**Size of the Earth Calculation**

Around 200 BCE, the Greek astronomer Eratosthenes was one of the first (that we know of) to make a geometric estimate of the size of the Earth. (Previous to him, other astronomers from ancient Greece had argued that the Earth must be spherical, such as Aristotle’s argument that the Earth’s shadow on the Moon was round during a lunar eclipse.) Eratosthenes used the following information to make his argument:

1. If the Sun is sufficiently far away from Earth, incoming light rays from the Sun will appear to be parallel to one another.
2. At noon on the first day of summer (Summer Solstice) in Syene, Egypt, sunlight hit the bottom of a vertical well (i.e. the light rays were perpendicular to Earth’s surface at that location).
3. When he measured the shadow of a column in Alexandria, Egypt at noon on the Summer Solstice, he found that the length of the shadow implied that the light rays were coming down at an angle of 7 degrees away from a line perpendicular to Earth’s surface.

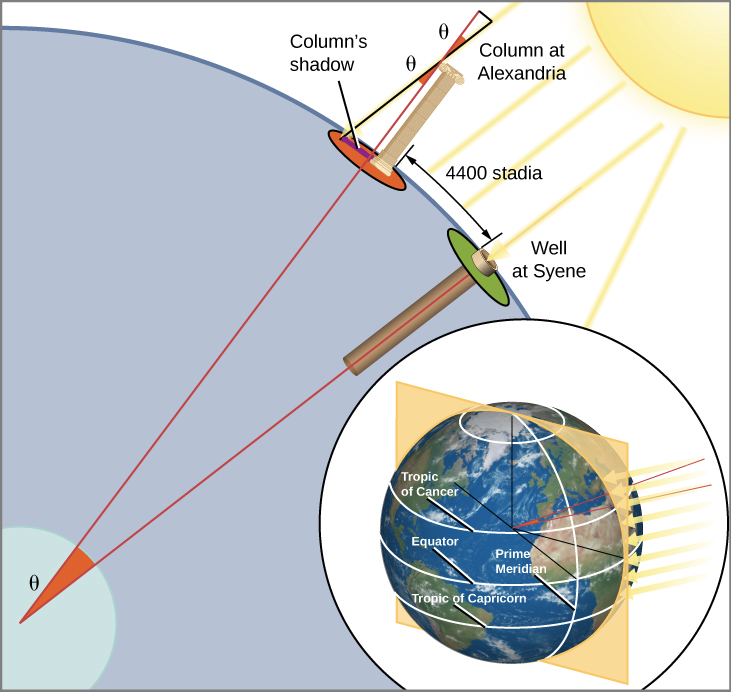


Figure 1: From Figure 2.11 of OpenStax Astronomy (modification of work by NOAA Ocean Service Education).

1. If the angle between Alexandria and Syene is 7 degrees, what fraction of a full circle (360 degrees) will this be?
2. Given your answer to question 1, what fraction of the circumference of a full circle around the Earth is given by the curve between those two cities?
3. If the distance between Alexandria and Syene was measured in ancient times as being 4400 stadia, as stated in Figure 1, then what would be the circumference of a full circle around the Earth passing between those two cities, in stadia?
4. If each stadium (the singular of stadia) is, in modern units, 1/6 of a kilometer, what would your answer to question 3 be in kilometers?
5. If the circumference of the Earth is currently measured at about 40,000 km, how close could Eratosthenes have been to the actual value for Earth’s circumference?