Universal Understanding through Unit Conversions

When getting around town (for example to and from school) we often report the distance traveled in __miles__. However these are not very convenient units for reporting distances between objects in our solar system. For example, Neptune averages 2,703,959,960 miles from Earth. We often report very big or small numbers using scientific notation. Round the distance from Earth to Neptune to the nearest million and write it in scientific notation:

$$2.704 \cdot 10^{9}$$

To provide a convenient way to express and relate distances of objects in the solar system, astronomers often use the Astronomical Unit, AU. An AU is a unit of length equal to the average distance between the Earth and the Sun.

One AU is approximately 9.2956x10⁷ miles. Write it without scientific notation:

$$92,956,000$$

However when reporting distances to other stars even the AU becomes inconvenient. For example the closest star, Proxima Centauri, is about 268,770 **AU** and the Galactic Center is about 1.644 x 10⁹ AU. Astronomers often report distances beyond our solar system using light years (ly), the distance that light travels in one year.

Convert the distance to Proxima Centauri into light years with the help of these unit conversions:

$$\frac{1\,ly}{9,460,730,472,580.8\,km}, \quad \frac{1\,in}{2.54cm}, \quad \frac{1\,mi}{5,280\,ft}, \quad \frac{92,955,807.3\,miles}{1\,AU}$$

$$268,770\,AU = \frac{92,955,807.3\,mi}{1\,Au} \cdot \frac{5,280\,ft}{1\,mi} \cdot \frac{12\,in}{1\,ft} \cdot \frac{2.54\,cm}{1\,in} \cdot \frac{1\,m}{100\,cm} \cdot \frac{1\,km}{1000\,m} \cdot \frac{1\,ly}{9,460,730,472,580.8\,km} = \boxed{4.25\,ly}$$

Now convert:

1 mi to inches and **1 ly to AU**

$$1\,mi. \quad \frac{5,280\,ft}{1\,mi} \cdot \frac{12\,in}{1\,ft} = \boxed{63,360\,in} \qquad 1\,ly. \quad \frac{268,770\,AU}{4.25\,ly} = \boxed{63,240\,AU}$$

Wow, look at that. The number of inches in a mile and the number of Astronomical Units in a light year are

In his 1978 Celestial Handbook, Robert Burnham Jr., a staff member of the Lowell Observatory, used this coincidental fact to present a model that offers us a way to get a conceptual grasp on some of the tremendous distances discussed in astronomy.

In his scale model:

- **One mile in the model represents a light year.**
- **One inch in the model represents the distance from the Sun to Earth.**

Convert the following to AU so that we can draw his model of the Solar System. (remember

$$\frac{1\ AU}{92,955,807.3\ miles}$$

Diameter of the Sun: 880,000 mi.

$$\frac{1\ Au}{92,955,807.3\ mi} = \boxed{0.0095\ Au} \Rightarrow \frac{1}{100}^{th}\ in$$

Distance from the Sun to:

Mercury: 35 million miles
$$\frac{1\ Au}{93\ mil.\ mi} = \boxed{0.38\ Au} \Rightarrow \frac{3}{8}\ in$$

Saturn: 889 million miles
$$\frac{1\ Au}{93\ mil\ mi} = \boxed{9.56\ Au} \Rightarrow 9\tfrac{1}{2}\ in$$

Jupiter: 484 million miles
$$\frac{1\ Au}{93\ mil\ mi} = \boxed{5.20\ Au} \Rightarrow 5\tfrac{1}{4}\ in$$

Neptune: 2.8 billion mileses
$$\frac{1\ Au}{.093\ bil\ mi} = \boxed{30.11\ Au} \Rightarrow 30\tfrac{1}{8}\ in$$

$$\frac{1\ AU}{93\ million\ mi}$$

mercury

Earth

Jupiter

Saturn

Our Sun and its nearest neighboring star are like two pieces of dust that are more than four miles away from each other.