Space Place: Make a Balloon-Powered Nanorover

NASA SUMMER OF INNOVATION

UNIT
Engineering—Design Process

GRADE LEVELS
7 – 9

CONNECTION TO CURRICULUM
Science and Technology

TEACHER PREPARATION TIME
40 minutes

LESSON TIME NEEDED
1 hour *Complexity : Moderate*

LESSON DESCRIPTION

Design and build a robotic rover with cardboard and a balloon**.**

OBJECTIVES

Students will

- Design a rover using patterns and materials provided
- Investigate the engineering challenges of wheels, speed, and friction
- Examine the concept of a prototype in engineering
- Demonstrate the use of potential and kinetic energy
- Explain ways the rover can be used in space travel and exploration

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
- Skills necessary to become independent inquirers about the natural world
- Dispositions to use the skills, abilities, and attitudes associated with science

Physical Science Standards

- Motions and Forces
- Transfer of Energy

Science and Technology Standards

- Abilities of technological design
- Understanding about science and technology

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

Research and Information Fluency

- Plan strategies to guide inquiry
- Process data and report results

Critical Thinking, Problem Solving, and Decision Making

- Plan and manage activities to develop a solution or complete a project

MANAGEMENT
Read the directions carefully and gather all of the materials. Build a sample rover. Ask the students to work in small groups no larger than three in a group.

MATERIALS
- 3 large Styrofoam meat trays (at least 9 by 11 inches)
- Ruler
- 4 flexible plastic drinking straws
- 3 small (10-inch) bamboo skewers (for making shish-kabobs)
- 7 pea-sized blobs of clay or Play-doh© or 7 small gum drops
- 1 large wire paper clip
- 1 small (7-inch) party balloon
- 1 small rubberband
- Transparent tape (not the removable kind)
- Printed pattern, decals, and wheel treads (all on 2 sheets of paper)

CONTENT RESEARCH
The nanorover was designed to attach to a spacecraft going to Asteroid 4660 Nereus in 2002. Just a couple of inches high ("nano" meaning very tiny) and built by the NASA's Jet Propulsion Laboratory, the rover was designed to explore the surface of the asteroid and to take pictures. Read the information on the nanorover and the intent of using the nanorover on the asteroid mission. http://spaceplace.nasa.gov/nanorover/en/
There are several additional activities for this lesson on the Space Place.

Key Concepts:

Asteroid: Rocky space objects varying in size between a few feet wide to a few hundred miles wide. Most orbit between Mars and Jupiter.
MUSES-CN: Mission for nanovers that was scrubbed due to cost and weight.
Nanorover: The robot is a small motorized vehicle that is just a couple of inches high called a nanorover ("nano" meaning very tiny). The rover will explore the surface of the asteroid and take pictures.
Robot: Machine or device that operates automatically or by remote control.

Read more at http://www.answers.com/topic/robot#ixzz1K07FOktG

LESSON ACTIVITIES

Build a Nanorover—Use cardboard and a balloon to power a rover across the floor:
http://spaceplace.nasa.gov/en/kids/muses_nanorover.pdf

Be glad you are not a Cyclops: Stereo vision:
http://spaceplace.jpl.nasa.gov/en/kids/urbie_action.shtml

MARSDIAL: Show Me the Way to Go Home:
http://marsrovers.jpl.nasa.gov/classroom/marsdial/activity02.html

RELATED RESOURCES
Asteroid Lithograph: http://www.nasa.gov/pdf/62205main_Asteroids.Lithograph.pdf

Rover Photo Gallery: http://www.nasa.gov/mission_pages/mer/multimedia/gallery/gallery-index.html

Rovers: Life on Mars: http://marsrovers.jpl.nasa.gov/home

Robotics Alliance Web Page: http://robotics.nasa.gov/

Send a Postcard to Spirit: http://beamartian.jpl.nasa.gov/spiritpostcards

Lunar Rovers and the Future of Robotic Rovers Web Site:
http://lunarscience.arc.nasa.gov/articles/nasa-budget-to-fund-robotic-lunar-exploration

Mars Rover YouTube:
http://www.youtube.com/watch?v=UyM1bgKWzngONS

DISCUSSION QUESTIONS

1. Look at your rover and discuss and list the features found on cars designed for use on Earth. What kinds of Earth vehicles are similar to rovers? *Snowmobiles, tanks, dune buggies, and all-terrain vehicles are similar. They all have good traction, are very stable, have powerful engines, and do not require a roadway.*

2. What features are needed for rovers that are unique to their mission? *Kids see that engineers face special design challenges when developing equipment to be used in space.*

3. Why do engineer build prototypes? *With a prototype, kids can quickly see what is working and what is not. They then know where to make improvements.*

4. How does friction affect your rover? How can you overcome friction in your design? *To be efficient, there needs to be minimal friction between the axle and the axle hole in the cardboard and there needs to be lots of friction between the wheels and the ground to move the rover.*

5. How did the rover use potential and kinetic energy? *Potential energy is energy that is stored. Kinetic energy is the energy of motion. Winding the front wheels increased the amount of potential energy stored by the rubber band. When the wheels spin, this potential energy is turned into kinetic energy, and the axle and wheels turn.*

ASSESSMENT ACTIVITIES

Ask the students to make presentations of their rovers with an explanation of the design challenges they faced building them. Data showing speed, potential, and kinetic energy also should be presented. An explanation of how rovers are used in space exploration should be included.

ENRICHMENT

1. Determine the effect of friction.
2. Graph the effect of increased potential energy on the distance traveled (amount of air in the balloon).
3. Test the effect of different wheels on the rovers.
4. Report on the three Mars rovers and their missions.