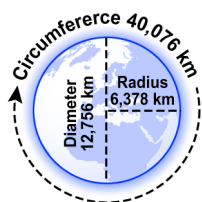


31.1 Earth and Moon

Earth is one of nine planets that along with numerous other smaller objects revolve around the sun in our solar system. It is approximately 150 million kilometers from Earth to the sun. Revolving around Earth at a distance of 384,400 kilometers is our only moon. Since the invention of spacecraft, our knowledge of Earth and the moon has grown tremendously. In this section, you will learn important information about Earth and the moon that will help you understand the rest of the solar system.

Earth dimensions

How big is Earth?



Earth's shape is almost spherical except for a slight bulge at the equator. If you were to travel exactly once around along the equator, you would travel 40,076 kilometers. This distance is the *circumference* of Earth. The *diameter*, or the distance through the center, is 12,756 kilometers and its *radius* at the equator is equal to half of this value, or 6,378 kilometers. Because of its slight bulge at the equator, if you were to measure the radius from one of the poles it would be slightly less (6,357 kilometers). Our current knowledge of Earth's dimensions comes mostly from satellite data, but how were its dimensions determined before this technology existed?

Eratosthenes and the circumference of Earth

More than 2,000 years ago, Greek astronomers knew that Earth was spherical. Eratosthenes was the first astronomer to discover a way to measure the circumference of the planet's sphere. He made a precise measurement of Earth's circumference by using *indirect measurement*. On the first day of summer in Syene, Egypt, he could see the reflection of the sun at the bottom of a deep, narrow well. This meant the sun was *directly* overhead. Exactly one year later, he measured the angle of the sun's rays in Alexandria, which was 787 kilometers due south of Syene. The angle he measured was 7.2° from the vertical. From this, he was able to compute the circumference of Earth using the following relationship:

$$\frac{7.2^\circ (\text{from Syene to Alexandria})}{360^\circ (\text{in a circle})} = \frac{787 \text{ km (distance from Syene to Alexandria)}}{x \text{ (circumference of Earth)}}$$

$$x = \frac{360^\circ \times 787 \text{ km}}{7.2^\circ} = 39,350 \text{ km}$$

How fast are we moving?

To make a full rotation in 24 hours, Earth must spin at a speed of 1000 miles per hour. Earth also revolves around the sun. Since it is 93 million miles away, the total distance Earth must travel through one complete trip around the sun is close to 600 million miles. Since Earth travels this distance in only 365.25 days, its average speed is 66,000 miles per hour!

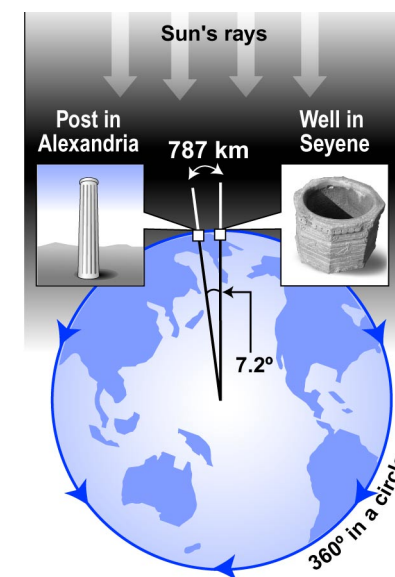


Figure 31.1: How Eratosthenes figured out Earth's circumference.