FYI Looking Back in Time

When you look at the face of a friend, you are able to see him because light from another source, such as the sun or a lamp, is reflecting off his face toward you. There is a very slight time lapse between the time the light leaves his face and when it reaches your eye. The distance between you and your friend is very small, and the speed of light is very fast, so the time lapse is imperceptible, but for more distant objects it can be noticeable.

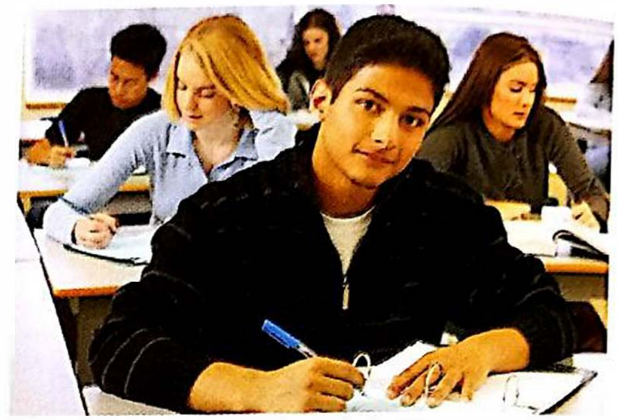

Figure 1-4: Photograph of a young man

Suppose you could see your friend's face while he is sitting on the moon. The light from his face would take about 1.3 seconds to reach your eyes. From the sun, the light would take about 8 minutes. From Pluto, it would take over 5 hours. If your friend were sitting on Proxima Centauri, the next closest star to our own, light would take 4.2 years to travel from his face to your eyes. This means that the face you are seeing would actually be the face of your friend from 4.2 years earlier! Imagine if your friend were sitting in a star cluster that is 70 light-years from Earth. The light would take 70 years to reach us. By the time you could see his face as a teenager, he would already be an old man. And if he were in the nearest galaxy to ours, the Andromeda Galaxy, the light would not reach us for 2 million years.

The time it takes light to travel from one point to another is a function of its speed and the distance between the two points. Light travels with a constant speed, c. Although this speed is often called the **speed of light**, it refers to the speed at which all electromagnetic radiation travels, 3×10^8 m/s. So,

$$\text{travel time} = \text{distance/speed}$$

$$t = d/c$$

Time and distance in the universe are linked by the speed of light. The light we receive from astronomical objects left those objects long ago—as long as billions of years ago for distant galaxies near the edge of the observable universe. This means that when we look at those galaxies, we are seeing them as they appeared billions of years ago, near the beginning of time. As we look farther and farther out into space, we are also looking farther and farther back in time.

As technology advances, and new telescopes enable us to see greater distances, we also are seeing farther back in time. Each new image of the edge of the observable universe gives another clue about the formation and early stages of our universe.

Checking In

1. How are time and distance linked in the observable universe?
2. If a star in the Andromeda Galaxy were to undergo a supernova explosion tomorrow, will you ever see it? Why or Why not?