

PARTICIPATION

Name _____ Date _____ Section or TA _____

Looking at Distant Objects

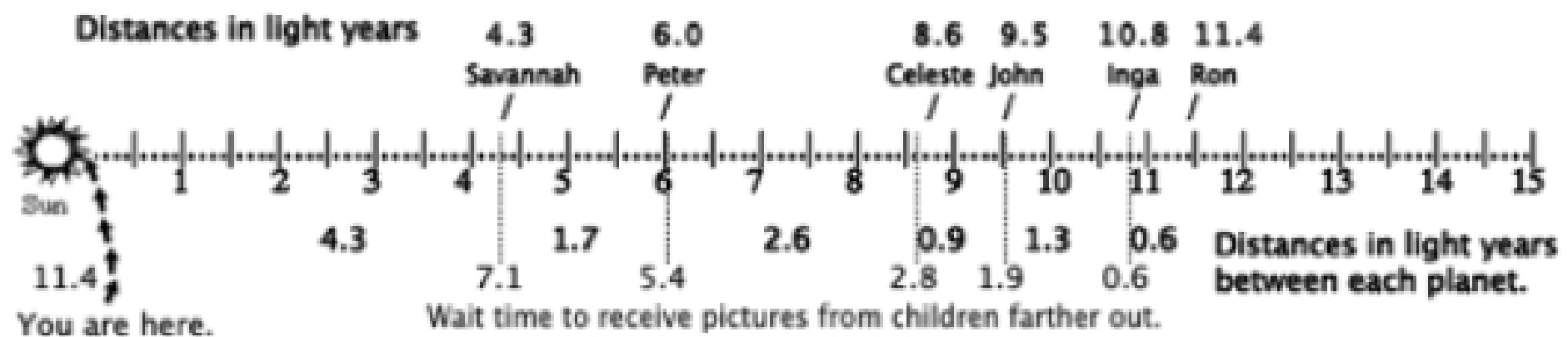
(Adapted from Lecture-Tutorials for Introductory Astronomy, ©CAPER Team, Preliminary Edition, 2002)

01. Describe what a light year is (is it time? distance? speed?), giving some measurement comparisons that will help someone who has never taken an astronomy class understand.

Imagine that you have received six pictures of six different children who live near six of the closest stars to the Sun. Each picture shows a child on his or her 12th birthday. The pictures were each broadcast directly to you via radio waves on the exact day of the child's 12th birthday. From the closest to the most distant the children are:

- *Savannah lives on a planet orbiting Alpha Centauri, which is 4.3 sly from our Sun.
- *Peter lives on a planet orbiting Barnard's Star, which is 6.0 ly from our Sun.
- *Celeste lives on a planet orbiting Sirius, which is 8.6 ly from our Sun.
- *John lives on a planet orbiting Ross154, which is 9.5 ly (light year) from our Sun.
- *Inga lives on a planet orbiting Epsilon Eridani, which is 10.8 ly from our Sun.
- *Ron lives on a planet orbiting Procyon, which is 11.4 ly from our Sun.

Here is a rough scale, marking the distances from the Sun, and each child's name. We'll assume –although this is highly improbable – that these stars are situated in a straight line away from the Sun.



02. What were the shortest and longest lengths of time that it took for any one of the pictures to travel from the child to you? Relate your answer to the distances to those children.

03. How old did each child look in his or her picture?

04. If each child was 12 years old when he or she sent his or her picture to you, how old was each child—in his or her time frame—when you received their picture?

Savannah _____ Peter _____ Celeste _____ John _____ Inga _____ Ron _____

05. Is there a relationship between the current age of each child and his or her distance away from Earth? If so, describe this relationship.

Let's change the circumstances a bit. Imagine that the six pictures were broadcast by satellite to you from those planets, and that they all arrived at exactly the same time. To make this happen the child that is the farthest away sends his picture first, taken when he was 12 years old. The next farthest child waits until she receives that picture, and then sends her picture right away. This continues as signals travel to Earth. The amount of time that passes between each child before he or she receives the pictures from those children farther away is marked on the figure.

06. How old will Ron look when we receive his picture? _____ yrs. Inga? _____ yrs. John? _____ yrs.

Celeste? _____ yrs. Peter? _____ yrs. Savannah? _____ yrs.

07. How old is each child in his or her time frame when you finally receive all of their pictures? Ron _____

Inga _____ John _____ Celeste _____ Peter _____ Savannah _____

08. In 1987, astronomers discovered a new supernovae in the Large Magellanic Cloud (the "LMC"), which they named SN1987A. However, the Large Magellanic Cloud is ~170,000 light years away. When did this supernova actually occur?

09. Although they are many thousands of light-years away, the Magellanic Clouds are actually quite close to us, compared to the many other galaxies in the Universe. Astronomers can routinely detect galaxies that are as far as 11 billion light-years away! Although we are just detecting the light from these galaxies now, how many years ago was the light from these galaxies emitted?
_____ years ago

10. Galaxies located in the nearest super cluster, the Virgo super cluster, are about 65,000,000 light years away. Let's say there is an advanced civilization on a planet orbiting a star in a galaxy in this super cluster with its extremely powerful telescopes pointed at Earth. What major catastrophe do they observe?

11. Assuming that the Universe is 13.7 billion years old, the maximum age any galaxy can have today is about 13 billion years (it took a few hundred thousand years for galaxies to start forming). Are the apparent ages of these distant galaxies very young or very old? How old are they in their time frame? Explain your reasoning.

12. Quasars are "...luminous long-lived objects in the universe ... known to lie in the nuclei of massive galaxies (and so the phenomenon belongs to the class of objects known as *active galactic nuclei*).... Because the universe is expanding with time, the light we *receive* from a quasar is "redshifted," i.e., shifted to longer wavelengths compared to the light that was *emitted* by the quasar long ago. Their extreme intrinsic brightnesses allow us to view them to back to the era when galaxies were first putting themselves together. Neither quasars nor galaxy formation is yet well understood. However, evidence is presently building that the quasar phenomenon is intimately tied up in the formation (and) early evolution of massive galaxies."¹ If quasars were present only as part of the early evolution of massive galaxies, are there any quasars in existence today or are they extinct? Explain your answer.

¹ <http://homepages.wmich.edu/~korista/quasars.html> retrieved 11/27/2011