INTRODUCTION
In the last lesson you researched a technology product that was developed for the space program and was later adapted for use on Earth. Now it is time for you to tell other students about your space technology spinoff. First, you will present your five-point Space Technology And Research (STAR) poster to the class. You will share your ideas with the class and evaluate other students’ presentations. At the end of the lesson, you will prepare for your final assessment in Lesson 22.

OBJECTIVES FOR THIS LESSON

Present information about a space spinoff product or process.

Discuss and ask questions about other students’ explanations of their products.

Evaluate designs or products that use space technology.

Review the concepts addressed in Lessons 11–21.
Inquiry 21.1
Communicating Our Findings

PROCEDURE

1. You will be invited to present your STAR poster to the class. Share with the class any props, photographs, or product models that you might have.

2. Discuss your ideas about each product or process with the class.

3. Discuss other students’ explanations about their space product or process and ask questions.

MATERIALS FOR LESSON 21

For you
1 copy of your completed STAR
1 copy of your completed Student Sheet 20: Solar System Review
REFLECTING ON WHAT YOU’VE DONE

1. Evaluate other students’ space spinoff designs or products. Which form of space technology seemed the most common in the products presented?

2. Brainstorm some of the other space spin-off products that you think scientists and engineers have adapted for use on Earth.

3. Read “Sugars in Space.” How is technology being used to search for life in other galaxies?

4. To prepare for your final assessment in Lesson 22, review Student Sheet 20 with your teacher.
Sugars in Space

For as long as humans have looked at stars in the night skies, we’ve been asking the same question: Is there any life out there? And as we study the universe with telescopes, we might wonder whether alien astronomers are peering back at us.

As far as our own solar system is concerned, it is almost certain that we don’t have any nosy neighbors. In fact, it seems increasingly unlikely that we have neighbors at all. After decades of exploring the nearby planets, scientists have (continued)
not found a single sign of life. But that doesn’t prove that there is no life out there—so we keep looking.

Among the things that scientists look for are the essential building blocks of life—water, oxygen, and organic chemicals. Wherever these building blocks exist, scientists say, it is at least possible that life could exist.

What building blocks of life have scientists found in space? We know that there is plenty of water on Mars, and almost all of it is frozen. On Europa, one of Jupiter’s moons, there seems to be a great liquid sea under a surface made entirely of ice. And on the Moon, a recent space probe detected the possibility of ice, located in a crater at the Moon’s south pole. Where there is water, there might be life.

Another amazing discovery was made recently by a group of American scientists, including Dr. Jan M. Hollis of NASA Goddard Space Flight Center. Using a large radiotelescope at Kitt Peak Observatory in Arizona, these scientists looked at a giant cloud of gas and dust near the center of the Milky Way galaxy. In that cloud, they found a chemical called glycolaldehyde (gly-co-LAHL-dee-hyde), that belongs to a family of chemicals that we know by a much more common name: sugars.

A radiotelescope works just like any other radio—except that it’s much more powerful. To give you a rough idea of how powerful it is, imagine sitting on a park bench in New York City and being able to hear a cricket chirping in Los Angeles!
When these astronomers aimed their radio-telescope at the dust cloud, they detected a faint radio signal emitted by the sugar molecules. As those molecules spin around in space, they emit radio waves at a precise frequency just like the signals you receive from different radio stations. When the scientists detected the signals from the dust cloud, they knew those signals could only have been produced by glycolaldehyde.

Glycolaldehyde is a small molecule that is composed of carbon, oxygen, and hydrogen. It combines with other molecules to form either ribose or glucose. Ribose is a building block of RNA and DNA, the molecules that carry the genetic codes of all living things. Glucose is a sugar that is found in fruit.

Why are sugar molecules floating around our galaxy in giant dust clouds? We know that the dust clouds are remnants of ancient exploding stars and that they are made up of different elements and compounds, many of which are necessary for life. Eventually, the clouds will condense to form new stars and planets. That’s what happened with the Sun, Earth, and other planets of our solar system, about 4.5 billion years ago.

The presence of glycolaldehyde and other organic chemicals in space means that the essential building blocks of life are scattered over the Milky Way galaxy. Perhaps someday we may detect astronomers in other parts of the universe, searching through the barrels of their telescopes as they try to find answers to the same questions that we have been asking all these years!