66	31
2004	43	19

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Reminders for making a graph:

- You graph should have a title that describes the information inside
- Your x-axis in a line graph should measure time
- Your y-axis in a line graph should measure whatever is changing over time
- Include units in your axis labels
- For this graph your time values begin at 1969, so set your axis scale to start at "1969". Google Sheets will do this automatically.

If you are making your graph in Google Sheets, check out this tutorial: Creating a Line Graph in Google Sheets or https://tinyurl.com/sbctgraph

1. Plot the number of sunspots (vertical axis) for each year (horizontal axis). During what years did the peaks in the sunspots occur?

2. Plot the number of decayed satellites (vertical axis) for each year (horizontal axis). When did the peaks in the satellite reentries occur?

3. Is there a pattern between the two sets of data? Why do you think so?

4. If you are a satellite operator, should you be concerned about the sunspot cycle? Why or why not?

5. What are at least two ways that the sun could affect a satellite's orbit?

6. How do you rely on satellites, or satellite technology, during a typical week?

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