

Living and Working in Space

Teacher Information

Background

If we loosely define an astronaut as someone who travels through space, then everyone is an astronaut. Even though we may be standing still on the surface of the Earth, we are actually traveling through space. Indeed, our planet may be thought of as a spaceship on a never-ending voyage. As “astronauts” traveling through space on the surface of Earth, we take for granted the complex environment that sustains life.

When astronauts leave the surface of their planet and travel into space, they must carry some of their environment with them. It must be contained in a physical shell. The shell that is used is called a spacecraft—a rigid collection of metal, glass, and plastic. Though far simpler in function than Earth’s, a spacecraft’s environment serves well for short missions lasting a few days or weeks. On some flights, the shell is deliberately opened and the astronauts pass through an airlock to venture outside. When doing so, they must still be protected by a smaller and very specialized version of their spacecraft, a space suit with a life-support system. The space suit with its systems is called an EMU, or Extravehicular Mobility Unit. Astronauts wearing EMUs need to be able to move arms, hands, and legs to perform an array of tasks in space. They must be able to operate many types of scientific apparatus, collect samples, take pictures, assemble equipment and structures, pilot themselves about, and repair and service defective or worn-out satellites and other space hardware. The tasks of astronauts outside their mother ship are called extravehicular activities, or EVAs.

An unprotected astronaut in outer space would perish in a few moments. The spacecraft or spacesuit must provide pressure, thermal and micrometeoroid protection, oxygen, cooling water, drinking water, food, waste collection (including carbon dioxide removal), electrical power, and communications. Maneuvering capability can be added by fitting a gas-jet-propelled Manned Maneuvering Unit (MMU) over the EMU’s primary life support system.

Even with all of this protection, life in space is still very different from life on Earth. One of the advantages of working in space is that objects, including astronauts, have no weight. Regardless of the weight of an object on Earth, a single crew member can move and position that object in orbit with ease, provided that the crew member has a stable platform from which to work. On the down side, a simple Earth task, such as turning a nut with a wrench, can become quite difficult, because the astronaut—and not the nut—may turn. This condition of weightlessness can also become awkward when an astronaut is trying to keep track of objects, because the objects may float away if they are not strapped down.

Living in space is a challenge which leads to new discoveries and better understanding of known principles.

Living and Working in Space (continued)

Teacher Information

Objective

Students will go through some of the steps necessary to design a space suit. Students will work in teams to construct their own space helmets.

Key Concepts

- The environment of Earth is different from the environment of space.
- Certain characteristics of Earth's environment must be provided by a spacecraft or space suit for humans to survive in space.
- Careful study of the human body is necessary for building adequate space suits.

Materials

student worksheet
cloth tape measure (metric)
calipers pattern (see diagram)
pencil and paper
large, round balloons
graph paper
brass paper fasteners
scissors
newspapers
papier-mache paste
cardboard

Procedures

1. Gather materials.
2. Copy student worksheets.
3. Assign partners/teams.
4. Discuss the teacher/student background information.
5. Have students think of ways that astronauts have to adapt to a microgravity environment and working in space.

Answer Key

1. Actual space suit helmets are made of a hard plastic which protects astronauts when small, fast-moving particles in space impact the astronauts. The visor of the space suit has a special film which protects astronauts from harmful radiation.
2. Data measurements help designers to decide measurements on stock space suit parts.

Living and Working in Space (continued)

Teacher Information

3. Velcro is useful in a weightless environment to keep things from floating away. For example, if you are using a pencil and paper to make notes, when you put the pencil down it may float away if you do not have a way to make it stay in place.

Extensions

- Have the students pretend they are astronauts on the space shuttle. With a partner, simulate making a peanut butter sandwich in the weightlessness environment of space. Then, they can present their simulations to the class.
- Have the students draw a picture of themselves wearing a space suit and exploring the Moon.
- Have the students research and discuss present uses of space suit technology and other space spinoffs.