ROBOTICS
Classroom Activity

Title: Building a Robotic Arm

Objective:
To construct and operate a robotic arm.

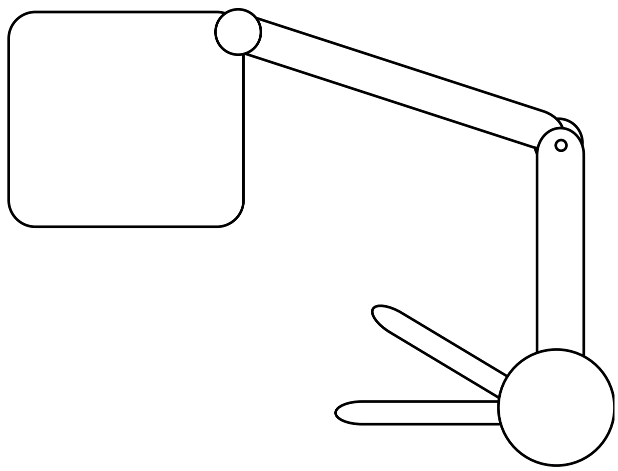
Science Standards:
• Abilities of technological design
• Forces and motions
• Order and organization
• Evidence, models, and explanation
• Form and function

Background:
In the case of many planetary surface robots, it is very desirable to have a robotic arm on board for manipulation and collection of objects on the surface. In order for those arms to function effectively they must be able to easily follow instructions. Those instructions may involve very detailed tasks, but in the realm of long distance communication, it is highly desirable to deliver those instructions as quickly and efficiently as possible. In this activity, you will construct your own robotic arm with the help of your classmates and then write out a set of procedures to be completed. It may be more difficult than it sounds!

Materials Needed: (for teams of two)
Blindfolds
Cups
Large marshmallows
Salad tongs or chopsticks

Procedure:
1. Organize students into pairs. Each pair should have at least one of all items mentioned above. However, do not dispense the materials until students have completed step 4.
2. Do not tell students ahead of time what the task will be. They should just know that their "arm" should be as flexible as possible.

3. The arm must be operated like a Remotely Operated Vehicle. The operator will be blindfolded and must follow directions given by the “Brain” (human operator).
4. Use twelve, one-word commands,, such as Forward... Backward... Up... Down... Open... Close.. .etc. Each team must write these commands out before beginning the operation. The commands must be preceded by another command designating the joint to be moved. The joints in the “arm” which can be designated include shoulder, elbow, wrist, and instrument (tongs, chopsticks, etc.) The resulting combination of two words will be the full command. Some examples might include "shoulder down"... "wrist left"... "elbow in"... etc. Choose commands carefully.
5. After the commands have been selected, one partner must be blindfolded, only then should the marshmallows and cup be handed out and the task of putting the marshmallow into the cup through the use of the commands be explained to the other partner.
6. The marshmallow should be placed somewhere in the room for the “robot” partner to locate by following the commands of the “brain.” After the marshmallow has been retrieved, the commands should be used to place it inside the cup.



Extensions:
1. Set up a timed competition between teams on the tasks specified in this lesson.
2. You may want to add variations to the theme by altering conditions. Try turning the cup upside down, or switching the partners’ roles in the activity.
3. Repeat the competition after students have had the opportunity to research and design better robot arms. You may want to allow dual-arm interaction.

ROBOTICS
Classroom Activity

Title: A Sojourn to the Great Mars Valley

Objective:
Students will design and build a model of a robotic rover.

Science standards:
- Abilities related to scientific inquiry
- Forces and motions
- Origin and evolution of the universe
- Abilities of technological design
- Science and technology in local, national, and global challenges

Background:
In November of 1996 *Sojourner*, a Remotely Operated Vehicle, will journey to Mars aboard the Mars Global Surveyor, an orbiter designed to map the surface of Mars. The journey will last approximately 10 months. Upon reaching Mars' orbit, the orbiter will initially be inserted into an elliptical capture orbit. During the months that follow, it will slowly descend closer to the surface of the planet, and using thruster firings and aerobraking (a technique designed to minimize thruster use by using the forces of atmospheric drag) it will gradually correct its path to that of a circular orbit. Then, using radar techniques similar to those used by the Venus orbiter, Magellan, the orbiter will begin mapping the surface of the red planet in January of 1998. It will map the surface of Mars for approximately one Martian year, or two Earth years. When the mapping has been completed, the orbiter will be used as a signal relay for other robotic probes scheduled to visit Mars.

The robotic rover carried onboard Surveyor is being designed to land on the surface of Mars. This Sojourner rover will trace the planetary climate evolution and to search for traces of water in the Martian soil.

One feature of the Martian surface which is of interest to many researchers and civilians alike is the Valles Marineris. This is a series of canyons very similar to the grand canyon, except for the fact that in many places the "Valley of the Mariner" is four miles or more deep, and if it were placed on the surface of Earth it would easily stretch from New York City to Los Angeles. We can only guess what wonders might lie within this massive set of gorges. Therefore, your task will be to design a Remotely Operated Vehicle (ROV) to explore the Valles Marineris.

Procedure:

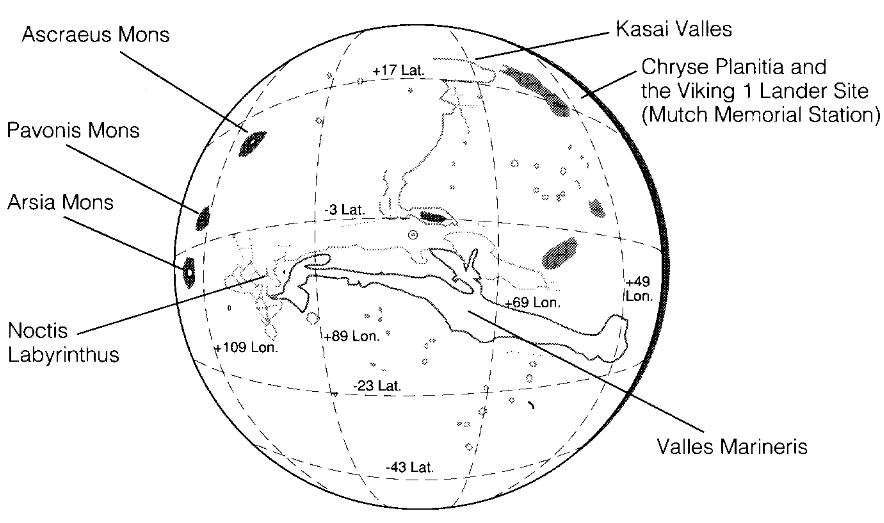
Before designing a robotic vehicle to explore the surface, students should detail what they hope to accomplish through their exploration of the valley. You may want to procure more detailed information on the Valles Marineris itself before proceeding with this step. A good place to start would be on NASA's Spacelink via the Internet.

Spacelink can be accessed by computer through direct-dial modem or the internet.

Modem line:	(205) 895-0028
Terminal emulation:	VT-100 required
DATA format:	8-N-1
Telnet:	spacelink.msfc.nasa.gov
World Wide Web:	http://spacelink.msfc.nasa.gov
Gopher:	spacelink.msfc.nasa.gov
Anonymous FTP:	spacelink.msfc.nasa.gov
Internet TCP/IP/address:	192.149.89.61

After writing a mission objective statement, detailing the investigations their ROV will make, students should either describe in detail or build a model of their rover. You may want to do this as a class activity, or you may choose to continue in groups or as individuals. Whatever your decision, it will be a good idea to begin with a drawing or schematic diagram of the lander you choose to build. You may want to construct a full-sized model or simply a scaled version. However you choose to proceed with this activity, several questions and concerns should be kept in mind. A few of those include:

How will the rover be able to move over all sorts of terrain?
What instruments will be necessary for proper research?
How will the rover move itself down into the valley without losing control?
How will it be controlled? Remember that radio transmissions from Earth to Mars require 19 minutes to travel each way.
How could you relay information back to Earth?
What type of power system will you employ?
Will it be possible to send rock and/or soil samples back to Earth?
What types of instruments would be necessary to detect life?
Will your design be able to accomplish all of the objectives you set for yourself in your mission statement?



National Aeronautics and
Space Administration

Office of Human Resources
and Education
Education Division

ROBOTICS
Classroom Activity

Title: Family Robot

Objective:
Students will write an analysis about the technological, societal, and ethical circumstances surrounding the future inclusion of human-like robots in our culture.

Science standards:
• Structure and function in living systems
• Abilities of technological design
• Science and technology in society

Background:
Imagine that you have a sophisticated robot/android as a member of your household. Consider how your life would be different and what functions that unit would perform for you (household tasks, tutoring, etc.).

Procedure:
Students should write an essay concerning the ways in which their daily lives would be affected by the presence of such an android. What would the robot be able to do? How would a typical day differ? In your essay, do not discount the possibility of the robot/android being "self-aware." If that were true, how might the machine react to being simply the household servant? Might he/she want free-time of its own, relationships, voting rights? The possibilities are endless! How would society deal with this?

Next, if you had to design a robot to perform one daily task for you, what would that task be and how would you design it to effectively perform that function?

Extension:
In actuality, some robotic devices already exist for the purpose of fulfilling specific tasks, and others are being researched at this time. Some of these devices are available for you to interact with via the Internet. One such example is the Tele-Garden. The Tele-Garden features an adept robotic arm surrounded by a garden of living plants. On-line members are able to plant, water, and track the progress of various forms of plant life by using their computer mouse to control the robotic arm. An internet tour of the facility is available for those who are interested. For more information, contact *goldberg@usc.edu* on the Internet.