

TIME AND DISTANCE

Light-year is an astronomical term almost everyone knows. While it may sound paradoxical at first, a light-year is not a unit of time, rather, it is a unit of distance. A light-year is the distance that light travels in a year. Since the speed of light is the fastest possible speed (approx 186,000 miles per **second** or 300,000 km/sec), measuring distances in terms of how far light travels in a certain time is a good way to measure the unfathomably large distances in space.

We just learned that the Moon is 240,000 miles from the Earth. This is a pretty large number, but possibly understandable for people who drive a great deal, and might put that much mileage on a car (or cars) over the course of decades. However, the distance to the sun is approximately 93,000,000 million miles, and that is a distance far beyond the scope of any human's everyday experience. So how can we begin to compare these two very large numbers to get a better sense of the relative distances between objects in space.

We can do this by considering the light travel time to these objects, that is, how long it takes light to travel from the Earth to another object in space.

We start by asking how long it would take light to travel from the Earth to the Moon. At the speed of light, this trip is just a bit more than 1.25 secs, so we would say that the distance to the Moon is about 1 1/4 light-seconds. If you have ever seen the footage of astronauts on the Moon, you may have noticed that it seemed like their conversations with ground control were on some strange time delay. This occurs because radio waves are a form of electromagnetic radiation and travel at the speed of light, so it takes about 1 1/4 secs for "hello, how are you" to get from the Earth to the Moon, and an equal time for "fine, and you?" to return to Earth.

In terms of light travel time, the Sun is eight light minutes away. The light travel time to the Moon is about how long it takes to count from one to six, and eight minutes is much too long to hold our breaths. The planet Jupiter is about 45 light minutes away, or about the time of a single class period. The most distant planet planet in the solar system, Pluto, is a bit more than 5 light hours away, or about the length of one class day.

The next nearest stars are incredibly distant, but still understandable in our light travel time context. The next nearest stars to the Earth (the sun is the nearest of course) are about 4.3 light years away, or about the time it takes to complete high school or college. So, if we want to understand how far stars are from Earth, we can use light travel times to put these distances into a framework that we can understand.