

Figure 1. International Space Station Mobile Servicing System.

**National Science Content Standards:**

Abilities of technological design.

**Mathematics Standards:**

Communication

Geometry

## Technology Activity 2

# International Space Station Robotic Arm

**Objective**

Students will develop an understanding of engineering design and of the roles of troubleshooting, research and development, invention and innovation, and experimentation in problem solving.

**NASA Challenge**

You are a NASA Robotics Engineer, and you need to find a way to grab the foot restraints the astronauts are attached to using the robotic arm.

**Materials**

Styrofoam coffee cups

12 cm pieces of string

Cellophane tape

Plastic picnic knives

Lollipop

**Management**

This activity can be conducted in a classroom and should be done in teams.

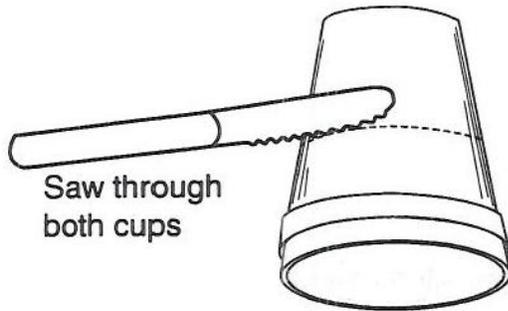
**Background**

New exploration strategies are at work at NASA where the goal is to have humans and robots working together.

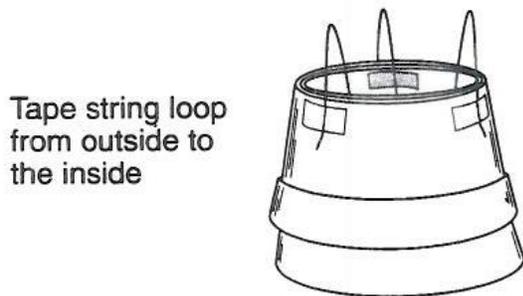
To assemble part of the International Space Station (ISS), Astronauts jointly will operate the robotic arm on the Space Shuttle and the ISS to move the Truss from the cargo bay of the ISS. To move the truss, the astronauts must rely on a camera view of the module. Neither can look out the window and see what they are working on directly.

## Procedure: Make the End Effector

1. Have the robotics engineers work in pairs or small groups.
2. Nest the two cups together and cut through both cups where indicated in the diagram by the dashed line. Smooth the cut edges by scraping them with the picnic knife edge.



3. Cut three 12-centimeter lengths of string.
4. Tape the end of the first string to the side of the inner cut just below the cut edge.
5. Tape the other end of the string outside of the cup, but do not press this piece of tape tightly yet.



6. Repeat Steps 5 and 6 twice more, but place the strings about a third of the way (120 degrees) around the cup from the first string.
7. While holding the rim of the inner cup, rotate the outer cup until the three strings cross each other. The strings will have

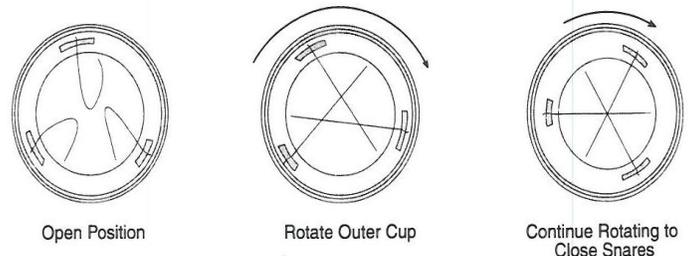
some slack. Pull the end of the strings on the outside until they are straight and intersect exactly in the middle of the opening. Press the tape on the outside to hold the strings.

## Procedure: Use the End Effector

1. Use the end effector to pick up the lollipop. Have someone hold the lollipop upright.



2. Open the end effector so that the strings are not crossing each other.



3. Slip the end effector over the lollipop so that the straw extends down the center and not through the loops.



4. Rotate the outer cup until the strings grasp the lollipop.



### Extension:

1. Additional Challenge: Have the Robotics Engineer try to pick up other objects and have them assess the difficulty in performing this. Ask them what they would change to make it easier to pick up other objects.

Now compare the closed snares (strings) made in this activity with the way the closed snare looks on the real ISS robotic arm. See Figure 2 and 3 below.



Figure 2. Closed snare made in activity.



Figure 3. Closed snare on the robotic arm.