Looking Back in Time

Lesson Procedures

Part 1: Begin by asking how they would measure something very far away. Would they measure in feet, yards, miles? Now ask the students how they think astronomers and other scientists measure stars and galaxies very far away. Explain that stars are so incredibly far away, that we could measure in miles, but that we have a better way of measuring: light years. A light year is defined as the distance that light can travel in one year. One light year is equal to about 5.9 trillion miles. To get an idea of just how far away these stars are, tell the students that the closest star to our solar system is Alpha Centauri, which is 4 light years away (or about 23.6 trillion miles away). That means that light that left Alpha Centauri 4 years ago is just now reaching the Earth.

Show the students segment 5 of the Swift, Looking Back in Time [Time – 3:53]. Tell the students that Swift will be measuring gamma-ray bursts that are **billions** of light years away. Ask the students to keep in mind this fact while viewing the segment.

Part 2: To make this concept of distance in space equaling distance in time more concrete, have the students devise a time line. Give each student a copy of Measure Distance and Time (see Student Handout) that lists the scientists from the first Swift activity in this series. Part 1 of Measure Distance and Time presents the scientists in chronological order to facilitate construction of the time line.

As a class, develop a standardized measurement scale for your time line. For example, one inch could equal a century. Although you should facilitate ideas about how to get the time line going, the students should determine the measurement scale. Ask them to use trial and error to find the most logical scale that they can. Measure out a 3000-year-time-span in the area where you will be laying out your time line Once the students have developed a scale, provide masking tape and markers. Allow them to create their time line on the designated floor or wall.
Notes:

- If one inch represents 100 years, a 3000 year time line would use 25 feet of space.
- Use of the metric system could give an alternative time line creation.
- It might be informative for different groups of students to use the two different measuring systems in constructing their time lines.

Have the students plot the dates of the scientists from their handout, using color dots or post-it notes to indicate when the scientists were born. Label the scientists on the timeline. Ask the students to measure the distance between several of the scientists and record them on their handout. Not every scientist on the time line has to be measured. Several can be selected to abbreviate the time needed for this activity. Select 3-4 different scientists at different points on the time line. Ask the students to use their measurements to calculate how many years are between the various scientists.

Direct the students to Part 2 of their handout. Have the students repeat the measurement scale and time line development for the stars. To plot the stars on their new time line, start with the current year and measure backwards on the timeline. It would be most helpful for this activity if the time lines could be near each other for comparison.

Looking Back in Time

Explain to the students that the farther you are from the start of your time line (your distance in space), the farther in time you go. Compare the distance of the scientists to distances of stars as they fall on the time line. Use this as a way of making the idea of distance in space equals time elapsed more concrete and tangible. For example, ask the students to notice that the star Polaris (the North Star) is 400 light years away. Ask them to also notice that Isaac Newton was born approximately 400 years ago. This means the light that left Polaris when Isaac Newton was born is just now reaching the Earth.

Part 3: Now that your students have a better understanding of distance in space being relative to elapses in time, explain to them how Swift can be considered a "time machine." The Swift satellite has the ability to look at gamma-ray bursts that happened billions of years ago, but are just now appearing to us. From the data that Swift collects, we might be able to gather clues about how the universe was formed.

Assessment strategies

The following questions are provided as discussions starters with the students.

- How are the two time lines you developed the same?
- How are they different?
- Why is it important to develop standard measurements instead of approximating?
- What advantages do we have on Earth when we measure things that the scientists do not have when they measure stars and planets in space?
- Why is it important for Swift scientists to use the concept of distance=time in their calculations of gamma-ray bursts?

Vocabulary

Light Year – the distance that light travels in one year (5.9 trillion miles/ 9.5 trillion km)