TEACHER EVENT CHECKLIST
SPACEBOTS EXPEDITION (ROBOTICS)

Date Completed	**PRE-EVENT REQUIREMENTS**
	1. Print out a copy of this entire file (color copy preferred). Please note: this document is 17 pages long.
	2. Have students take Pre-Event Quiz on page 5.
	3. Complete all pre-event activities with the students on page 3.
	4. Teacher to E-mail a minimum of 5 student questions to our office no later than 3 business days prior to your event.
	5. Review NASA Event Guidelines with students on page 16.
	DAY OF EVENT ACTIVITIES
	1. The students will be asked to share their results from their pre-work activities with the NASA DLO presenters.
	2. Bring classroom projects and drawings to support student presentations.
	POST EVENT REQUIREMENTS
	1. Have students take Post-Event Quiz to demonstrate knowledge of subject.
	2. Teacher(s) and students to fill out event feedback.
	2. Digital Learning Network will respond to any follow-up questions.
	3. At teacher's discretion, students can complete extended activities.

Instructional Goal

Upon completion of this learning module, students will be able to discuss how robotics are used in space exploration and describe some of the career opportunities that exist in the field of robotics.

Learning Objectives

1. Students will be able to define the term "robot" historically and identify everyday applications.
2. Students will be able to discuss the characteristics of robots and their role-use in space exploration.
3. Students will explore career opportunities and the education required in the field of robotics.

National Education Standards:

Science Standards (NSES)

Science and Technology
Abilities of Technological Design

History and Nature of Science
Science as a Human Endeavor
Historical Perspectives

Technology Ed. Content Standards

8. Students will develop an understanding of the attributes of design
9. Students will develop an understanding of engineering design

Mathematics Standards

Measurement
Understand measurable attributes of objects and the units, systems, and processes of measurement. Apply appropriate techniques. Tools, and formulas to determine measurements.
Connections
Recognize and use connections among mathematical ideas. Understand how mathematical ideas interconnect and build on one another to produce a coherent whole. Recognize and apply mathematics in contexts outside of mathematics.

Grade Level:

Grades K-12

Estimated Time Requirements:

- Activity Set #1 50 minutes
- Activity Set #2 **Grade dependent**
- Video Teleconference 50 minutes

STUDENTS WILL PRESENT RESULTS AND PROJECTS DURING THE DLN EVENT.

Texas Essential Knowledge and Skills (TEKS)
Science
- 3.E
- 5.A,B,C

Social Studies
- 29.A

English
- 15.A

OVERVIEW

Learn how NASA defines robotics; see how robotic systems are already widely used in the space program and what plans there are for future robotic applications. This interesting look into the world of space robotics will also highlight educational and professional opportunities that could be the catalyst that helps some students to identify a career path. So join us for this live, interactive session for a glimpse into the technologies of the 21st century happening now at NASA.

INSTRUCTIONAL STRATEGY

Pre-Event Classroom Component

Activity Set #1

1. Students take Pre-Event Quiz on page 5 to test their knowledge prior to these lessons about Robotics-. Students keep these quizzes on file to compare to their Post-Event Quiz.

2. Develop a class definition of a Robot and introduce additional terminology that will be used in the activities and during the event with NASA. It is up to the teacher's discretion on how and when to introduce the terms.

Activity Set #2

1. Grades K-4

   Please complete the following two activities with your class.

   - Activity A on page 9. In this activity, students create, illustrate, and write about how robots could be used in their daily life.
   - Activity B on page 9. In this activity, students experience how hard it is to accurately guide a robot through simple tasks.

2. Grades 4-6

   Please complete ***AT LEAST*** two, preferably all, of the following activities with your class.

   - Activity C on page 10. In this activity, students create a simple end effector.
   - Activity D on page 11. In this activity, students experience the challenge of performing everyday tasks without using their fingers or eyes.
   - Activity E on page 12. In this activity, students design and build a microrover spacecraft for exploring the moon.

3. Grades 6-12

   Please complete the following two activities with your class.

   - Activity F on page 13. In this activity, students learn how the end effectors on the robotic arms are used on the Space Shuttle and International Space Station. They also will design and construct a grapple fixture that will enable the end effector to pick up an object.
   - Activity G on page 14. In this activity, students create a complex end effector.

Students will be asked to present their ideas, results, and designs during the video teleconference.

Activity Set #3

1. Student Questions – A Desire To Explore Further
   - Develop at least 5 questions from the class on space stations
   - These questions should go beyond the basic information within the program
   - E-mail your questions at least 3 business days prior to your event with NASA
   - E-mail address is: DLO1@jsc.NASA.gov

2. Prepare the students for their participation in a live, interactive video teleconference with NASA's Digital Learning Network.

Activity #1 Pre/Post Quiz
Spacebots Expedition

1) Provide a written definition of a Robot. What can a robot do? What does a Robot look like?

2) Provide an illustration that shows a typical Robot used for Space Exploration?

3) Write a set of directions on how to move your arm from your side to scratch your nose. This will be a set of program directions similar to those written by engineers working to design a robotic system for movement to complete a task.

4) List at least 3 jobs or careers in robotics.

5) Match the following terms with their correct definitions:

Articulated	A mechanical or electromechanical device that performs human tasks, automatically or by remote control.
End Effector	The study and application of robot technology.
Degrees of Freedom	Each plane in which a robot can maneuver.
Anthropomorphic	To move by turning over and over. To rock back and forth.
Dexterity	Jointed arm.
Yaw	To move left or right with out turning over or moving up or down
Pitch	To control a device or object from a distant location.
Roll	To have human characteristics.
Autonomous	A robot that is operated remotely.
Robot	Device at the end of a robot arm that is used to grasp or engage objects.
Telerobotics	To rise up or dip down.
Teleoperation	Skill, flexibility, and range of mobility.
Robotics	Existing or functioning independently

Pre/Post Quiz
Spacebots Expedition

TEACHER ANSWER KEY – Please don't share with the students. Answers should be similar to:

1. Provide a written definition of a Robot. What can a robot do? What does a Robot look like?

Generally, robots are machines that operate by computer controls. A mechanical or electromechanical devise that performs human tasks, either automatically or by remote control. It senses, thinks, and then acts.

2. Provide an illustration that shows a typical Robot used for Space Exploration?

Any creative ideas are acceptable.

3. Write a set of directions on how to move your arm from your side to scratch your nose. This will be a set of program directions similar to those written by engineers working to design a robotic system for movement to complete a task.

Any thoughtful responses are acceptable.

4. List at least 3 jobs or careers in robotics.

Designer for planetary rovers, building anthropomorphic robots, robotics careers can include the fields of: Mechanical Engineering, Electrical Engineering, Computer Engineering, Materials Science, Biomedical Engineering

5. Match the following terms with their correct definitions:

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

Yaw – To move left or right with out turning over or moving up or down

Pitch – To rise up or dip down

Roll – To move by turning over and over. To rock back and forth.

Dexterity – Skill in using one's hands, body, or mind. Skill, flexibility, and range of mobility.

Robot – Mechanical or electromechanical device that performs human tasks, either automatically or by remote control (From the Czech work robota)

Robotics – Study and application of robot technology

Telerobotics – Robot that is operated remotely

Teleoperation – To control a device or object from a distant location

Anthropomorphic –To have human characteristics

Autonomous – existing or functioning independently

Spacebots Expedition Vocabulary

The following is a list of words and definitions that your students need to be familiar with because the words are used throughout the activities and video teleconference. They will be asked to explain the meaning of these terms **in their own words during the videoconference**.

Articulated – Jointed arm; example - Canadarm

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; yaw, pitch, and roll

Yaw – To move left or right with out turning over or moving up or down

Pitch – To rise up or dip down

Roll – To move by turning over and over. To rock back and forth.

Dexterity – Skill in using one's hands, body, or mind. Skill, flexibility, and range of mobility.

Robot – Mechanical or electromechanical device that performs human tasks, either automatically or by remote control (From the Czech work robota)

Anthropomorphic –To have human characteristics

Robotics – Study and application of robot technology

Telerobotics – Robot that is operated remotely

Teleoperation – To control a device or object from a distant location

Autonomous – existing or functioning independently

Activity #2
(Listed By Grade Level)

Activity A
Grades K-4
Robots In Action

In this activity, students create, illustrate, and write about how robots could be used in their daily life.

http://media.nasaexplores.com/lessons/01-046/k-4_1.pdf

"Astronauts' Little Helpers" article

http://nasaexplores.com/search_nav_k_4.php?id=01-046&gl=k4

Student Presentation:
Students will be asked to show and explain their illustrated robots during the NASA DLO event.

Activity B
Grades K-4
Think Like A Robot

In this activity, students experience how hard it is to accurately guide a robot through simple tasks.

http://media.nasaexplores.com/lessons/01-046/k-4_2.pdf

Student Presentation:
Students will be asked to discuss their experience during the NASA DLO event.

Activity C

Grades 5-6

Robot Arm and End Effector

Materials

- Wooden craft sticks
- Drill
- Small brass paper fastener
- Assorted materials

Background

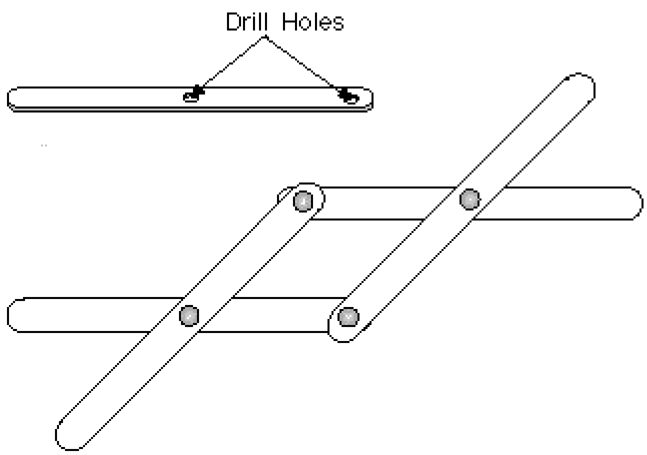
One of the important objectives in the development of robots is to enable robots to interact with their environment. Interaction is often accomplished with some sort of arm and gripping device or end effector.

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?

Student Presentation

Students will be asked to demonstrate their robot arm and end effector during the NASA DLN event.



Activity D
Grades 5-6
Can a Robot Tie Your Shoes?

Background

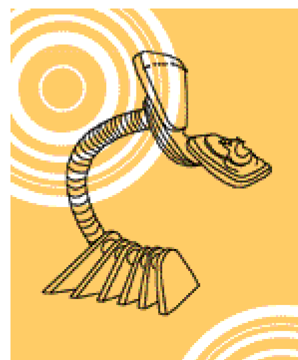
Robots are machines that do specific tasks. Movies are full of robots that can do everything that humans can do and more. However, in reality, there are limits to what robots can do. This activity is designed to help analyze a simple, everyday task from the point of view of a robot. Gloves, blindfolds and pliers are used to limit sensory information, and tongue depressors limit the number of moving joints.

Tying a shoe, an every-day task that seems easy enough for us, is difficult, if not impossible, for a mechanical robot. Robots have limited movement, only a few sensors, and are controlled by computers, which must be programmed with instructions for each step required. It is difficult for two people to work together to tie a shoe. Likewise two robots working together is very difficult to coordinate and only recently has been achieved. (A line of robots working sequentially in an assembly plant is different than two robots working together on the same task.)

It is helpful for participants to discuss their experience after each variation.

Materials Needed

- shoes that tie
- tongue depressor
- masking tape
- heavy gloves
- 2 pairs of pliers
- blind folds



Procedure

Try tying your shoes blindfolded. Not too hard! Now, repeat the activity but with heavy gloves on your hands. Then, tape tongue depressors onto your thumbs and forefingers and try again.

And if those activities weren't difficult enough, tie your shoes with pliers. First, use pliers in both hands; then with only one hand; finally with two people -- each with one pair of pliers. For fun, these activities can be set up as a race between two people

Student Presentation
Students will be asked to share their experiences & findings during the NASA DLN event.

Activity E
Grades 5-6
Design a Microrover for the Moon

Materials

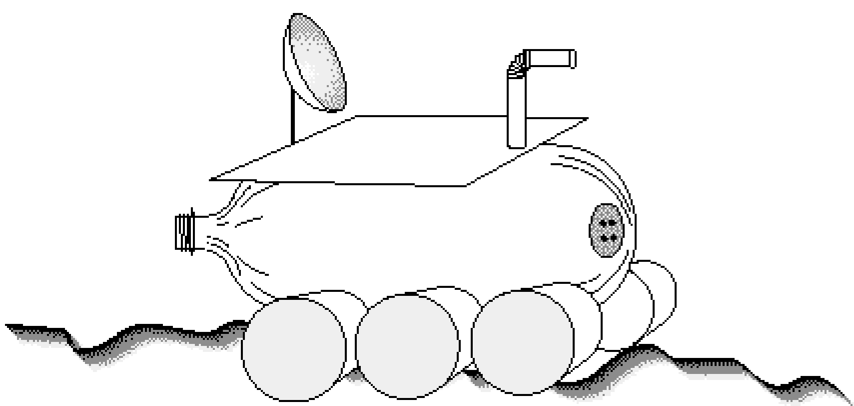
- paper
- art supplies
- assorted materials (plastic food containers, Styrofoam packaging, spools, broken toys, etc.)
- glue
- tape

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.



Student Presentation

Students will be asked to demonstrate their microrover during the NASA DLO event.

Activity F
Grades 6-12
Shuttle-ISS Robot Arm End Effector

In this activity, students learn how the end effectors on the robotic arms are used on the Space Shuttle and International Space Station. They also will design and construct a grapple fixture that will enable the end effector to pick up an object.

http://virtualastronaut.jsc.nasa.gov/teacherportal/pdfs/Humans.and.Robots.pdf

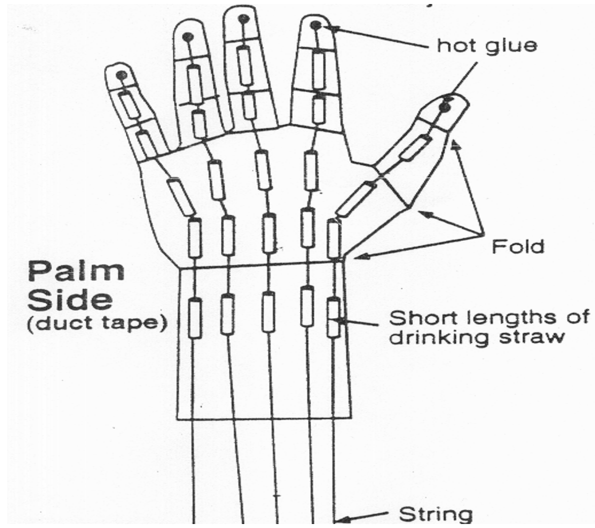
Student Presentation

- Students will be asked to demonstrate their robot arm and end effector during the NASA DLN event.

Activity G

Grades 9-12

Robot Hand (End Effector)



Materials

- Styrofoam Food Tray (one per student)
- Marker Pens
- Duct Tape
- Scissors
- Glue
- Straws (one per student)
- String (two large rolls)
- Rubber Bands (approx. 3 per student)
- Paint Stick (one per student)
- *Robot Hand (End Effector)* handout (one per student)

Background

Robots are often used to assist humans. In this activity, students will create an end effector designed to replicate the human hand.

Procedure

1. Remind the students what an end effector is.
2. Announce that they will be creating a rather complex end effector.
3. Pass out the *Robot Hand (End Effector)* handout.
4. Allow the remainder of class for the students to complete the activity.

Student Presentation:

Students will be asked to demonstrate their robot hand during the video teleconference.

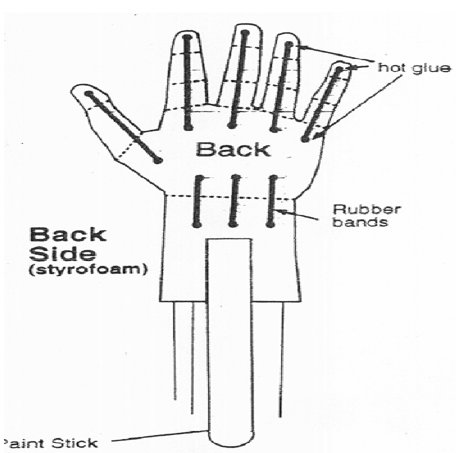
Robot Hand (End Effector)

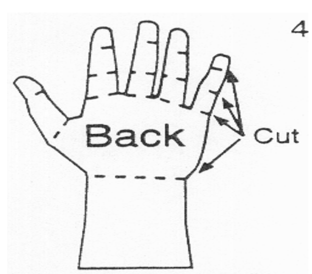
Name: ____ Class: _________ Date: _________

Directions: Collect all the required materials from your teacher. Then follow the step-by-step procedure below to create your robot hand.

Procedure:

1. Place your hand with fingers spread on the smooth side of a Styrofoam food tray. Use a marker pen to trace your hand.
2. Cover the tracing of your hand with duct tape and press it smooth.
3. Trace your hand again on the duct tape and cut it out with scissors.
4. Turn the hand over and score the Styrofoam on each finger with the point of a ballpoint pen where the knuckles should be. Bend each joint gently until the Styrofoam "pops". The tape on the other side becomes the hinge of the knuckle. Also make a wrist joint.
5. Glue short lengths of straw on palm side of hand where indicated on diagram.
6. Knot 5 pieces of string on one end and glue the knots to fingertips. Run the other end of the strings through the straws as shown.
7. Glue pieces of rubber bands across each knuckle joint on the Styrofoam side to serve as muscles and tendons. The rubber bands must be stretched enough so that all the fingers on the hand will open automatically.
8. Work the hand by pulling on the strings.
9. Answer the questions on the following page.





Questions:

1. How many degrees of freedom does the robot hand have? Explain.

2. What might you be able to use your robot hand for?

NASA Event Guidelines

Review the following points with your students prior to the video teleconference event:

1. A video teleconference is a two-way event. Students and NASA presenters can see and hear one another.
2. Students are representing their school; they should be on their best behavior.
3. Students should be prepared to give brief presentations, ask questions and respond to the NASA presenters.
4. A Teacher(s) or other site facilitator should moderate students' questions and answers.
5. Students should speak into the microphone in a loud, clear voice.

Get Ready, Be Ready, and have fun with your Digital Learning Network Event with NASA!

Post-Event Teacher – Student Evaluation

1. **We need your help and support!** We welcome any input that you have. Providing us with feedback usually takes teachers and students **less than 10 minutes** to complete. Choose the appropriate feedback form at the following site: http://nasadln.nmsu.edu/dln/content/feedback/

2. Students and Teachers are **welcome to e-mail the Digital Learning Network** with any follow-up questions from the event at: jsc-dislearn@mail.nasa.gov

3. **Please send** us any photos, video, web page link, newspapers articles, etc. of your event. We will be glad to post them on our web page!

Extended Activities for Spacebots

1. The NASA Robotics Education Project (RE) encourages people to become involved in robotic science and engineering, and competitions. http://robotics.nasa.gov/

2. FIRST robotic competition link http://robotics.arc.nasa.gov/archive/webcasts.htm

3. Rover Ranch http://prime.jsc.nasa.gov/ROV/