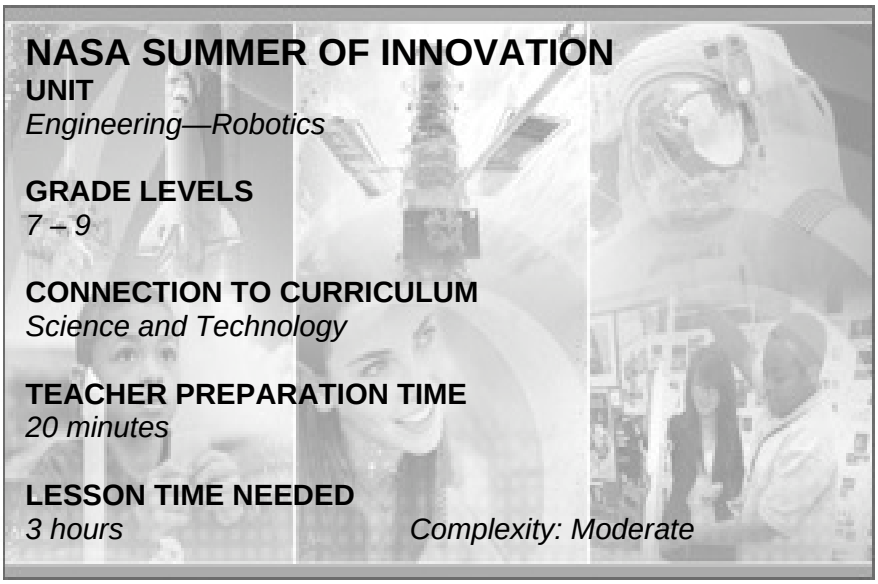
Using Robotics

LESSON THEME
This lesson includes a series of activities that are based on robotics applications.

OBJECTIVES
Students will
• Simulate operating a planetary rover and problem solve solutions
• Work within a mission team setting to problem solve and accomplish a common goal
• Research examples of real-world applications of robotics



NASA SUMMER OF INNOVATION
UNIT
Engineering—Robotics

GRADE LEVELS
7 – 9

CONNECTION TO CURRICULUM
Science and Technology

TEACHER PREPARATION TIME
20 minutes

LESSON TIME NEEDED
3 hours *Complexity: Moderate*

NATIONAL STANDARDS

National Science Education Standards (NSTA)
Science as Inquiry
- Understanding of scientific concepts
- An appreciation of "how we know" what we know in science
- Understanding of the nature of science
- Skills necessary to become independent inquirers about the natural world
- The dispositions to use the skills, abilities, and attitudes associated with science

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

Science in Personal and Social Perspectives
- Personal health
- Risks and benefits
- Science and technology in society

History and Nature of Science
- Science as a human endeavor
- Nature of scientific knowledge
- Historical perspectives

ISTE NETS and Performance Indicators for Students
Creativity and Innovation
- Apply existing knowledge to generate new ideas, products, or processes
- Use models and simulations to explore complex systems and issues
- Identify trends and forecast possibilities

Communication and Collaboration

- Interact, collaborate, and publish with peers, experts, or others employing a variety of digital environments and media
- Communicate information and ideas effectively to multiple audiences using a variety of media and formats
- Develop cultural understanding and global awareness by engaging with learners of other cultures
- Contribute to project teams to produce original works or solve problems

Critical Thinking, Problem Solving, and Decision Making

- Identify and define authentic problems and significant questions for investigation
- Plan and manage activities to develop a solution or complete a project
- Collect and analyze data to identify solutions and/or make informed decisions
- Use multiple processes and diverse perspectives to explore alternative solutions

MANAGEMENT

Model for students how to use the different tools (stopwatches, meter sticks, compass, calculators). Demonstrate how to use the computer virtual program.

CONTENT RESEARCH

The following link provides additional resources for teachers and students and is not necessarily a NASA resource but rather private industry, colleges, universities and organization that have taken an interest in one form or another in robotics, robotics competition, teaching, and design.
Please review content from the following resource:
http://robotics.nasa.gov/edu/6-8.php

Artificial Intelligence

Today's robots have multiple sensors and are able to make their own decisions based on given information. Robots come in all shapes and sizes. Artificial intelligence allows robots to behave more like humans and to act independently in a changing environment.

MATERIALS

- Narrow rubberbands
- Drinking straws
- Cardboard
- Scissors
- Nylon cord
- Centimeter ruler
- Pencils
- Drawing compass
- Tape
- Glue
- Markers
- Crayons
- Colored pencils
- Pen
- 6 ounce Styrofoam coffee cups (2 each)
- 12-cm pieces string (1 each)
- Cellophane tape
- Plastic picnic knives (serrated)

LESSON ACTIVITIES

Robotic Online Virtual Exploration Rover

To program the rover using a series of commands to avoid obstacles and reach a target destination before battery power runs out.
http://www.nasa.gov/audience/foreducators/robotics/home/ROVER.html

Out of Sight Activity

To operate a robotic vehicle while it is not directly in view of the driver or operations team.
www.nasa.gov/pdf/392973main_Out_of_Sight_Activity.pdf

Rover Races

To have the rover driver design and execute a series of commands that will guide a human rover through a simulated Martian surface, allowing the rover team to experience some of the challenges of teleoperating a robotic vehicle on another planet. www.nasa.gov/pdf/392975main_Rover_Races_Activity.pdf

ADDITIONAL RESOURCES

Station Robotic Arm: Canada contributed an essential component of the International Space Station, the Mobile Servicing System. This robotic system plays a key role in space station assembly and maintenance: moving equipment and supplies around the station, supporting astronauts working in space, and servicing instruments and other payloads attached to the space station. Astronauts receive robotics training to enable them to perform these functions with the arm.
http://www.nasa.gov/mission_pages/station/structure/elements/mss.html

Robonaut 2: Latest generation of the Robonaut astronaut helpers, launched to the space station aboard Space Shuttle Discovery on the STS–133 mission in 2011. It is the first humanoid robot in space, and although its primary job for now is teaching engineers how dexterous robots behave in space, the hope is that through upgrades and advancements, it could one day venture outside the station to help spacewalkers make repairs or additions to the station or perform scientific work.
http://www.nasa.gov/mission_pages/station/main/robonaut.html

Mars Science Laboratory: Unmanned robotic rover designed to land on Mars and assess whether Mars ever was, or is still today, an environment able to support microbial life to determine the planet's habitability. The rover, named Curiosity, is about the size of a small sport-utility vehicle. It will carry an advanced suite of instruments to study Martian terrain and soil.
http://sse.jpl.nasa.gov/missions/profile.cfm?MCode=MarsSciLab

Curiosity Robot Cam: Curiosity Cam takes you inside the clean room at NASA's Jet Propulsion Laboratory in Pasadena, California, so you can watch the next Mars rover being built. The camera may be turned off periodically for maintenance. The rover may occasionally be out of view as it is moved around the clean room. When Curiosity Cam is off air, you will see a slideshow of Mars and rover images.
http://www.nasa.gov/mission_pages/msl/building_curiosity.html

NASA Robotics: Find out how NASA plans to create a human, technical, and programmatic resource of robotics capabilities to enable the implementation of future robotic space exploration missions.
http://robotics.nasa.gov/

eClips: Real World: Robotic Arm; Real World: TriATHLETE—The Engineering Design Process in Action; NASA 360 Mind Body Connection.
http://www.nasa.gov/audience/foreducators/nasaeclips/search.html?terms=robotics

Athena: Designed for the Mars Explorer Rover Mission launched in 2003. These rovers are even smarter and bigger rovers! This "super-rover" will be much like a roving geologist on Mars.
http://athena.cornell.edu/

LAPIS: Originated as an educational program designed to involve school students in testing the Mars Sample Return prototype rover, FIDO. Lapis is a blue stone first mined in Afghanistan in 4000 BC and believed to give good judgement.
http://wufs.wustl.edu/lapis2/

DISCUSSION QUESTIONS

- Ask the students to share their tables and discuss the outcomes. *Answer will vary.*
- Instruct students to search for other NASA missions utilizing robots, here on Earth or elsewhere. *Answers will vary.*
- What do you think would be the hardest challenge about driving a remote vehicle on another planet? *Energy source, controlling the vehicle, and getting the vehicle there.*
- What changes could you have made that would have given you better results? *Improve on calibrating tools, have a better control, have more trial and take the average.*

ASSESSMENT ACTIVITIES
Review the tables or charts created by your students.

ENRICHMENT

- Students can enter FIRST LEGO Robotics Competitions: http://robotics.arc.nasa.gov/events/2011_sponsorship.php
- NASA Robotics: http://robotics.nasa.gov/students/sumo.php
- Robotics Summer Camps: http://robotics.nasa.gov/students/summer_camps.php
- NASA–KSC Luna-Botics : http://www.nasa.gov/offices/education/centers/kennedy/technology/lunabotics.html