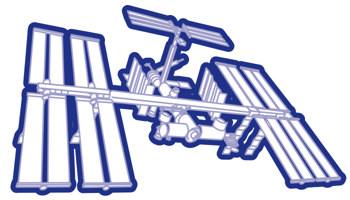
Educational Product	
Educators	Grades 5-12

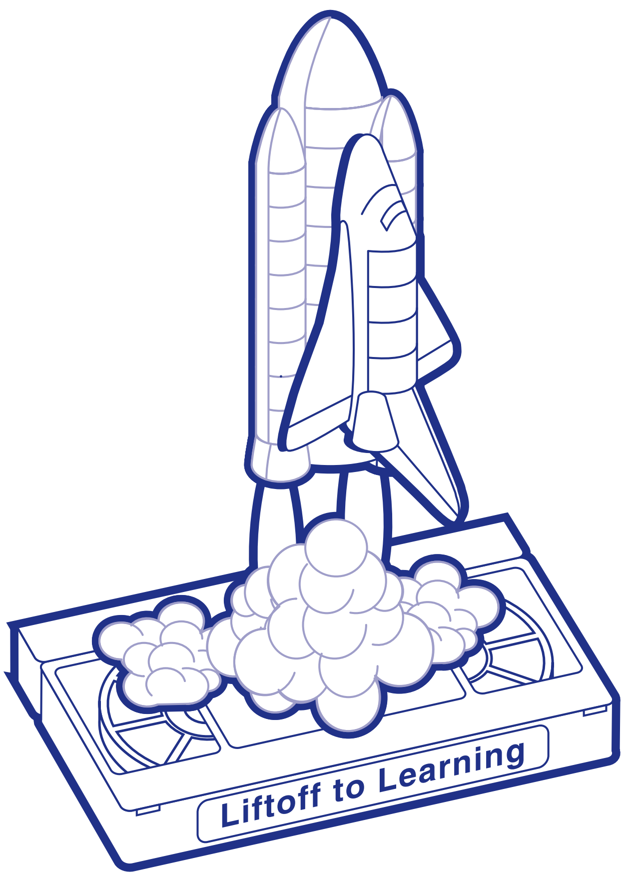
National Aeronautics and
Space Administration

Liftoff to Learning



Let's Talk *Robotics*

A Videotape for Technology Education and Physical Science



Video Resource Guide

EV-1998-04-015-HQ

Video Synopsis

Title: Let's Talk *Robotics*

Length: 14:41 minutes

Subjects: NASA's use of robotics in space exploration.

Description:
This video program examines some of NASA's robotic research and how robots are used in space exploration. Classroom scenes show robot study at the intermediate and high school level.

Science Standards:
Science and Technology
- -Abilities of technological design
- -Understandings about science and technology

Universals Of Technology:*
- - Utilizing Technological Systems
- - Determining and Controlling the Behavior of Technological Systems
- - Designing and Developing Technological Systems
- - Nature and Evolution of Technology
- - Physical Systems
- - Linkages

*Technology standards are under development.

Background

The word *robot* comes from the Czech word *robota* which means forced or repetitive labor. Czech playwright Karel Capek coined the term for his 1920 play R.U.R. (Rossum's Universal Robots). In the play, the human-like robots take over the world.

Today's robots usually look very different from humans. They are found in manufacturing, research, medical treatment, entertainment, and space. NASA uses robots to explore Earth and the other planets, to manipulate payloads on the Space Shuttle, and plans to use several robot arms on the International Space Station.

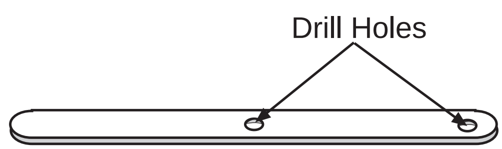
The definition of what a robot is varies with the source referenced. Generally, robots are machines that operate by computer controls. In terrestrial applications, robots are most often used for dangerous, dirty, or dull jobs. Examples include painting and welding robots in automotive assembly lines and robots used to dismantle old nuclear power plants. In NASA-sponsored experiments, walking robots were used to explore active volcanoes in Alaska and the Antarctic.

In this video, several of NASA's robotic applications are explored. Viewers will learn about the *Pathfinder* robot that landed on Mars in 1997 and released a microrover spacecraft (*Sojourner*) to explore the nearby Marscape. Viewers will also learn about the 15 meter-long Remote Manipulator System arm that Space Shuttle astronauts use to handle payloads in space and assist in space construction and satellite repair operations. Research being done to test robot arms for the International Space Station and a free-flying camera robot will also be seen.

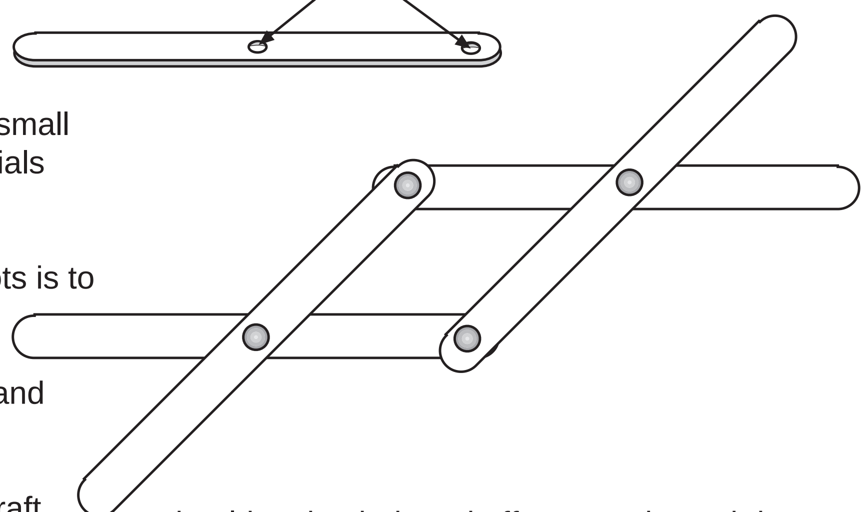
Terms

Articulated - Jointed arm.
End Effector - Device at the end of a robot arm that is used to grasp or engage objects.
Degrees of freedom - Each plane in which a robot can maneuver.
Robot - Mechanical device that performs human tasks, either automatically or by remote control. (From the Czech word, *robota.)*
Robotics - Study and application of robot technology.
Telerobotics - Robot that is operated remotely.

Classroom Activities



Robot Arm and End Effector



Materials: Wooden craft sticks, drill, small brass paper fastener, assorted materials

Background: One of the important objectives in the development of robots is to enable robots to interact with their environment. Interaction is often accomplished with some sort of arm and gripping device or end effector.

Procedure: Drill holes through the craft sticks as shown in the diagram. Each student will need four drilled sticks and four brass paper fasteners. Dampening the sticks before drilling can reduce cracking the wood. Have students assemble robot arms as shown in the illustration above. Tell them to try to pick up a pencil or some other object with the arm. They will find the task difficult. Next, tell the students to design some sort of end effector for the end of the arm that will enable them to pick up the object. Students should make their end effector and attach it to the ends of the arm with glue. Evaluate their work by having them demonstrate picking up the object. Ask students what other objects they can pick up with the arm. Would the arm and end effector have to be modified to pick up sediment and pebbles on Mars?

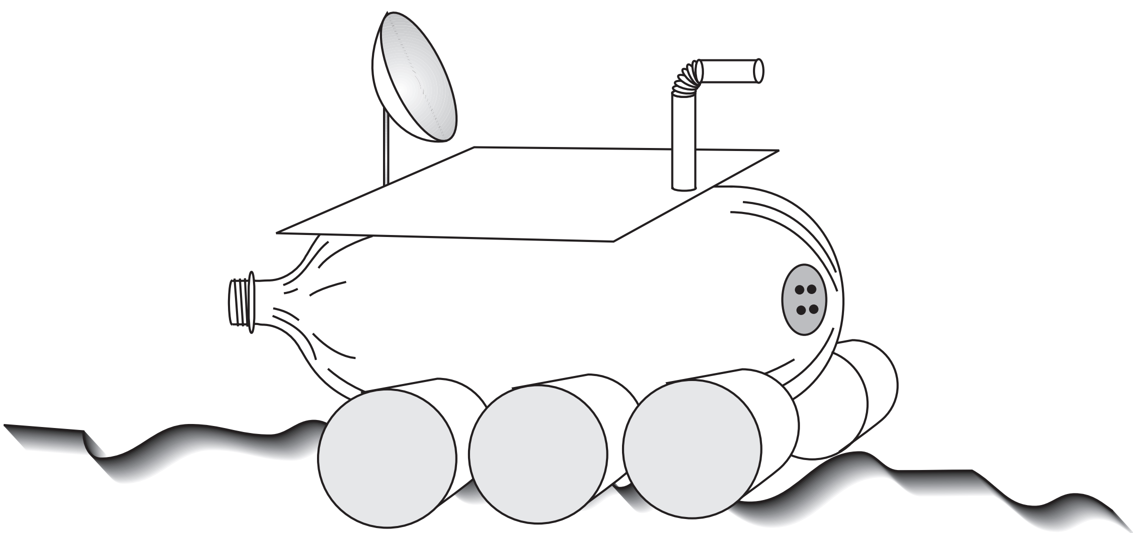
Design a Microrover for the Moon

Materials:
Paper, art supplies, assorted materials (plastic food containers, styrofoam packaging, spools, broken toys, etc.), glue, and tape

Background:
NASA has shifted its planetary exploration strategies from complex and expensive "do-everything" spacecraft to simpler and less expensive spacecraft that do only a few jobs. A good example of this operational change is the *Sojourner* microrover robot spacecraft that explored small areas of the Martian surface in 1997. Microrovers are easier to design and construct than the larger complex craft and several can be constructed for the same price. If a major malfunction should take place in one rover, others can be deployed to replace it.

Recent studies of the Moon by the robot Lunar Prospector spacecraft have confirmed that water, in the form of ice, exists at the Moon's South Pole. The water is found in depressions that are forever shielded from the Sun's heat. The discovery of water means that future human explorers of the Moon can use the water for drinking, for production of breathing oxygen, and for production of rocket fuel.

Procedure: Challenge students to design a microrover spacecraft for exploring the Moon's South Pole region. The purpose of the rover is to map the extent of water ice found there. The robot will have to have some sort of transportation system, sensors, power, scientific instruments, and a communication system. Have students sketch their robot design or construct a model of the robot from assorted materials. Have students write a description of how their robot works or present an oral report.



References

NASA On-line Resources for Educators provide current educational information and instructional resource materials to teachers, faculty, and students. A wide range of information is available, including science, mathematics, engineering, and technology education lesson plans, historical information related to the aeronautics and space program, current status reports on NASA projects, news releases, information on NASA educational programs, useful software and graphics files. Educators and students can also use NASA resources as learning tools to explore the Internet, access information about educational grants, interact with other schools, and participate in on-line interactive projects, communicating with NASA scientists, engineers, and other team members to experience the excitement of real NASA projects.

You can access these resources through the NASA Education Home Page:

http://education.nasa.gov

Other web sites of interest:

http://www.jsc.nasa.gov
http://mpfwww.jpl.nasa.gov
http://robotics.jpl.nasa.gov
http://ranier.oact.hq.nasa.gov telerobotics_ page/telerobotics.shtm
http://piglet.cs.umass.edu:4321/robotics.html

Crew Biographies

(In order of appearance)

STS-85

Robert L. Curbeam, Jr. (Lieutenant Commander, USN) was born March 5, 1962, in Baltimore, Maryland. He graduated from Woodlawn High School, Baltimore County, Maryland, in 1980. He earned a bachelor of science degree in aerospace engineering from the United States Naval Academy in 1984, a master of science degree in aeronautical engineering from the Naval Postgraduate School in 1990, and a degree of aeronautical and astronautical engineering from the Naval Postgraduate School in 1991. Curbeam reported to the NASA Johnson Space Center in March, 1995 as an astronaut candidate and served on the crew of STS-85 in 1997 as a mission specialist.

Stephen K. Robinson (Ph.D.) was born October 26, 1955, in Sacramento, California. He graduated from Campolindo High School, Moraga, California in 1973. Robinson then earned a bachelor of science degree in mechanical/aeronautical engineering from University of California at Davis in 1978, a master of science degree in mechanical engineering from Stanford University in 1985, and a doctorate in mechanical engineering, with a minor in aeronautics and astronautics, from Stanford University in 1990. Robinson reported to the NASA Johnson Space Center in March, 1995 as an astronaut candidate and served on the crew of STS-85 in 1997 as a mission specialist.

Jan Davis (Ph.D.) was born November 1, 1953, at Cocoa Beach, Florida, but considers Huntsville Alabama, to be her hometown. She graduated from Huntsville High School in 1971 and received bachelor of science degrees in applied biology from Georgia Institute of Technology and in mechanical engineering from Auburn University in 1975 and 1977 respectively. Davis also earned a master of science degree and a doctorate in mechanical engineering from the University of Alabama in Huntsville, in 1983 and 1985, respectively. Davis reported to the NASA Johnson Space Center in March, 1987 as an astronaut candidate and was a mission specialist on STS-47 in 1992, STS-60 in 1994, and STS-85 in 1997.

STS-87

Kalpana Chawla (Ph.D.) was born in Karnal, India. She graduated from Tagore School, Karnal India, in1976, and received her bachelor of science degree in aeronautical engineering from Punjab Engineering College, India, in 1982. She earned her master of science degree in aerospace engineering from the University of Texas in 1984 and her doctorate of philosophy in aerospace engineering from the University of Colorado, in 1988. Chawla reported to the NASA Johnson Space Center in March, 1995 as an astronaut candidate and served as a mission specialist on the crew of STS-87 in 1997.

Steven W. Lindsey (Major, USAF) was born on August 24, 1960, in Arcadia, California. He considers Temple City, California, to be his hometown. He graduated from Temple City High School, Temple City, California, in 1978 and received a bachelor of science degree in engineering sciences from the U.S. Air Force Academy in 1982. Lindsey then earned a master of science degree in aeronautical engineering from the Air Force Institute of Technology in 1990. Lindsey reported to the NASA Johnson Space Center in March, 1995 as an astronaut candidate and served as the pilot on STS-87 in 1997.

NASA Liftoff to Learning
Let's Talk Robotics

EDUCATOR REPLY CARD
Video Resource Guide

To achieve America's goals in Educational Excellence, it is NASA's mission to develop supplementary instructional materials and curricula in science, mathematics, geography, and technology. NASA seeks to involve the educational community in the development and improvement of these materials. Your evaluation and suggestions are vital to continually improving NASA educational materials.

Please take a moment to respond to the statements and questions below. You can submit your response through the Internet or by mail. Send your reply to the following Internet address:

http://ehb2.gsfc.nasa.gov/edcats/educational_videotape

You will then be asked to enter your data at the appropriate prompt.

Otherwise, please return the reply card by mail. Thank you.

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   Number of Teachers/Faculty:
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   College/University - ______ Undergraduate ______ Graduate

   Number of Students:
   ______ K-4 ______ 5-8 ______ 9-12 ______ Community College
   College/University - ______ Undergraduate ______ Graduate

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   ______ Administrators/Staff ______ Parents ______ Professional Groups
   ______ General Public ______ Civic Groups ______ Other

2. What is your home 5- or 9-digit zip code? __ __ __ __ __ — __ __ __ __

3. This is a valuable video and video resource guide.
   ❑ Strongly Agree ❑ Agree ❑ Neutral ❑ Disagree ❑ Strongly Disagree

4. I expect to apply what I learned in this video and video resource guide.
   ❑ Strongly Agree ❑ Agree ❑ Neutral ❑ Disagree ❑ Strongly Disagree

Fold along line and tape closed.

5. What kind of recommendation would you make to someone who asks about this video and video resource guide?
   ❑ Excellent ❑ Good ❑ Average ❑ Poor ❑ Very Poor

6. How did you use this video and video resource guide?
   - ❑ Background Information
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   - ❑ Demonstrate NASA Materials
   - ❑ Demonstration
   - ❑ Group Discussions
   - ❑ Hands-On Activities
   - ❑ Integration Into Existing Curricula
   - ❑ Interdisciplinary Activity
   - ❑ Lecture
   - ❑ Science and Mathematics Standards Integration
   - ❑ Team Activities
   - ❑ Other: Please specify: ______________________

7. Where did you learn about this video and video resource guide?
   - ❑ NASA Educator Resource Center
   - ❑ NASA Central Operation of Resources for Educators (CORE)
   - ❑ Institution/School System
   - ❑ Fellow Educator
   - ❑ Workshop/Conference
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8. What features of this video and video resource guide did you find particularly helpful?
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9. How can we make this video and video resource guide more effective for you?
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10. Additional comments:
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