Living and Working in Space

Student Worksheet

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)

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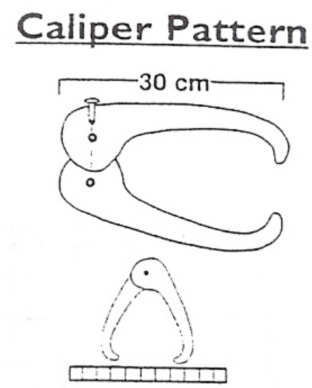
Read the following

You will go through some of the steps necessary to design a space suit. You will work in teams to construct your own space helmet.

Materials

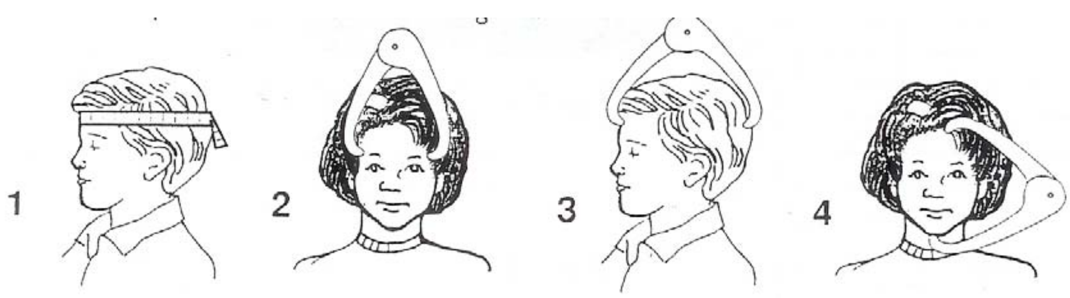
cloth tape measure (metric)
calipers pattern (see diagram)
pencil and paper
large, round balloons
graph paper
brass paper fastners
scissors
newspapers
papier-mache paste
cardboard



Procedures

Head Measurements

1. Draw a pattern for calipers on stiff cardboard and cut out the pieces. Use a brass fastener to fasten the pieces together.
2. Working with your partner(s), take four measurements, using calipers and tape measure, of each member's head in centimeters, and enter the data into the table below. The measurements will be: (1) Head Circumference (2) Head Breadth, (3) Head Depth, (4) Chin to Top of Head. Refer to the diagram.



Team Member	Head Circumference	Head Breadth	Head Depth	Chin to Top of Head

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3. On your chart, find the largest of each type of measurement and circle it. These are the numbers you will use to make sure your helmet is large enough to fit every team member.

Designing a Space Helmet

1. Working with the same partner(s), draw sketches on graph paper of your ideas for a space helmet that could be worn by your partner(s).
2. In designing the helmet, consider the following: (1) it must fit anyone on your team, (2) it must provide adequate visibility, (3) it must be made as small as possible to reduce its launch weight and make it as comfortable to wear as possible.
3. Blow the balloon up to the predetermined size of the helmet.
4. Using the papier-mache paste and strips of newspaper, cover the balloon following the directions of the papier-mache paste. This may take a couple of days to allow time to dry and apply multiple layers.
5. Once the papier-mache has dried, cut a hole at the bottom of the helmet for you and your partner(s) head.
6. Next, cut visor openings and prepare your helmet according to your drawing.
7. Your helmet is complete when each member of your group can put on and take off the space helmet.
8. Answer the questions listed below.

Questions

1. What are actual space helmets and visors made from and how do they protect

   astronauts? ____

   ____

2. How do the data measurements of astronauts help designers? ______________

   ____

3. How is Velcro useful to astronauts when in space? ______________________

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