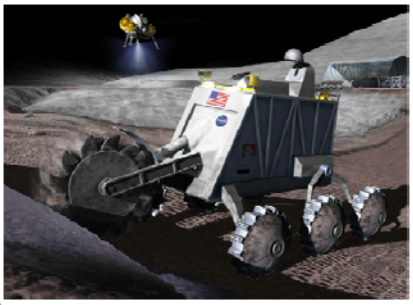
NASA's Exploration Systems Mission Directorate

is proud to announce the inaugural

Lunabotics Mining Competition

May 25-28, 2010

Astronaut Hall of Fame
Kennedy Space Center, Florida



Purpose:
The purpose of the Lunabotics Mining Competition is to engage and retain students in Science, Technology, Engineering, and Math (STEM) in a competitive environment which may result in innovative ideas and solutions that could be applied to actual lunar excavation for NASA.

Eligibility:
Undergraduate and graduate student teams enrolled in a U.S. college or university are eligible to enter the inaugural Lunabotics Mining Competition.

Design teams must include:

- One faculty or industry advisor with a college or university affiliation and
- Two or more undergraduate or graduate students.

A group of universities may also work in collaboration on an excavator project entry. Multidisciplinary teams are encouraged. Collaborations between majority institutions and minority serving institutions are encouraged. Corporate sponsorship is allowed. Click on link for information on available excavator project funding by NASA.

Important Dates:
Excavator Project proposals accepted from August 1, 2009 through February 28, 2010
Competition Registration Deadline: February 28, 2010
Collaboration Notification due: February 28, 2010
Systems Engineering Paper due: April 15, 2010
Slide Presentation due: April 15, 2010
Outreach Report due: April 15, 2010
Practice Days: May 25-26, 2010
Competition Days: May 27-28, 2010

The Lunabotics Mining Competition will be similar to NASA's Regolith Excavation Centennial Challenge. Until the Lunabotics Mining Competition official rules are posted to this website, refer to rules and regulations for the Regolith Excavation Challenge at: http://regolith.csewi.org/rulesandregistration.

Prizes:
In addition to prizes listed below, school plaques and individual certificates will be awarded for exemplary performance in the following Lunabotics Mining Competition categories:

Category	Required/ Optional	Due Dates	Prizes	Maximum Points
Lunabotics Mining (On-Site in Sand Box)	Required	Registration: February 28, 2010 Practice: May 25-26, 2010 Competition: May 27-28, 2010	1st Place $5,000 and VIP KSC launch tickets	30
			2nd Place $2,500 and VIP KSC launch tickets	25
			3rd Place $1,000 and VIP KSC launch tickets	20
Systems Engineering Paper	Required	April 15, 2010	$500	20
Outreach to Informal Education or K-12 Education	Required	April 15, 2010	$500	20
Slide Presentation	Optional	April 15, 2010	$500	20
Team Spirit Competition	Optional	May 27-28, 2010	$500	15
Collaboration between a majority school with a designated minority serving institution	Optional	February 28, 2010		10 bonus points
Digital video of the team's lunar regolith excavator design and building process for the competition documentary	Optional	May 25, 2010 (at check-in)		5 bonus points
Multidisciplinary Teams - 1 bonus point for each engineering discipline on team	Optional	February 28, 2010		up to 10 bonus points
Joe Kosmo Award for Excellence (Highest Cumulative Score)			Trophy, KSC VIP launch tickets, and up to $1,500 travel for each team member & 1 advisor to attend NASA Desert RATS	130 max

Disclaimer:
In the case of a tie, the prize(s) will be equally divided between all teams tied for first, second, or third place. For example: In the case of only two teams qualifying for a prize and tying for first place in the excavator performance category, each would receive $3,750 and the third prize amount of $1,000 would not be awarded. Judges' decisions will be final.

Winning the Lunabotics Mining Category:
The challenge will be conducted in a "head to head" format, in which the teams will be required to perform a competition attempt using the regolith simulant, sandbox and collector provided by NASA. NASA will fill the sandbox with regolith simulant, compact it, and place rocks in the sandbox. Each competition attempt will occur sequentially. Between each competition attempt, the rocks will be removed, the regolith will be returned to a compacted state and the rocks will be returned to the sandbox. Consideration of prize awards will be based on each team's performance during the official competition attempt. All excavated mass deposited in the collector during the competition attempt will be weighed after completion of the competition attempt. The teams that excavate the first, second, and third most lunar regolith simulant mass over the minimum excavation requirement within the time limit will respectively win first, second, and third place prizes. Official Rules TBD. Students, check back at a later date.

Winning the Other Categories:
Prizes will be awarded to the qualifying entries with the highest score in each of the other categories. Minimum scores on the following scoring rubrics are required to qualify in each category. Awards for these categories are not dependent on the on-site performance of the excavator.

Category Details and Scoring Rubric

Lunabotics Mining Systems Engineering Paper

Each team must submit a Lunabotics Mining Systems Engineering Paper electronically in PDF format to Susan Sawyer @ Susan.G.Sawyer@nasa.gov by April 15, 2010. Cover page must include: team name; title of paper; full names of all team members; university name; and faculty advisor's full name. Appendices are not included in the page limitation and the judges are not obligated to consider lengthy appendices in the evaluation process. A minimum score of 15 out of 20 possible points must be achieved to qualify to win in this category. In the case of a tie in the score, the judges will choose the winning Systems Engineering Paper. The judges' decision is final. The team with the winning Systems Engineering Paper will receive a team plaque, individual certificates, $500, and the paper will be featured at the Lunabotics Mining Competition Awards Ceremony on May 28, 2010.

Systems Engineering Paper Scoring Rubric				
Elements	**4**	**3**	**2**	**1**
Content: • Cover Page • Introduction • Purpose • Body of Paper • Sources	All five elements are clearly demonstrated.	Four elements are clearly demonstrated.	Three elements are clearly demonstrated.	Two or less elements are clearly demonstrated.
Intrinsic Merit (Quality and Feasibility): • Deliverables identified • Budget • Schedule • Major Reviews: SRR, PDR, & CDR	All four elements are clearly demonstrated.	Three elements are clearly demonstrated.	Two elements are clearly demonstrated.	One or less elements are clearly demonstrated.
Technical Merit: • Requirements definition • Requirement flow-down to validation & checkout • Tradeoff assessment • Risk assessment • Interfaces defined	All five elements are clearly demonstrated.	Four elements are clearly demonstrated.	Three elements are clearly demonstrated.	Two or less elements are clearly demonstrated.
Illustrations: • Relevant • Supports the technical content • Uses graphs effectively • Uses tables effectively	All four elements are clearly demonstrated.	Three elements are clearly demonstrated.	Two elements are clearly demonstrated.	One or less elements is clearly demonstrated.
Formatting & Appearance: • Clearly organized • Correct grammar & spelling • 10 – 15 pages; 12 font size; single spaced (Cover page, references and appendices excluded in page limit) • Sources referenced	All four elements are clearly demonstrated.	Three elements are clearly demonstrated.	Two elements are clearly demonstrated.	One or less elements is clearly demonstrated.

Lunabotics Mining Outreach Project

All teams must participate in an educational outreach project. Outreach examples include actively participating in school career days, science fairs, technology fairs, extracurricular science or robotic clubs, or setting up exhibits in local science museums or a local library. Other ideas include organizing a program with a Boys and Girls Club, Girl Scouts, local library, museum, etc… Teams are encouraged to have fun with the outreach project and share knowledge of science, robotics, and engineering with the local community.

Each team must submit a report of the Outreach Project electronically in PDF format to Susan Sawyer @ Susan.G.Sawyer@nasa.gov by April 15, 2010. Cover page must include: team name; title of paper; full names of all team members; university name; and faculty advisor's full name. A minimum score of 15 out of 20 possible points must be achieved to qualify to win in this category. In the case of a tie in the score, the judges will choose the winning outreach project. The judges' decision is final. The team with the winning Lunabotics Mining Outreach project will receive a team plaque, individual certificates, $500, and the project will be featured at the Lunabotics Mining Competition Awards Ceremony on May 28, 2010.

Outreach Project Scoring Rubric				
Elements	**4**	**3**	**2**	**1**
Content: • Introduction • Outreach Recipient Group Identified • Purpose • Cover Page	All four elements are clearly demonstrated.	Three elements are clearly demonstrated.	Two elements are clearly demonstrated.	One element is clearly demonstrated.
Educational Outreach: • Inspires K-12 students to learn about robotics, engineering, or lunar activities • Engages K-12 students in robotics, engineering, or lunar activities • Offers hands-on activities to K-12 students	All three elements are clearly demonstrated.	Two elements are clearly demonstrated.	One element is clearly demonstrated.	No elements are clearly demonstrated.
Creativity: • Inspirational • Engaging • Material corresponds to students' grade level	All three elements are clearly demonstrated.	Two elements are clearly demonstrated.	One element is clearly demonstrated.	No elements are clearly demonstrated.
Illustrations & Media: • Appropriate • Shows the Outreach Project • Pictures	All three elements are clearly demonstrated.	Two elements are clearly demonstrated.	One element is clearly demonstrated.	No elements are clearly demonstrated.
Formatting & Appearance: • Correct grammar & spelling • 5 page limit (Cover page and appendices excluded in page count.) • Clearly organized	All three elements are clearly demonstrated.	Two elements are clearly demonstrated.	One element is clearly demonstrated.	No elements are clearly demonstrated.

Lunabotics Mining Slide Presentation

Must be submitted electronically by April 15, 2010 in PDF format to:
Susan Sawyer @ Susan.G.Sawyer@nasa.gov

The Lunabotics Mining Slide Presentation is an optional category in the overall competition. A cover slide must contain the team name; title of presentation; full names of all team members; university name; and faculty advisor's full name. A minimum score of 15 out of 20 possible points must be achieved to qualify to win in this category. In the case of a tie in the score, the judges will choose the winning presentation. The judges' decision is final. The team with the winning presentation will receive a team plaque, individual certificates, $500, and will present presentation at the Lunabotics Mining Competition Awards Ceremony on May 28, 2010.

Slide Presentation Scoring Rubric				
Elements	**4**	**3**	**2**	**1**
Content: • Cover slide • Introduction • Purpose • Stand alone • Sources referenced	All five elements are clearly demonstrated.	Four elements are clearly demonstrated.	Three elements are clearly demonstrated.	Two or less elements are clearly demonstrated.
Technical Merit: • Requirements definition • Requirement flow-down to validation & checkout • Tradeoff assessment • Interfaces defined • Excavator functionality	All five elements are clearly demonstrated.	Four elements are clearly demonstrated.	Three elements are clearly demonstrated.	Two or less elements are clearly demonstrated.
Creativity: • Innovative • Inspirational • Engaging	All three elements are clearly demonstrated.	Two elements are clearly demonstrated.	One element is clearly demonstrated.	No elements are clearly demonstrated.
Illustrations & Media: • Appropriate • Supports the technical content • Shows progression of project • Clearly presents design of excavator	All four elements are clearly demonstrated.	Three elements are clearly demonstrated.	Two elements are clearly demonstrated.	One or less elements is clearly demonstrated.
Formatting & Appearance: • Proper grammar • Correct spelling • Copy edited • Readable • Aesthetically pleasing	All five elements are clearly demonstrated.	Four elements are clearly demonstrated.	Three elements are clearly demonstrated.	Two or less elements are clearly demonstrated.

Lunabotics Mining Team Spirit Competition

The Lunabotics Mining Team Spirit Competition is an optional category in the overall competition. A minimum score of 10 out of 15 possible points must be achieved to qualify to win in this category. In the case of a tie in the score, the judges will choose the winning team. The judges' decision is final. The team winning the Team Spirit Award at the Lunabotics Mining Competition will receive a team plaque, individual certificates, $500, and will be featured at the Lunabotics Mining Competition Awards Ceremony on May 28, 2010.

Team Spirit Competition Scoring Rubric			
Elements	**3**	**2**	**1**
Teamwork: • Exhibits teamwork in and out of the sandbox • Exhibits a strong sense of collaboration within the team • Supports other teams with a healthy sense of competition	All three elements are clearly demonstrated.	Two elements are clearly demonstrated.	One element is clearly demonstrated.
Attitude: • Exudes a positive attitude • Demonstrates an infectious energy • Motivates and encourages team	All three elements are clearly demonstrated.	Two elements are clearly demonstrated.	One element is clearly demonstrated.
Creativity: • Demonstrates creativity • Wears distinctive team shirts or hats • Gives out objects of fun such as pins, noise makers, etc.	All three elements are clearly demonstrated.	Two elements are clearly demonstrated.	One element is clearly demonstrated.
Engage: • Engages audience in team spirit activities • Engages other teams in team spirit activities • Makes acquaintances with members of other teams	All three elements are clearly demonstrated.	Two elements are clearly demonstrated.	One element is clearly demonstrated.
Originality: • Demonstrates originality in team activities • Displays originality in the team name • Displays originality in the team logo	All three elements are clearly demonstrated.	Two elements are clearly demonstrated.	One element is clearly demonstrated.

Collaboration between a majority school with a designated minority serving institution:
The collaboration between a majority school and a designated minority serving institution must be indicated on the team roster by February 28, 2010 to receive 10 extra points.

Video for Lunabotics Mining Competition Documentary:
Submission of digital video of the team's lunar regolith excavator design and build process is highly encouraged and may be brought to the competition on a DVD to receive 5 extra points. The actual competition will be recorded by NASA. A NASA documentary will be developed after the competition.

Multidisciplinary Engineering Teams:
Each different science, technology, engineering, or math (STEM) discipline represented will count for 1 bonus point up to a maximum of 10. Disciplines will be indicated on the team roster by February 28, 2010. No bonus points will be given in this category if a team has only one discipline represented. If a member of your team is in a science, technology, engineering, or math (STEM) discipline that is not on this list, you may e-mail Susan Sawyer at Susan.G.Sawyer@nasa.gov to request approval of that discipline for the competition.

Systems Engineering	Astronomy
Engineering Management	Astrophysics
Aerospace Engineering	Chemistry
Aeronautical Engineering	Optics
Astronautical Engineering	Physics
Chemical Engineering	Atmospheric Sciences
Civil Engineering	Geography
Environmental Engineering	Geosciences
Health Engineering	Natural Resource Management
Electrical Engineering	Oceanography
Computer Engineering	Mathematics
Software Engineering	Computer Science
Information Technology	Astrobiology
Industrial/Manufacturing Engineering	Biology
Materials/Metallurgical Engineering	Biochemistry
Mechanical Engineering	Biophysics
Nuclear Engineering	Microbiology
	Bacteriology

Competition POCs:

Susan Sawyer	Mandi Falconer
ReDe/Critique JV	ReDe/Critique JV
KSC Education Office	KSC Education Office
ESMD Space Grant Project Specialist	ESMD Space Grant Project Specialist
Voice: (321) 867-5482	Voice: (321) 867-4439
E-mail: Susan.G.Sawyer@nasa.gov	E-mail: Mandi.C.Falconer@nasa.gov

Joe Kosmo Award for Excellence

The team with the most cumulative points will win the Joe Kosmo Award for Excellence. The winner will receive a school trophy and plaque, individual certificates, KSC VIP launch tickets, and up to $1,500 travel expenses for each team member and one faculty advisor to participate with NASA Desert RATS.

What is the NASA Desert RATS?

The Desert RATS is a NASA-led team of research partners working together to prepare for human-robotic exploration. This "working group," led by NASA personnel, is comprised of both NASA and non-NASA Members.

The Desert RATS field test activity is the culmination of the various individual science and advanced engineering discipline areas year-long technology and operations development efforts into a coordinated field test demonstration under representative (analog) planetary surface terrain conditions. The purpose of the RATS effort is to drive out preliminary exploration operational concepts for EVA system requirements by providing hands-on experience with simulated planetary surface exploration extravehicular activity (EVA) hardware and procedures.

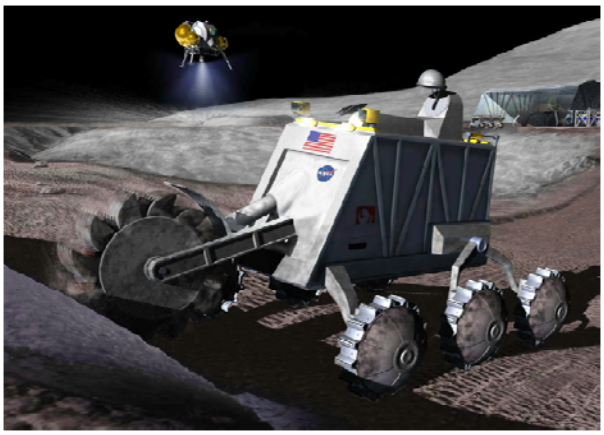
The RATS activities also are of significant importance in helping to develop the necessary levels of technical skills and experience for the next generation of engineers, scientists, technicians, and astronauts who will be responsible for realizing the goals of the Constellation Program.

NASA's Lunabotics Mining Competition is sponsored by:

Exploration Systems Mission Directorate Education

Lunar Surface Systems - Advanced Systems Division

Exploration Technology Development Program (ETDP)



Excavator Project Support

Lunar Regolith Excavator Senior Design Course Curriculum:
The Lunar Regolith Excavator Senior Design Course Curriculum has been developed by Dr. David Beale, Auburn University for NASA and is available at: http://education.ksc.nasa.gov/esmdspacegrant/LunarRegolithExcavator.htm. **This curriculum has a whole section devoted to systems engineering.**

Excavator Design, Build, & Compete Project Funds:
A university faculty advisor or student team may propose for up to $5,000 to support a student team to design and build a lunar regolith excavator and for travel expenses to compete in the Lunabotics Mining Competition at Kennedy Space Center the week of May 25-28, 2010.

Team proposals must adequately address the following areas:

- team roster including students' names and e-mail addresses (if known);
- faculty advisor's name and e-mail address; college or university;
- plan and commitment to use a systems engineering approach to design, build and verify a lunar regolith excavator;
- outreach plan;
- budget request and plan;
- schedule for completion of the excavator in time for competition;
- collaboration with minority universities plan (optional, but encouraged);
- plan for multidisciplinary engineering team (optional, but encouraged);
- plan for recording video of the project (optional, but encouraged); and
- commitment to compete in the Lunabotics Mining Competition at Kennedy Space Center during the week of May 25-28, 2010.

Approved proposals will be funded on a first come/first serve basis by NASA through the National Space Grant Foundation. $50,000 has been set aside for this purpose. Proposals will be accepted electronically between August 1, 2009 and February 28, 2010 to:

Susan Sawyer
E-mail: Susan.G.Sawyer@nasa.gov

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