



Staying Cool In Space

Background

Working in space takes a great amount of effort. During the first spacewalks or Extravhicular Acti-(EVA), astronauts have relayed how warm it gets while wearing a spacesuit that has a mass of over 100 kilograms!

To help the spacewalkers stay cool during an EVA, researchers developed the Liquid Cooling-and-Ventilation Garment. The garment is a one-piece body suit with a zippered-front. Its soft nylon lining is covered with an additional layer of Spandex™ and a network of plastic tubing that surrounds the body. This tubing is used for cooling and ventilating the suit. A set of tubes is used to circulate cool liquid, while another set of tubes is used to transport sweat, carbon dioxide, and any other contaminants into the Primary Life Support System to purify the atmosphere within the suit.

The Activity

Students will use plastic tubing and water to lower their body temperature.

The Objective

This activity teaches students about an astronaut's challenge of working in space and the need for researchers to devise solutions for real-life problems. Students will have the opportunity to experience how an astronaut regulates his body temperature while working in space.

Materials

- two buckets
- 3 metres of aquarium tubing
- water
- ice to fill a bucket to the halfway point
- kitchen size plastic garbage bags (one per student)

Method

Understanding Heat Retention

1. Give each student a plastic bag. Students should roll up one shirt sleeve.
2. Ask the students to place their bare arms in the plastic bag. Wrap the bag around the arm (but not too tightly). For a period of two minutes, they should wave their covered arms.
3. After this time period, ask the students to observe the sensation in the arm once they remove these bags. The following discussion should explain how the suit, like the plastic, retains body heat, and why their arms suddenly felt cooler with the removal of the bags. (Warm air in the bag was released and moisture from perspiration on the arms began to evaporate to create a cooling effect.)
4. You can now segue into the next part of the exercise. Students will understand how to circumvent the problem of heat retention within the suit.





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A "Cool" System

1. Set up a bucket of water and ice on a desk.
2. Set up the empty bucket on the floor.
3. Ask a student volunteer to sit on a chair in front of the desk and the ice water.
4. Wrap the tubing around the student's bare arm and place one end of the tube in the ice water and the other end of the tube in the empty bucket.
5. Start a siphon flow from the ice water to the empty bucket. Ask the student to describe the sensation for the rest of the class.

More Activities to Stimulate Interest and Learning

- Devise a method that will eliminate the need for the siphons and buckets of water in this experiment. How can you ensure that water can be continuously circulated?
- Set up teams to design and construct liquid cooling garments. Each team can choose their base garment (e.g. long underwear, thermal undershirt, running tights, bodysuit). They can also decide on how much tubing to apply for maximum cooling and how it can most effectively be networked and attached to the suit.
- Devise a method to compare and test the effectiveness of each of the suits. Which was most effective? Which was least effective? Why?
- Who else might benefit from these liquid cooling garments?

For more information about the Liquid Cooling-and-Ventilation Garment or spacesuits in general, please visit the KidStation for Cosmofans at <http://www.space.gc.ca/ks-cosmofans>.