Name: ____________________ Teacher: _______________ Pd. ___ Date: ________

STAAR Science Tutorial 37
TEK 8.8D: Light Years

TEK 8.8D: Model and describe how light years are used to measure distances and sizes in the universe.

Generally, we pick a measurement unit that is close to the size of the object we are measuring. To measure the size of a leaf, we use centimeters. To measure a room we use meters. To measure the distance between cities, we use kilometers.

Because distances in space are so large, the metric units of distance measurement that we use on Earth, such as kilometers, are too small to be convenient. The closest object to Earth in our solar system is the Moon, which is about 375,000 kilometers away. While a large distance, we can still comprehend or visualize how far away that is.

The distance from the Sun to Earth is about 149,600,000 kilometers. To make measurement within our solar system more convenient, scientists created a new measurement called the **astronomical unit (au)** to match this average distance from the Earth to the Sun. This makes it easier to compare the distances between other planets and the Sun, since the Earth-Sun distance is 1 au. The distances from the Sun to each of the eight planets is as follows: Mercury: 0.4 au; Venus: 0.7 au; Earth: 1.0 au; Mars: 1.5 au; Jupiter: 5.2 au; Saturn: 9.5 au; Uranus: 19.6; Neptune: 30 au. This means that Neptune is 30 times further away from the Sun than is the Earth.

Outside of our solar system, the astronomical unit is too small to measure the distances to even the nearest stars. For these distances, scientists use the **light-year**, which is the distance that light travels in one year, about 9.5 trillion kilometers, or about 63,241 au.

The light-year is a unit of distance, not time, but it does have the added advantage of also stating how long it will take light to travel that distance. For example, Proxima Centauri, the closest star (other than our Sun) to Earth, is 4.2 light-years away from Earth, which also means that it takes 4.2 years for its light to reach Earth. When you look out into space, you are also looking back in time.

Our galaxy, the Milky Way, is about 100,000 light years in diameter. The Sun is about 26,000 light years away from the center of the Milky Way galaxy. The nearest galaxy outside of our own, the Large Magellanic Cloud, is 165,000 light years away. The largest galaxy in our local group of galaxies, Andromeda, is 250,000,000 light years away. Using the largest telescopes, scientists can see galaxies over 13 billion light years away.

For distances much less than one light-year, it is sometimes useful to measure in light-minutes or light-seconds. When astronauts visited the Moon, their radio signal took about 1.2 seconds to travel from the Moon to Earth, because radio waves travel at the speed of light, and the Moon is about 1.2 light-seconds away. Light from the Sun takes about 8.3 minutes to travel to Earth, because the Sun is about 8.3 light-minutes away from Earth. If the Sun has a coronal mass discharge, it takes us on Earth about 8.3 minutes to find out.

Practice Questions

1. Why are kilometers not a good unit of measurement in space? ________________

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2. What distance measurement unit is used for objects within our solar system?

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3. How many kilometers are in one astronomical unit? _________________________

4. What distance measurement unit is used for objects outside of our solar system? ____

5. How many kilometers are in one light-year? ________________________________.

6. How far away is the nearest star to Earth other than our Sun?

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7. How far away is the center of the Milky Way Galaxy from Earth?

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8. What is the diameter of the Milky Way Galaxy?

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9. How far away is the Andromeda Galaxy from Earth?

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10. How long does it take for light from our Sun to reach Earth?

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11. What is the distance from the Sun to the Earth, in light-minutes?

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