National Aeronautics and
Space Administration

Educational Product	
Educators	Grades K–4

Educational Topic

From Sunlight to Power: International Space Station Solar Arrays

Objective
The students will construct and use a simple solar collection device to demonstrate the generation of heat created by the light of the Sun.

Science Standards
Science as Inquiry
Physical Science
  Light, heat, electricity, and magnetism
Earth and Space Science
  Objects in the sky

Math Standards
Problem Solving
Communication
Reasoning
Measurement
Estimation

Materials *(for each team of two)*
4 paper cups, unwaxed
White paper
Aluminum foil
Black paper
Plastic wrap
Scissors
Newspaper
Tape
Apple slices
2 thermometers

Background Information
The International Space Station will be the largest orbiting spacecraft in history. The space agencies of the United States, Russia, Japan, Europe, and Canada are working together to build what can only be called "A New Star on the Horizon." The dimensions are staggering. Its wingspan will be approximately 110 meters and its length 80 meters. It will weigh almost a million pounds and orbit at an average altitude of 220 nautical miles. It will hold a crew of three during the construction phase and up to seven when the Space Station is complete.

Worldwide research in biology, chemistry, physics, and other sciences will be conducted in the Space Station's six laboratories. This will open the door to future long-duration human exploration of the solar system, as well as provide continuous benefits to science, industry, and medicine on Earth.

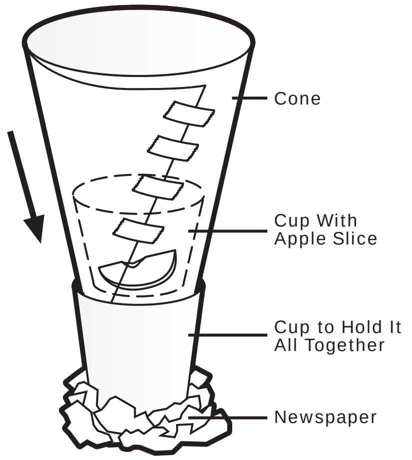
Power will be generated for the International Space Station by utilizing the energy of the Sun. The Sun's energy will be absorbed by eight solar arrays. These eight solar arrays make up the four large, flexible photovoltaic (photo: light; voltaic: producing electricity) modules. Modules are made up of silicon-based photovoltaic cells, which generate small currents of electricity when exposed to energy from the Sun. These modules will produce approximately 240 kilowatts of power, which is enough to run 60 average-sized homes.

The power obtained from the solar arrays will be distributed in several ways. Half of the power obtained will charge the Space Station's batteries. The batteries are used when the Space Station is not in sunlight. They are also used when more power is needed for experiments and research. The other half of the power produced will go directly to the laboratories and modules, or rooms, of the Space Station. This half of the power will also run the life support systems, which includes the air the astronauts will breath, the food systems, and the temperature controls, to name a few.

Living and working in space is an exciting adventure. Even the way the International Space Station will receive its electricity is wondrous. Better yet, the same method that will be used for producing electricity on the International Space Station is also being used in homes and businesses all over the world. Communications satellites that send television signals around the world also use solar cells. From toys to lights for the backyard, a variety of products are available that use solar cells to produce their own power.

Solar Cooker Activity
Have a class conversation about the use of electricity. List how electricity is used in homes and at school. Make a second list of ideas about how astronauts use electricity when they are in space. Are the lists similar? How are they different? Identify how we get electricity on Earth. Can the astronauts on the International Space Station get their power the same way?

This activity is a demonstration using the energy from the Sun. It does not produce electricity.



Step 1: Line the inside of two cups with black paper and place a slice of apple in each one.

Step 2: Cover the tops of the two cups with plastic wrap.

Step 3: Make two large cones: one with white paper lined inside with aluminum foil, the other with plain white paper.

Step 4: Wrap each cone around a cup with the apple slices inside.

Step 5: Cover the bottom of each cup and cone with another cup to hold it in place.

Step 6: Crumple newspaper around the bases of the outside cups. This serves as an insulator.

Step 7: Aim the cookers at the Sun.

Step 8: Lower thermometers into the cones. Record temperatures.

Step 9: Cook until the apples are done.

Note: This experiment takes an estimated 2–4 hours to complete and should be conducted on a warm, sunny day.

Discussion:

1. Taste the apples from each cooker. Which one of the cookers did the better job?

2. Which cooker generated heat faster?

3. How do the cookers work like the solar arrays on the International Space Station?

4. Why did you use aluminum foil in your cooker? (to reflect and concentrate heat)

Assessment:

1. Have the students draw a diagram of their solar cooker.

2. Write a list of instructions for making a solar cooker.

Extensions:

1. Graph the temperature changes as they occur over a period of time.

2. Design and build a model of the International Space Station solar arrays using materials that will actually conduct heat.

3. Design and build a large-scale solar cooker.

4. Make a list of how we can conserve energy on Earth and on the International Space Station.

5. Solar cells can be found in certain toys and yard lights. These can be used in demonstrations.

For more information about the International Space Station, please visit: **http://station.nasa.gov**

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