

Space Spinoffs

Overview

In the process of sending people into space, NASA has developed technologies that are useful on Earth. This activity gives students a chance to explore some of what has been learned from space exploration and applied to our daily lives. Students learn about commercial products developed as a result of the space program and about space problems that NASA engineers worked on. Teams try to match products to space problems and give reasons for their matches. Throughout this guide, all information in italics is a “teacher tip.”

North Carolina Essential Science Standards

6.E.1.3 Summarize space exploration and the understandings gained from them.

Background

Go to <http://www.nasa.gov/externalflash/nasacity/index2.htm> to see examples of products that NASA claims as spin-offs. NASA spin-offs are products or services that the space program has developed either directly or indirectly. More than 50 years ago, NASA set up a technology transfer program make space innovations available to the public. They regularly publish "NASA Tech Briefs" and "Spinoffs" about technologies that might help industry or are already commercialized. Examples of spin-offs include freeze-dried food, memory foam, emergency blankets, cochlear implants, and more than 1,800 other products used in computers, the environment, agriculture, medicine, public safety, transportation, and recreation.

Materials

Materials for the whole class

- Computer projection capability
- “Space Problems” PowerPoint to project. To access the PowerPoint, go to <http://ciblearning.org/teacher-resources/lesson-materials/> Click on “Grade 6 Solar System Materials.” Enter the password: solarsystem6

Materials for Each Team

- *Science notebook
 - 1 Space Spinoff Products Card (a color card in the kit)
 - 1 Spinoff/Product Connections sheet (BLM 12)
 - 1 Spinoff Answer Key (BLM 13).
- * *supplied by the teacher*

Preparation

1. Preview and be ready to project the “Space Problems” PowerPoint.
2. For each team, be ready to give out one double-sided Space Spinoff Products Cards and a Spinoff/Product Connections sheet (for Set 2 only).
3. For the Set 2 round, print one Spinoff Answer Key (BLM 13) per team.

Procedure

Form teams of 2 students. Give each team a Spinoff Products Sheet (BLM 12). Ask each team to have their science notebook.

Exploration

1. Ask each team to look at the first product in Set 1 of their Space Spinoff Products Card (Thermal Blankets) and speculate how this technology might have been useful for NASA. Allow a few minutes for them to discuss this. Hold a short class discussion to hear people's ideas.
2. Show slide 2, "Protecting Spacecraft from Extreme Temperatures," which explains the space problem that NASA faced.
3. Show slide 3, "From Protecting Spacecraft to Preventing Hypothermia," which explains how the space technology resulted in a commercial product.

Set 1

1. Ask each team to look at the remaining four products on Set 1 of the Space Spinoff Products Card. Allow a few minutes for this.
2. **Explain:** We will repeat what we've just done, only in reverse. This time, the class will see space problems and solutions projected, one at a time. Each space problem resulted in one of the products in Set 1 on the sheet. When the class sees a problem, they will look over the Space Spinoff Products and discuss them to decide which product they think came from it and why they think so.
3. Work through the next four problems to the end of Set 1 together as a class. Start with Slide 4, titled "Protecting Astronauts from Impact and G-Forces" and ask everyone to look through the products to find the one that might have come from this. After most students find a product, project the next slide, which asks "Which product...?" Discuss, then show how Temper Foam was developed on the next slide, "From Protecting Astronauts to Better Pillows." Allow the class to discuss this if they want to.
4. Repeat this procedure with the remaining Set 1 slides, one at a time. Allow a minute for teams to agree, discuss as a class, then project the next slide (answer). Continue to the slide "End of Set 1" and stop.

Set 2

1. Ask teams to turn over the Space Spinoff Products Card to find the Set 2 products. Explain that we will go through the same process again, but this time, teams are on their own to figure out connections between space problems and products. Allow a few minutes for them to become familiar with Set 2 products.
2. While the space problems are shown, teams will record their ideas in a notebook. No explanation will be given about how problems resulted in products. After teams see all of the problems, they will receive a Spinoff/Product Connections sheet to fill in together. Teams should fill in the sheet using what they wrote in their notebooks.
3. Go through the Set 2 slides one at a time. Remind teams to use their notebooks.

4. When you reach the “End of Set 2,” give each team a Spinoff/Product Connections sheet (BLM 12) and allow 5 minutes to fill it in.
5. After all teams finish, give out Spinoff Answer Key (BLM 13) and allow a few minutes to read it.
6. Discuss as a class. For discussion purposes, if desired, the answer key is available on the PowerPoint after the slide “End of Set 2.”

Other Resources

Students who succeed at NASA’s “Spinoff Challenge”

<http://www.nasa.gov/externalflash/nasacity/index2.htm>,

unlock access to the NASA Home and City feature, which contains many more spinoff technologies in daily use outside of the space program.

BLM 12 Spinoff/Product Connections

Space Problem #1: Stronger Parachute Straps

Product I think was developed from this technology: _____

I chose this product because: _____

Space Problem #2: Lightweight Powerful Motors

Product I think was developed from this technology: _____

I chose this product because: _____

Space Problem #3: Light Weight Parts

Product I think was developed from this technology: _____

I chose this product because: _____

Space Problem #4: How to Measure a Planet's Temperature

Product I think was developed from this technology: _____

I chose this product because: _____

Space Problem #5: How To Grow Healthy Food in Space

Product I think was developed from this technology: _____

I chose this product because: _____

BLM 13 Spinoff Answer Key

From Stronger Parachute Straps to Long Lasting Tires For parachute straps to attach the Mars Viking Lander, Goodyear Tire Company developed a fibrous material five times stronger than steel. Recognizing how durable this material is, Goodyear used it to produce a radial tire that goes 10,000 miles farther than any other radials at the time.

From Moon Drill to DustBuster® Black & Decker made cordless power tools before people went to the moon. Naturally, when NASA needed a moon drill, Black & Decker got the call. At that time, cordless power tools were large, heavy, and weak, with short battery life. NASA needed a motor that used as little power as possible, but strong enough to break moon rocks. Black & Decker created a computer program to design that motor. The computer program turned out other small, strong, efficient motors for other products such as portable consumer drills. Eventually, the program helped them develop the cordless miniature vacuum cleaner called the DustBuster®.

From Light Weight Parts to Golf Clubs: Under contract from NASA, McDonnell Douglas and Memry® Corporation developed nitinol metal, an alloy of nickel and titanium. After a force deforms this very elastic metal, it springs back to its original shape. It also changes shape when temperature changes. It can be used to make super light weight parts that change shape without otherwise moving. After supplying nitinol to NASA for wing flight controllers, Memry® Corporation saw other applications. One application was in golf club faces. Memry® Corporation developed a version of shape memory alloy called Zeemet® for that purpose. Today, these clubs are very popular among golfers.

From Measuring a Planet's Temperature to Taking a Baby's Temperature: In 1982, to measure temperatures of objects in the sky, NASA devised extremely sensitive heat measuring tools for the IRAS satellite. These tools read infrared radiation emitted from objects in space. Soon after, scientists from NASA's Jet Propulsion Laboratory helped Diatek Corporation adapt these sensors for medical use. In 1991, Diatek released the Model 7000 infrared thermometer, which quickly reads body temperature by measuring infrared energy emitted from the eardrum. Although electronic thermometers were already available, this was the first made with sensors modified from space technology.

From Growing Healthy Food in Space to Baby Food In the 1980s, scientists at Martin Marietta Corporation worked with NASA to test types of microalgae for use as food on space journeys. Some of the algae turned out to have nutritional properties that are important both in space and on Earth – especially a critical omega-3 fatty acid known as DHA. In 1985, knowing that DHA could be extracted and used as a food supplement, the scientists formed Martek Biosciences. Martek found ways to add the supplement to foods including cooking oil, bread, eggs, milk, orange juice, and yogurt. They also found a way to develop another fatty acid called ARA that is key to infant health.

Bibliography

Padilla, Michael J., 2005, *Science Explorer*, Pearson Prentice Hall, New Jersey.

Plesser, Ronen, and John Heffernan, 2004, 3rd Grade Astronomy Lessons,
<<http://www.cgtp.duke.edu/~plesser/outreach/kenan/>>.

Science, Grade 6, 2005, McDougal Littell, Evanston, Illinois.

Sneider, Cary I., 1986, *Earth, moon, and Stars*, Great Explorations in Math and Science (GEMS), Lawrence Hall of Science, University of California, Berkeley.