ROBOTIC EXPLORATION OF MOON AND MARS: THEMATIC EDUCATION APPROACH

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Introduction: Safe, sustained, affordable human and robotic exploration of the Moon, Mars, and beyond is a major NASA goal. Robotic exploration of the Moon and Mars will help pave the way for an expanded human presence in our solar system. To help share the robotic exploration role in the Vision for Space Exploration with classrooms, informal education groups, and the public, our team researched and consolidated the thematic story components and associated education activities into a useful education materials set for educators. We developed the set of materials for a workshop combining NASA Science Mission Directorate and Exploration Systems Mission Directorate engineering, science, and technology to train informal educators on education activities that support the robotic exploration themes. A major focus is on the use of robotic spacecraft and instruments to explore and prepare for the human exploration of the Moon and Mars.

Robotic Exploration Themes – Connection to NASA's Story:

What Is a Robot?
Learning about the present and future use of robots to explore.

Why Robots?
Robots have the potential to enhance exploration capabilities, increase overall mission safety and success, and handle failures and unpredicted events effectively. Robots can do work instead of humans, as well as work along side of humans increasing the overall performance and reducing risks.

Human Robot Interface –
Extensive human-robot interface is required in the return of humans to the Moon in preparation for human exploration of Mars

Robotic Exploration for Outposts – Paving the Way
Robotic missions will precede the humans with the important objectives of landing site reconnaissance, natural resource assays, and reducing risk to humans and the machines that will support their presence on the moon.

People: Who Gets the Job Done?
The success of robotic and human exploration of the Moon and Mars depends on many individuals representing broad and diverse skill sets.

Getting There-Rocketry and Propulsion
Rocket design and propellants are important in balancing payload versus cost and ability to leave Earth's gravitational pull.

Getting There: Orbital Mechanics-Trajectory and Navigation
Orbital mechanics is a companion to the challenges of rocketry.

Trail Blazers History of Lunar Exploration/Mars Exploration
Looking back can often provide a rich context for considering present and future endeavors. In our return to the Moon and preparing for a human presence on the surface of Mars, using the previous moon and Mars exploration missions has an additional value.

Earth-based Observation of the Moon and Mars: The Moon in our Backyard
Human exploration of the moon began with human observation of the Moon from Earth.

How We Explore
Essential robotic exploration topics provide a structure to distinguish between human and robotic exploration.

Why We Explore
NASA has stated six reasons for robotic and human exploration of the Moon: human civilization, scientific knowledge, exploration preparation, global partnerships, economic expansion, and public engagement. Each of these reasons can also apply to Mars exploration.

Thematic Robotic Exploration Resources:

What Is a Robot? – Design Squad WGBH Boston– simple engineering activities
http://pbskids.org/designsquad/

Why Robots? – Robotic End Effectors – classroom activities
http://www.thetech.org/exhibits/online/robotics/activities/page04.html

Robotic Exploration for Outposts-Paving the way – Moon Mining
http://ksnn.larc.nasa.gov/21Century/p7.html -- click on Educator Section on right
From 21ST Century Explorers -- Simple activity using effervescent
tablets and filters to illustrate searching for resources.

Getting There-Rocketry and Propulsion – Newton Car – investigate changing design and load
Rockets –An Educator Guide –NASA
http://www.nasa.gov/audience/foreducators/topnav/materials/listbytype/Rockets.html

Trail Blazers History of Lunar Exploration/Mars Exploration – Chariots for Apollo: A History of Manned
Lunar Spacecraft http://history.nasa.gov/SP-4205/contents.html

Earth-based Observation of the Moon and Mars: The Moon in our Backyard – Oreo Moon Phases
http://www.lpi.usra.edu/education/explore/news/archive/dec_2006/index.shtml
Students use Oreo cookies to demonstrate the phases of the Moon.

How We Explore – Mission: Moon Activity
http://www.lpi.usra.edu/education/explore/LRO/activities/mission_moon/
In teams participants gather information about potential landing sites on the Moon based on existing information and ideas.

Conclusion: The Robotic Exploration of Moon and Mars education materials provide a thematic approach and a concentrated resource of activities that will allow educators to comfortably and inexpensively share the excitement and science of the robotic exploration with students and the public. NASA seeks to connect with young learners through formal and informal programs that inspire and motivate the next generation of explorers to pursue careers in science, technology, engineering, and mathematics. The Robotic Exploration of Moon and Mars materials, through science and applied engineering design, will assist educators in reaching young explorers.