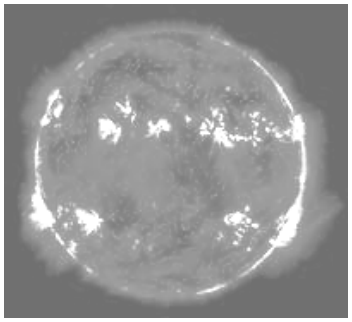
Our Star, the Sun



(Image Credit: NASA/Transition Region & Coronal Explorer)

In this Exploration, find out:

- How do the distances of stars compare to our scale model solar system?
- What is a light year?
- How long would it take to reach the nearest star to our solar system?

Stellar Distances

Now that we have modeled the sizes of main sequence stars, we will examine the distances between stars using the same scale factor of 1:10 billion.

Alpha Centauri, the closest star to the Sun, is actually a triple star. Multiple stars are very common. Fifty to seventy-five percent of all stars are in such systems.

Table 1: Distances in the Alpha Centauri System

	Class	Average Distance from Alpha Centauri A	Scaled Distance from Alpha Centauri A
Alpha Centauri A	G	0 km	
Alpha Centauri B	K	3 billion km	
Alpha Centauri C	M	1600 billion km	

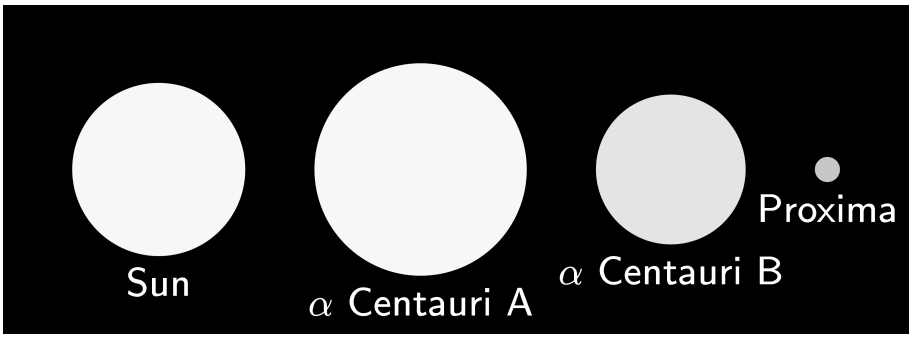


Image credit: David Benbennick, http://en.wikipedia.org/wiki/Image:Alpha_Centauri_relative_sizes.png

What is a Light Year?

A distance of 40,000 billion km or 40 trillion km is almost unimaginably large, and that's just how far it is to the nearest star to the Sun. Using such large numbers to refer to the distances of stars can become awkward very quickly.

Astronomers use a unit called the **light year** to help deal with this problem.

A light year is often confused with a measure of time, but is really a measure of distance.

It is defined as **the distance light can travel in one year. A light year is equal to about 9.5 trillion km or 6 trillion miles.**

The Sun is about 26,000 light years from the center of the galaxy.

1. Using the scale factor of 1:10 billion, how far away from Alpha Centauri A are the other two stars? Fill in the last column of Table 1.

2. How does the choice of Alpha Centauri A as the star from which the other distances are measured affect the distance for *Alpha Centauri C*, otherwise known as *Proxima Centauri*?

The Distances Between the Sun and the Nearest Stars:

The distance between the Sun and the Alpha Centauri System is 40,000 billion km.

3. How far away would the Sun be from Alpha Centauri on our scale model?

4. Where would you place the Sun on the scale model if Alpha Centauri A is at your school?

Table 2: The Twelve Nearest Star Systems to the Sun

Name	Number of Stars	Class	Distance from the Sun
Alpha Centauri	3	G K M	4.3 light years
Barnard's Star	1	M	6.0 light years
Wolf 359	1	M	7.5 light years
BD+36^{o}2147	1	M	8.2 light years
L726-8	2	M M	8.8 light years
Sirius	2	A white dwarf*	9.5 light years
Ross 154	1	M	9.5 light years
Ross 248	1	M	10 light years
L789-6	1	M	10 light years
eta Eridani	1	K	11 light years
Ross 128	1	M	11 light years
61 Cygni	2	K K	11 light years

* A white dwarf is a very small, hot star that is no longer on the main sequence

A star 11 light years from the Sun is more than 100 trillion km away, or 10,000 km away on our scale model!

Sirius, also known as the Dog Star, is the brightest star in sky. It is a hot, bright, A class star with a small companion. However, most of the stars in Table 2 aren't very bright in our sky because they are small and dim M class stars. Ancient astronomers didn't name them, so they were given designations like BD+36^{o}2147 by modern astronomers.

Traveling to the Stars:

How long would it take for a spacecraft to reach the nearest star?

We know it will take longer than 4.3 years, because nothing travels faster than light. Let's start by looking at how long it took spacecraft to reach objects in our solar system.

The Apollo spacecraft took about three days to travel the 384,000 km between the Earth and the Moon.

5. If you are an astronaut sent in a spacecraft traveling at the same speed to Alpha Centauri, how many years would it take you to get there? Would you arrive in your lifetime? Remember: Alpha Centauri is 40 trillion (40,000,000,000,000) km away from the Sun. Hint: How far would you travel in one year?

What if you sent a robotic spacecraft in your place?

Voyager 1 and Voyager 2 are robotic spacecraft that are currently traveling towards interstellar space. Voyager 1, the faster of the two spacecraft, is traveling at a speed of 540 million km per year.

6. If you sent a spacecraft that travels at the same speed as Voyager 1 to Alpha Centauri, how long would it take to get there?

NASA launched New Horizons in January 2006 to study Pluto and the Kuiper Belt. At launch, New Horizons was the fastest spacecraft yet built, flying the distance between the Earth and Moon in just 9 hours. On February 28, 2007, New Horizons flew by Jupiter, increasing the speed of the spacecraft to about 71,800 kilometers per hour (45,000 miles per hour).

7. If New Horizons were on its way to Alpha Centauri instead, how long would it continue into space at this rate? How long would take to get to Alpha Centauri at its current speed?