

PEANUTS and SPACE FOUNDATION

Spacesuit Repair

OBJECTIVES

Students will:

- ◆ Read *Snoopy, First Beagle on the Moon!* and *Shoot for the Moon, Snoopy!*
- ◆ Learn about the Extravehicular Mobility Unit (EMU) spacesuit.
- ◆ Use materials to repair a hole in a simulated damaged spacesuit in order to protect the inside from water, radiation, and punctures.

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SUGGESTED GRADE LEVELS

3 – 5

SUBJECT AREAS

Space Science, Engineering Design

TIMELINE

30 – 60 minutes

NEXT GENERATION SCIENCE STANDARDS

- ◆ 3-5-ETS1-1 Define a simple design problem reflecting a need or a want that includes specified criteria for success and constraints on materials, time, or cost.
- ◆ 3-5-ETS1-2 Generate and compare multiple possible solutions to a problem based on how well each is likely to meet the criteria and constraints of the problem.
- ◆ 3-5 ETS1-3. Plan and carry out fair tests in which variables are controlled and failure points are considered to identify aspects of a model or prototype that can be improved.

21st CENTURY ESSENTIAL SKILLS

Critical Thinking/Problem Solving, Creativity/Imagination, Collaboration and Teamwork, Communication, Information Literacy, Leadership, Initiative, Organizing Concepts, Constructing Explanations, Designing Solutions, Obtaining/Evaluating/Communicating Ideas

BACKGROUND

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- ◆ NASA has proudly shared an association with Charles M. Schulz and his American icon Snoopy since Apollo missions began in the 1960s. Schulz created comic strips depicting Snoopy on the Moon, capturing public excitement about America's achievements in space. In May 1969, Apollo 10 astronauts traveled to the Moon for a final trial run before the lunar landings took place on later missions. Because that mission required the lunar module to skim within 50,000 feet

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of the Moon's surface and "snoop around" to determine the landing site for Apollo 11, the crew named the lunar module Snoopy.

The command module was named Charlie Brown, after Snoopy's loyal owner.

- ◆ These books are a united effort between Peanuts Worldwide, NASA and Simon & Schuster to generate interest in space among today's younger children.
- ◆ In order to collect as much scientific information from the Moon as possible, astronauts had to be able to use retrieval instruments, collect samples, and perform experiments on the lunar surface and in free space—and to do so safely! Astronauts also needed a way to get from the lunar module to the command module in the event of an emergency that prevented the two modules from linking up after the lunar lift-off. The extravehicular mobility unit (EMU), also known as a spacesuit, was the solution.
- ◆ Spacesuits help astronauts in many ways. The suits protect astronauts from getting too hot or cold. Spacesuits also provide astronauts necessary oxygen to breathe while they are working in space. The suits hold water to drink. They also keep astronauts from getting hurt by space dust. Space dust may not sound very dangerous but when it moves faster than a bullet in space, the dust can hurt someone. The suits even have special gold-lined visors to protect astronaut's eyes from bright sunlight.
- ◆ A spacesuit is made up of many parts. One part covers the astronaut's chest while another part covers the arms and connects to the gloves, the helmet protects their head, and the last part covers the astronaut's legs and feet. Some parts of the suit are made of many layers of material and each layer does something different. Some layers keep oxygen in the suit while others protect astronauts from space dust.
- ◆ Under the suit, astronauts wear another piece of clothing called the Liquid Cooling Garment (LCG). It covers their whole body except for the head, hands and feet. Tubes are woven into it allowing water to flow through the tubes to keep the astronaut cool.
- ◆ On the back of the spacesuit is a backpack. The backpack holds oxygen so astronauts can breathe. It also removes carbon dioxide that astronauts have breathed out. The backpack also supplies electricity for the suit and houses a fan that moves the oxygen through the spacesuit. A water tank holds the cooling water.
- ◆ Connected to the back of the suit is a tool called SAFER. SAFER has several small thruster jets. If an astronaut floated away from the space station, he or she could use SAFER to fly back.
- ◆ All background information is available on NASA.gov.

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VOCABULARY

Spacesuit, Extravehicular Mobility Unit (EMU), Radiation, Water-Resistant, Design, Teamwork

MATERIALS

- ◆ 12"x 12" square of cotton material with 4" diameter hole cut in the middle – one per group
- ◆ Several small scraps of various types of fabric
- ◆ Small squares of bubble wrap
- ◆ Plastic wrap
- ◆ Masking tape
- ◆ Safety scissors – one pair per group
- ◆ UV beads (available at teacher supply stores, craft stores, or online)
- ◆ Ultraviolet light (either artificial or sunlight; lightbulbs are sufficient)
- ◆ Adult scissors
- ◆ Small paper cups
- ◆ Water

LESSON PROCEDURES

1. Read *Snoopy, First Beagle on the Moon!* and *Shoot for the Moon, Snoopy!* to the entire class to give students some background knowledge.
2. Teach students about the Extravehicular Mobility Unit (EMU) spacesuit. Focus on its purpose, its layers, the difficulties of working in space while wearing the EMU. Show a few images of astronauts wearing and working in the EMU.
3. Teach students about radiation from the sun and astronauts' risks of exposure to radiation. Using a UV bead is a great way to test for ultraviolet radiation, as they change color when exposed to UV light.
4. Explain that students will be repairing a “spacesuit” that has been damaged.
5. Repairs must ensure that the new spacesuit is water-resistant, blocks out ultraviolet radiation, and resists punctures from various objects (teacher will perform puncture tests).
6. Hand out one “damaged spacesuit” to each group (12"x 12" square of cotton material, with a 4" diameter hole in the middle).
7. Students must use the materials provided to create new layers to cover the 4" diameter hole (students may not simply tape the hole closed). Materials include small scraps of different types of fabric, plastic wrap, bubble wrap, and masking tape. Amount of masking tape should be limited to one foot in length per group.

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8. Ask students to illustrate their repair designs.
9. The repair should be no more than three layers thick.
10. Once their fabric square is repaired, they can test their repairs.
11. Teacher or other adult helpers should perform the tests.
 - a. Test 1 Radiation:
 - Lay repaired material on desk or table.
 - Place 4-5 UV beads under the repaired area.
 - Hold UV light above material for 10 seconds.
 - Turn UV light off and remove.
 - Remove material and see if the beads changed color.
 - If conducting this test using sunlight, place 4-5 UV beads in hand and cover with repaired material.
 - Expose to sunlight for 10 seconds, then go back inside while still covering beads with the material.
 - See if bead color changed and record results.
 - b. Test 2 Puncture:
 - Place fabric on a desk or table.
 - Instructor uses a pair of adult-size scissors and strikes the repaired area from a height of six inches above the surface of the fabric (firmly, but not dangerously).
 - Check if the scissors damaged the repaired area on the “inside” layer. Record results.
 - c. Test 3 Water Resistance:
 - Students hold the fabric at the corners.
 - Instructor pours a paper cupful of water onto the repaired area of the fabric.
 - Students watch for any leakage on the underside of the repaired area. Record results.
12. When all groups have completed all tests, have students discuss and write/draw their design, results, and conclusions.

EXTENSIONS

- ♦ Have students test single layers of other various materials to see how they hold up against the three tests.
- ♦ Students may discuss how they could complete a larger repair, perhaps up to a foot in diameter, and what kind of materials would be needed.

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RESOURCES

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