Learning Goals: Students know how to use Astronomical Units and Light Years as measures of distance between the Sun, Stars and Earth. Students know how models are used in science and why they are significant.

Learning Astronomical Units and Light years

Background Information:

1 AU = 149,597,870.691 kilometers

Definition: An astronomical unit (AU) is a measure of distance often used in astronomy, equal to the distance between the Earth and the Sun. In terms of more common units of measurement, an astronomical unit is equal to about 93 million miles (roughly 150 million km), or the distance light travels in a little over eight minutes. The symbol AU is most often used to represent the astronomical unit, though less commonly you may see UA used instead.

Historical Background: Tycho Brahe estimated the distance between the Sun and the Earth at 8 million kilometers (5 million miles). Later, Johannes Kepler estimated the AU was at 24 million kilometers (15 million miles). Although Kepler’s estimate is not accurate, Kepler is well known for his 3 laws of planetary motion. In 1672, Giovanni Cassini made a much better estimate of an Astronomical unit by using Mars. Cassini calculated the AU to be at 140 million kilometers (87 million miles), which is lower, but very close to the modern day number.

1. Define Astronomical Units in your own words. Why do you think we use Astronomical units when referring to distances in space?

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2. Make a model of our solar System. Include the names of the 8 planets and Sun. Draw and label an arrow showing the direction of gravity from the sun on the other planets. Draw and label an arrow or inertia showing the direction of the planet’s motion. Add a description of how the Sun’s gravity keeps planets in orbit. Use color.

Light Years: Read and highlight the background information and answer the questions in complete sentences.

Background Information:
While the sun is often referred to as the most important and only star within our solar system, it is certainly not the only one in our galaxy. There are too many stars for us to even begin to count. See how many you can count while gazing up at the sky on a clear night. Not only are there too many stars to count but, the stars are beyond our imagination as to how far away they are. They are so far away that standard units of measurement like miles and kilometers are awkward to measure these distances, therefore a unit known as the light year is used.
A light year is defined as the distance that light travels in one Earth year. Light moves extremely fast, 300,000 km/s or 180,000 miles/second. In one second light can travel around Earth almost four times. Nothing travels faster, establishing light as the ultimate speed limit. In 31,536,000 seconds--or one year--light will travel a distance of 9.46 trillion kilometers or 5.86 trillion miles, or 240 million times around Earth. This distance equals one light year.

Because light travels so very fast, everything appears to happen instantly in our everyday experience. If we are watching the Baltimore Ravens kick a field goal, we assume that the ball was kicked right at the moment that we saw it. In actuality we must see the light that is being reflected from the ball, and it does take time for the light to travel from the ball to our eyes. If the distance from the ball to our eyes were 10 m, the light reflecting off the ball would take only 300 millionths (.000003) of a second to reach our eyes, thus making it seem instantaneous.

Stars are millions and millions of kilometers away. To see a star, that star’s light must travel across space to our eyes. If the star is 5 light years away, then the light we are seeing from that star took five years to travel to our eyes. It also means that what we see happening at that star is actually what happened five years ago, not what is happening in the star’s present.

3. Suppose that a child is born on Earth in the year 2000. You are on an imaginary planet that is 94.6 trillion kilometers away from Earth and looking through a very high powered telescope and you witness this child’s third birthday party. How old is that child on Earth at the time you are watching the child’s third birthday party? (Hint: Calculate the number of light years this planet is from Earth.)

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4. Using exact quotes from the text
   a. What is the definition of a light year?
   b. How fast does light travel?
   c. If a star is 5 light years away, how long did it take for that light to travel to our eyes?

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5. Before watching the video, answer this question…

➢ Do you think the planets in our solar system are smaller or larger than stars? __________

Now, watch the 3 minute video “Size Comparison” and answer the questions.
http://www.youtube.com/watch?v=HEheh1BH34Q
A. Were you surprised by how much larger our sun is compared to the planets? 
________________. Were you surprised to see that our sun is not even that big 
compared to other stars? ____________.
B. What is the name of the largest known star?

C. How many years would it take to fly around that star?

D. Based on the size of our planets, stars, galaxies and universe, are why are models 
important?

6. **Watch the Bill Nye video clip “Demonstrating the distance between planets” and 
answer the ?’s.**
http://www.youtube.com/watch?v=97Ob0xR0Ut8
   A. Checking that you watched the video…how many meters to Venus? _____
      Km to Neptune? _____
   B. Do you think this is a good model of planetary distances? Explain your answer.

   C. How has your understanding of Sun to Planet distances has changed?

***Want additional references?
Refer to this interactive site.  http://scaleofuniverse.com/
Watch the 6 min video “The Known Universe”.
http://www.youtube.com/watch?v=17jymDn0W6U