LIGHT LAG
Teaching Guidelines

Subject: Mathematics

Topics: Algebra, Fractional exponents

Grades: 8 - 12

Concepts:

- Fractional exponents

Knowledge and Skills:

- Can solve complex, multi-step problems
- Can solve equations involving fractional exponents

Materials: None

Procedure: The investigation is best done by students working individually or in teams of 2.

Distribute the handout and ensure that students understand the question.

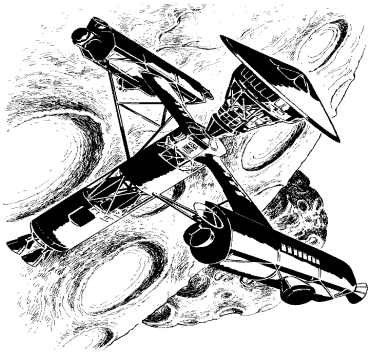
To carry out the task, students will first have to determine the value of k in the given equation. They can do that by plugging in the known values for a satellite in geosynchronous orbit (t = 24, d = 26,240)—but they will need to remember that the distance of a geosynchronous satellite from the center of the earth is 4000 miles greater than the distance to the surface of the Earth.

Once they know k, they can find the distance from the satellite to the center of the Earth for each given duration, but then they will need to remember to subtract 4000 miles to determine the distance to the surface of the earth, before dividing by the speed of light to get the light lag.

From: Chief Engineering Officer

To: Engineering Team #3

Regarding: Light Lag



As you know, one of the disadvantages of the geosynchronous orbit is the signal delay that we get when a satellite is 22,240 miles away from the surface of the earth.

Given that the speed of light is around 186,000 miles per second, we end up with a delay of around a quarter of a second from the time a signal is sent up to the satellite to the time it is received by an antenna back here on earth.

I would like to take a look at what would happen with satellites in other orbits. What if, for example, we had a satellite which orbits in 12 hours? Would the light lag be half as much, or something different?

Please work out the numbers for the chart below. Keep in mind that the relationship between a satellite's time duration of orbit (t) and its distance from the center of the earth (d) is given by this equation:

$$t = kd^{3/2}$$

Duration of orbit	Light lag
24 hours	.24 seconds
18 hours	
12 hours	
8 hours	
6 hours	
3 hours	
2 hours	

Be sure to double check your answers—I'm taking this data to the Board of Directors meeting next week.

--Guglielmo