Earth’s Satellites Analysis Teacher Guide

**These are Lesson Prompts for the teacher:**

This lesson comes in right after talking about Tycho Brahe & Kepler. Our task is to pretend we are a bunch of Kepler-like assistants, trying to make sense of all the data that we are given. Specifically, we are asked to figure out what affects the period of a satellite, and we are using data from all of the (listed) artificial satellites around the Earth.

🡪At this point, we will have already done the introduction lesson to Python, so students will have some familiarity with coding already.

*This comes in right before starting* **Make Some Cuts**

Satellites can orbit in different paths, the eccentricity of the orbit tells us \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ ***(how circular the path is)***. Search up Orbital Eccentricity; if I wanted to deal with a circle, what e (eccentricity) value should I use? \_\_\_\_\_\_ *(0, or as close to 0 as possible)*.

We will want to deal with orbits that are as close to a circle as possible, just to keep things simple. We’ll need to filter out any satellite info beyond the range of (0 to 0.0005)

🡪Now have students start going through the code about making cuts. How much data did we cut? 🡨

We want to figure out what affects the period of a satellite’s orbit

Review the titles of the columns to come up with some possible IVs. What seems like a reasonable potential IV? (Does “Official Name of Satellite” seem very applicable?)

**Class Check In**

Have groups summarize what they have found and present this to the rest of the class.

Next ask what Perigee means, compare to Apogee, reference eccentricity from before and why Perigee & Apogee will be essentially interchangeable for this set of data.

How do you convert km into m? Go through that section together.

What is the radius of the Earth in meters? 6,371,000m

What is the orbital radius of the ISS in meters? 6,600,000

Is the Perigee showing us the orbital radius (from center of one object to the center of the other object)?

**Finding and Graphing the Orbital Radius**

Students add on the Earth’s radius in their groups, check calculations, then make a graph.

**Conclusion**

Bottom left is ISS, Starlink (Elon Musk satellites), spy satellites.  These satellites want to be close to the Earth’s surface so it’s easier to communicate/ move back and forth between satellites & Earth.

Middle is most likely GPS, which orbit around 12 hrs

Top Right is Geosynchronous; even though the satellites are pretty far out, these are highly sought-after locations (about half of our listed satellites are located here)

Why did we use Python?

Python is great for when we have HUGE amounts of data. This was a lot of data, but Excel probably could have handled it, so why Python? Notice how easy it was to make the graphs; after we made a graph once, all we had to do was copy and paste (and slightly alter) the code to make another graph. You could do the analysis in Excel/ Sheets, but making the graphs would have involved a lot more clicking and changing.

Data from

Go to <https://www.kaggle.com/datasets/ucsusa/active-satellites> and get the database.csv