

NASA's Lunabotics Mining Competition

2011 Rules & Rubrics

November 23, 2010

Kennedy Space Center, Florida



Introduction

NASA's Lunabotics Mining Competition is designed to promote the development of interest in space activities and STEM (Science, Technology, Engineering, and Mathematics) fields. The competition uses excavation, a necessary first step towards extracting resources from the regolith and building bases on the moon. The unique physical properties of lunar regolith and the reduced 1/6th gravity, vacuum environment make excavation a difficult technical challenge. Advances in lunar regolith mining have the potential to significantly contribute to our nation's space vision and NASA space exploration operations. The competition will be conducted by NASA at Kennedy Space Center. The teams that can use telerobotic or autonomous operation to excavate the most lunar regolith simulatn within a 15-minute time limit will win the competition. The minimum excavation requirement is 10.0 kg, and the excavation hardware mass limit is 80.0 kg. Winners are eligible to receive first, second, or third place awards of \$5,000, \$2,500, and \$1,000, respectively.

Undergraduate and graduate student teams enrolled in a U.S. or international college or university are eligible to enter the Lunabotics Mining Competition. Design teams must include: at least one faculty with a college or university and two or more undergraduate or graduate students. Teams will compete in up to five categories including: on-site mining, systems engineering paper, outreach project, slide presentation (optional), and team spirit (optional). Additionally, teams can earn bonus points toward the Joe Kosmo Award for Excellence multidisciplinary teams and collaboration between a majority and U.S. minority serving institutions earn. All documents must be submitted in English.

Awards include monetary scholarships, a school trophy or plaque, individual certificates, KSC launch invitations, and up to \$1,500 travel expenses for each team member and one faculty advisor to participate with the NASA Desert RATS as the winners of the Joe Kosmo Award for Excellence. Award details are available at www.nasa.gov/lunabotics.

The Lunabotics Mining Competition is a student competition that will be conducted in a positive professional way. So this is a reminder to be courteous in your correspondence and on-site at the competition because unprofessional behavior or unsportsmanlike conduct will not be tolerated and will be grounds for disqualification.

Game Play Rules

- 1) These rules and specifications may be subject to future updates by NASA at its sole discretion.
- 2) Teams will be required to perform 1 official competition attempt using lunar regolith simulant, Lunarena and collector provided by NASA. NASA will fill the Lunarena with compacted lunar regolith simulant that matches as closely as possible to the lunar regolith described in the Lunar Sourcebook: A User's Guide to the Moon, edited by G. H. Heiken, D. T. Vaniman, and B. M. French, copyright 1991, Cambridge University Press. NASA will randomly place 3 obstacles and create 2 craters on each side of the Lunarena. Each competition attempt will occur with 2 teams competing at the same time, 1 on each side of the Lunarena. After each competition attempt, the obstacles will be removed, the lunar regolith simulant will be returned to a compacted state, and the obstacles will be returned to the Lunarena. See the Lunarena Diagrams on page 7.
- 3) In the official competition attempt, the teams that acquire (and deliver into the collector container) the first, second, and third most mass by excavating lunar regolith simulant over the minimum excavation requirement (10 kg) within the time limit (15 minutes) will respectively win first, second, and third place awards. In the case of a tie, the teams will compete in a head-to-head round, where the team that acquires the most lunar regolith simulant in that round wins.
- 4) All excavated mass deposited in the collector during the official competition attempt will be weighed after completion of the competition attempt. Any obstacles deposited in the collector will be removed from the lunar regolith simulant collected.
- 5) The excavation hardware shall be placed in the randomly designated starting zones. The order of teams will be randomly chosen throughout the competition.
- 6) A team's excavation hardware shall only excavate lunar regolith simulant located in that team's respective mining zone at the opposite end of the Lunarena from the team's starting zone. The team's exact starting point and traversal direction will be randomly selected immediately before the competition attempt.
- 7) The excavation hardware is required to move across the obstacle zone to the mining zone and then move back to the collector box to deliver the simulant into the collector box. See the Lunarena Diagrams on page 7.
- 8) Each team is responsible for placement and removal of their excavation hardware onto the lunar regolith simulant surface. There must be 1 person per 23 kg of mass of the excavation hardware, requiring 4 people to carry the maximum allowed mass. Assistance will be provided if needed.
- 9) Each team is allotted a maximum of 10 minutes to place the excavation hardware in its designated starting position within the Lunarena and 5 minutes to remove the excavation hardware from the Lunarena after the 15-minute competition attempt has concluded.
- 10) The excavation hardware operates during the 15-minute time limit of the competition attempt. The 15-minute time limit will be reduced if a team is not ready at the team's competition attempt start time. Time will start even if a team is still setting up their excavator after the 10 minute setup time period has elapsed. The competition attempt for both teams in the Lunarena will end at the same time.
- 11) The excavation hardware will end operation immediately when the power-off command is sent, as instructed by the competition judges.
- 12) The excavation hardware cannot be anchored to the lunar regolith simulant surface prior to the beginning of the competition attempt.
- 13) Each team will be permitted to repair or otherwise modify the excavation hardware after the team's practice time. The excavation hardware will be inspected the evening before the competition takes place and quarantined until just before the team's competition attempt. Batteries will not be quarantined and may continue to charge.

Field Rules

- 14) At the start of the competition attempt, the excavation hardware may not occupy any location outside the defined starting zone. At the start of each competition attempt the starting location and direction will be randomly determined.
- 15) The collector box top edge will be placed so that it is adjacent to the side walls of the Lunarena without a gap and the height will be approximately 1 meter from the top of the simulant surface directly below it. The collector top opening will be 1.65 meters long and .48 meters wide. See the Lunarena Diagrams on page 7. A target may be attached to the collector for navigation purposes only. This navigational aid must be attached during the setup time and removed afterwards during the removal time period. The mass of the navigational aid is included in the maximum excavation hardware mass limit of 80.0 kg and must be self-powered.
- 16) There will be 3 obstacles placed on top of the compressed lunar regolith simulant surface within the obstacle zone before the competition attempt is made. The placement of the obstacles will be randomly selected before the start of the competition attempt. Each obstacle will have a diameter of approximately 20 to 30 cm and an approximate mass of 7 to 10 kg. Obstacles placed in the collector will not be counted as part of the excavated mass. There will be 2 craters of varying depth and width, being no wider or deeper than 30cm. No obstacles will be intentionally buried in the simulant by NASA, however, simulant includes naturally occurring rocks.
- 17) Excavation hardware must operate within the Lunarena: it is not permitted to pass beyond the confines of the outside wall of the Lunarena and the collector during the competition attempt. The regolith simulant must be collected in the mining zone allocated to each team and deposited in the collector. The team may only dig in its own mining zone. The simulant must be carried from the mining zone to the collector by any means. The excavator can separate intentionally, if desired, but all parts of the excavator must be under the team's control at all times. Any ramming of the wall may result in a safety disqualification at the discretion of the judges. A judge may disable the excavator by pushing the [red](#) emergency stop button at any time.
- 18) The excavation hardware must not push lunar regolith simulant up against the wall to accumulate lunar regolith simulant.
- 19) If the excavation hardware exposes the Lunarena bottom due to excavation, touching the bottom is permitted, but contact with the Lunarena bottom or walls cannot be used at any time as a required support to the excavation hardware. Teams should be prepared for airborne dust raised by either team during the competition attempt.

Technical Rules

- 20) During the competition attempt, excavation hardware is limited to autonomous and telerobotic operations only. No physical access to the excavation hardware will be allowed during the competition attempt. In addition, telerobotic operators are only allowed to use data and video originating from the excavation hardware. Visual and auditory isolation of the telerobotic operators from the excavation hardware in the Mission Control Room is required during the competition attempt. Telerobotic operators will be able to observe the Lunarena through fixed overhead cameras on the Lunarena through monitors that will be provided by NASA in the Mission Control Room. These monitors should be used for situational awareness only. The Lunarena will be outside in an enclosed tent.
- 21) Mass of the excavation hardware shall not exceed 80.0 kg. Subsystems on the excavator used to transmit commands/data and video to the telerobotic operators are counted towards the 80.0 kg mass limit. Equipment not on the excavator used to receive commands from and send commands to the excavation hardware for telerobotic operations is excluded from the 80.0 kg mass limit.
- 22) The excavation hardware must be equipped with an easily accessible [red](#) emergency stop button (kill switch) of minimum diameter 5 cm on the surface of the excavator requiring no steps to access. The emergency stop button must stop excavator motion and disable all power to the excavator with 1 push motion on the button.

23) The communications rules used for telerobotic operations follow:

A. LUNABOT WIRELESS LINK

1. Each team will provide the wireless link (access point, bridge, or wireless device) to their Lunabot
 - a. KSC will provide an elevated network drop (Female RJ-45 Ethernet jack) in the Lunarena that extends to the control room, where we will have a network switch for the teams to plug in their laptops
 - i. The network drop in the Lunarena will be elevated high enough above the edge of the regolith bed wall to provide adequate radiofrequency visibility of the competition pit.
 - ii. A shelf will be setup next to the network drop and located 4 to 6 feet off the ground and will be no more than 50 feet from the Lunabot. This shelf is where teams will place their Wireless Access Point (WAP) to communicate with their rover.
 - iii. The WAP shelves for side A and side B of the regolith pit will be no closer than 25' from each other to prevent electromagnetic interference (EMI) between the units.
 - b. NASA will provide a standard 110VAC outlet by the network drop. Both will be no more than 2 feet from the shelf.
 - c. During setup time before the match starts the teams will be responsible for setting up their access point.
2. The teams must use the USA IEEE 802.11 b/g standard for their wireless connection (WAP and rover client) Teams cannot use multiple channels for data transmission. Encryption is not required but it is highly encouraged to prevent unexpected problems with team links.
 - a. During a match, one team will operate on channel 1 and the other team will operate on channel 11.
 - b. The channel assignments will be made either upon check-in or a few weeks prior to the event.
3. Each team will be assigned an SSID that they must use for their wireless equipment.
 - a. SSID will be "Team_###"
 - b. Teams shall broadcast their SSID
4. Bandwidth constraints:
 - a. There will not be a peak bandwidth limit.
 - b. Teams will be awarded in some way for using the least amount of total bandwidth during the timed and NASA monitored portion of the competition.
 - c. The communications link is required to have an average bandwidth of no more than 5 megabits per second.

B. RF & COMMUNICATIONS APPROVAL

1. There will be a communications judge's station where each team will have approximately 15 minutes to show the judges that their Lunabot & access point is operating only on their assigned channel.
2. To successfully pass the communications judge's station a team must be able to command their Lunabot (by driving a short distance) from their Lunabot driving/control laptop through their wireless access point. The judges will verify this and use the appropriate monitoring tools to verify that the teams are operating only on their assigned channel.
3. If a team cannot demonstrate the above tasks in the allotted time, they will be disqualified from the competition.
4. Each team will have an assigned time on Monday or Tuesday to show the judges their compliance with the rules.
5. The NASA communications team will be available to help teams make sure that they are ready for the judging station on Monday and Tuesday.
6. Once the team arrives at the judge's station, they can no longer receive assistance from the NASA communications team.
7. If a team is on the wrong channel during a match, they will be required to power down and be disqualified from that match.

C. WIRELESS DEVICE OPERATION IN THE PITS

1. Teams will not be allowed to power up their transmitters on any frequency in the pits once the practice matches begin. All teams shall have a hard-wired connection for testing in the pits.
 2. There will be designated times for teams to power up their transmitters when there are no matches underway.
- 24) The excavation hardware must be contained within 1.5m width x .75m length x 2m height. The hardware may deploy beyond the 1.5 m x .75 m footprint after the start of the competition attempt, but may not exceed a 2 meter height. The excavation hardware may not pass beyond the confines of the outside wall of the Lunarena and the collector during the competition attempt to avoid potential interference with the surrounding tent. The team must declare the orientation of length and width to the inspection judge. Because of actual lunar hardware requirements, no ramps of any kind will be provided or allowed.
- 25) To ensure that the excavation hardware is usable for an actual lunar mission, the excavation hardware cannot employ any fundamental physical processes (e.g., suction or water cooling in the open lunar environment), gases, fluids or consumables that would not work in the lunar environment. For example, any dust removal from a lens or sensor must employ a physical process that would be suitable for the lunar surface. Teams may use processes that require an Earth-like environment (e.g., oxygen, water) only if the system using the processes is designed to work in a lunar environment and if such resources used by the excavation hardware are included in the mass of the excavation hardware.
- 26) Components (i.e. electronic and mechanical) are not required to be space qualified for the lunar vacuum, electromagnetic, and thermal environments.
- 27) The excavation hardware may not use any process that causes the physical or chemical properties of the lunar regolith simulant to be changed or otherwise endangers the uniformity between competition attempts.
- 28) The excavation hardware may not penetrate the lunar regolith simulant surface with more force than the weight of the excavation hardware before the start of the competition attempt.
- 29) No ordnance, projectile, far-reaching mechanism, etc. may be used (excavator must move on the lunar regolith simulant).
- 30) No excavation hardware can intentionally harm another team's hardware. This includes radio jamming, denial of service to network, regolith simulant manipulation, ramming, flipping, pinning, conveyance of current, or other forms of damage as decided upon by the judges. Immediate disqualification will result if judges deem any maneuvers by a team as being offensive in nature. Erratic behavior or loss of control of the excavation hardware as determined by the judges will be cause for immediate disqualification.
- 31) Teams must electronically submit documentation containing a description of the excavation hardware, its operation, potential safety hazards, a diagram, and basic parts list.
- 32) Teams must electronically submit video documentation containing no less than 30 seconds of excavation hardware operation and at least 1 full cycle of operation. One full cycle of operations includes excavation and depositing material. This video documentation is solely for technical evaluation of the team's excavation hardware.

Video specifications:

Formats/Containers: .avi, .mpg, .mpeg, .ogg, .mp4, .mkv, .m2t, .mov; Codecs: MPEG-1, MPEG-2, MPEG-4 (including AVC/h.264), ogg theora; Minimum frame rate: 24 fps; Minimum resolution: 320 x 240 pixels

Definitions

Black Point-1 (BP-1) – A crushed lava aggregate with a natural particle size distribution similar to that of lunar soil. The aggregate will have a particle size and distribution similar to the lunar regolith as stated in the Lunar Sourcebook: A User's Guide to the Moon, edited by G. H. Heiken, D. T. Vaniman, and B. M. French, copyright 1991, Cambridge University Press. Teams are encouraged to develop or procure simulants based on lunar type of minerals and lunar regolith particle size, shape, and distribution.

Collector – A device provided by NASA for the competition attempt into which each team will deposit excavated regolith simulant. The collector will be large enough to accommodate each team's excavated regolith simulant. The collector will be stationary and located adjacent to the Lunarena. Excavated regolith simulant mass will be measured after completion of the competition attempt. The collector mass will not be counted towards the excavated mass or the mass of the excavation hardware. The collector will be 1.65 meters long and .48 meters wide. The collector walls will rise to an elevation of approximately 1 meter above the BP-1 surface directly below the collector. See the Lunarena Diagrams on page 7.

Competition attempt – The operation of a team's excavation hardware intended to meet all the requirements for winning the competition by performing the functional task. The duration of the competition attempt is 15-minutes.

Excavated mass – Mass of the excavated lunar regolith simulant delivered to the collector by the team's excavation hardware during the competition attempt, measured in kilograms (kg) with official result recorded to the nearest one tenth of a kilogram (0.1 kg).

Excavation hardware – Mechanical and electrical equipment, including any batteries, gases, fluids and consumables delivered by a team to compete in the competition.

Functional task – The excavation of regolith simulant from the Lunarena by the excavation hardware and deposit from the excavation hardware into the collector box.

Minimum excavation requirement – 10.0 kg is the minimum excavated mass which must be met in order to qualify to win the competition.

Power – All power shall be provided by a system onboard the excavator. No facility power will be provided to the excavator. There are no power limitations except that the excavator must be self-powered and included in the maximum excavation hardware mass limit of 80.0 kg.

Practice time – Teams will be allowed to practice with their excavators in the Lunarena. NASA technical experts will offer feedback on real-time networking performance during practice attempts.

Reference point – A fixed location on the excavation hardware that will serve to verify the starting location and traversal of the excavation hardware within the Lunarena. An arrow on the reference point must mark the forward direction of the excavator in the starting position configuration. The judges will use this reference point and arrow to orient the excavator in the randomly selected direction and position.

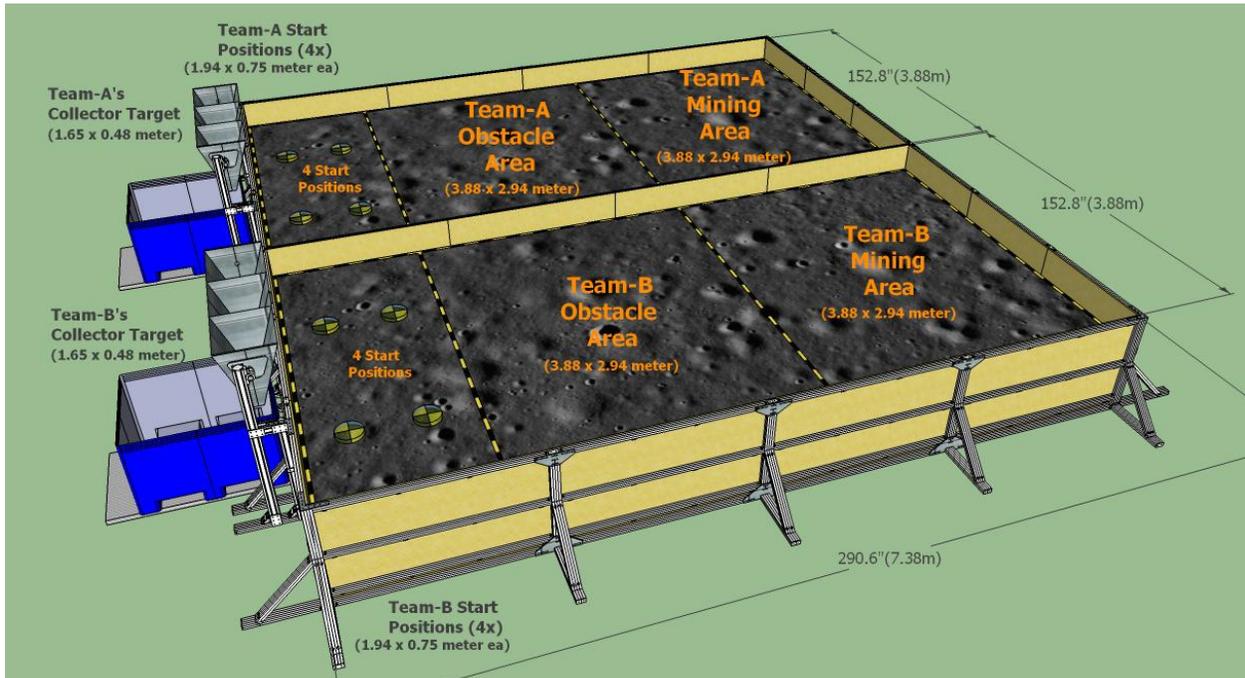
Lunabot – A teleoperated robotic excavator in NASA's Lunabotics Mining Competition.

Lunarena – An open-topped container (i.e., a box with a bottom and 4 side walls only), containing regolith simulant, within which the excavation hardware will perform the competition attempt. The inside dimensions of the each side of the Lunarena will be 7.38 meters long and 3.88 meters wide, and 1 meter in depth. A dividing wall will be in the center of the Lunarena. The Lunarena for the official practice days and competition will be provided by NASA. See the Lunarena Diagrams on page 7.

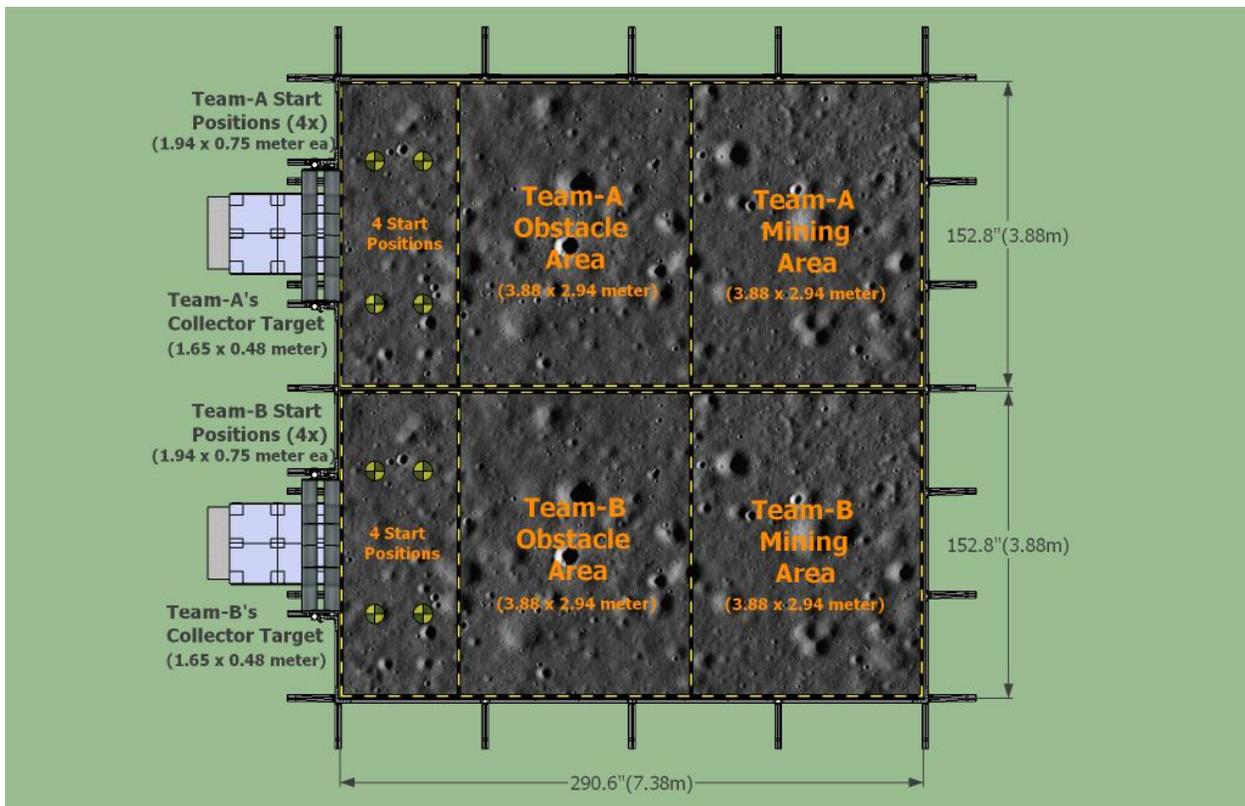
Telerobotic – Communication with and control of the excavation hardware during the competition attempt must be performed solely through the provided communications link which is required to have a total bandwidth of no more than 5.0 megabits/second on all data and video sent to and received from the excavation hardware.

Time Limit – The amount of time within which the excavation hardware must perform the functional task, set at 15 minutes; set up excavation hardware, set at 10 minutes; and removal of excavation hardware, set at 5 minutes.

Lunarena Diagrams



Lunarena Diagram (side view)



Lunarena Diagram (top view)

Lunabotics Systems Engineering Paper

Each team must submit a Systems Engineering Paper electronically in PDF by April 18, 2011. 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, 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, and a \$500 scholarship.

Lunabotics Systems Engineering Paper Scoring Rubric

Elements	4	3	2	1
Content:				
<ul style="list-style-type: none"> Formatted professionally, clearly organized, correct grammar and spelling, 10 – 15 pages; 12 font size; single spaced. Cover page Introduction Purpose 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:				
<ul style="list-style-type: none"> Deliverables identified Budget Schedule Major reviews: system requirements, preliminary design and critical design Illustrations support the technical content 	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:				
<ul style="list-style-type: none"> Concept of operations System Hierarchy Basis of design Interfaces defined Requirements definition Design margins Trade-off assessment Risk assessment Reliability Verification Requirement flow-down to validation and checkout Use of system life cycle 	One point for each element clearly demonstrated up to twelve points.			

Lunabotics 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, Boy Scouts, 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 Lunabotics Outreach Project electronically in PDF by April 18, 2011. 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, the judges will choose the winning outreach project. The judges' decision is final. The team with the winning outreach project will receive a team plaque, individual certificates, and a \$500 scholarship.

Lunabotics Outreach Project Scoring Rubric

Elements	4	3	2	1
Content:				
<ul style="list-style-type: none"> • 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:				
<ul style="list-style-type: none"> • Inspires others to learn about robotics, engineering or lunar activities • Engages others in robotics, engineering or lunar activities • Utilizes hands-on activities 	All three elements are clearly demonstrated	Two elements are clearly demonstrated	One element is clearly demonstrated	No elements are clearly demonstrated
Creativity:				
<ul style="list-style-type: none"> • Inspirational • Engaging • Material corresponds to audience's level of understanding 	All three elements are clearly demonstrated	Two elements are clearly demonstrated	One element is clearly demonstrated	No elements are clearly demonstrated
Illustrations and Media:				
<ul style="list-style-type: none"> • Appropriate • Demonstrates 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 and Appearance:				
<ul style="list-style-type: none"> • Correct grammar and spelling • Five-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 Slide Presentation

Must be submitted electronically by April 18, 2011 in PDF. The Lunabotics 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, 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, and a \$500 scholarship.

Lunabotics Slide Presentation Scoring Rubric

Elements	4	3	2	1
Content:				
<ul style="list-style-type: none"> Cover slide Introduction Purpose Stand alone – presentation will be judged prior to the competition without the benefit of a presenter 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:				
<ul style="list-style-type: none"> Final Lunabot design Design process Design decisions Lunabot functionality Safety features Special features 	All six elements are clearly demonstrated	Five elements are clearly demonstrated	Four elements are clearly demonstrated	Two or less elements are clearly demonstrated
Creativity:				
<ul style="list-style-type: none"> 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 and Media:				
<ul style="list-style-type: none"> 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 element is clearly demonstrated
Formatting and Appearance:				
<ul style="list-style-type: none"> Proper grammar Correct spelling Readable Aesthetically pleasing 	All four elements are clearly demonstrated	Three elements are clearly demonstrated	Two elements are clearly demonstrated	One element is clearly demonstrated

Lunabotics Team Spirit Competition

The Lunabotics 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, 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, and a \$500 scholarship.

Lunabotics Team Spirit Competition Scoring Rubric

Elements	3	2	1
Teamwork:			
<ul style="list-style-type: none"> Exhibits teamwork in and out of the Lunarena 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:			
<ul style="list-style-type: none"> 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:			
<ul style="list-style-type: none"> 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:			
<ul style="list-style-type: none"> 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:			
<ul style="list-style-type: none"> 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

Categories for Bonus Points

Collaboration between a majority school with a designated United States Minority Serving Institution

The collaboration between a majority school and a designated U.S. minority serving institution (MSI) must be identified by March 7, 2011 to receive 10 bonus points. MSI student team members must be indicated on the team roster. A list of U.S. minority serving institutions may be found at: <http://www2.ed.gov/about/offices/list/ocr/edlite-minorityinst.html>. Transcripts must be electronically submitted with the team roster by March 7, 2011.

Multidisciplinary Engineering Teams

Each different science, technology, engineering or mathematics (STEM) discipline represented will count for one bonus point up to a maximum of 10. Disciplines will be indicated on the team roster by March 7, 2011. 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 STEM discipline that is not on this list, you may e-mail Susan.G.Sawyer@nasa.gov to request approval of that discipline for the competition.

Aeronautical Engineering
Aerospace Engineering
Astrobiology
Astronautical Engineering
Astronomy
Astrophysics
Atmospheric Sciences
Bacteriology
Biochemistry
Biology
Biophysics
Chemical Engineering
Chemistry
Civil Engineering
Computer Engineering
Computer Science
Electrical Engineering
Engineering Management

Environmental Engineering
Geography
Geosciences
Health Engineering
Industrial/Manufacturing Engineering
Information Technology
Materials/Metallurgical Engineering
Mathematics
Mechanical Engineering
Microbiology
Natural Resource Management
Nuclear Engineering
Oceanography
Optics
Physics
Software Engineering
Systems Engineering

Lunabotics Checklist

Required Competition Elements

If required elements are not received by the due dates, then you are not eligible to compete in any part of the competition (NO EXCEPTIONS).

- | | |
|--|-------------------|
| <input type="checkbox"/> Registration | February 28, 2011 |
| <input type="checkbox"/> Systems Engineering Paper | April 18, 2011 |
| <input type="checkbox"/> Outreach report | April 18, 2011 |

Optional Competition Elements

Late presentations will not be accepted as part of the presentation competition, but the team is eligible to compete in all other parts of the competition and can make a presentation on site.

- | | |
|--|-----------------|
| <input type="checkbox"/> Presentation | April 18, 2011 |
| <input type="checkbox"/> Team Spirit (on-site) | May 23-28, 2011 |

Required Documentation

- | | |
|--|-------------------|
| <input type="checkbox"/> Registration | February 28, 2011 |
| <input type="checkbox"/> Team Roster including | March 7, 2011 |
| <input type="checkbox"/> Participant information | |
| <input type="checkbox"/> Transcripts (unofficial copy is acceptable) | |
| <input type="checkbox"/> Media Release Form | |
| <input type="checkbox"/> Team Picture | May 3, 2011 |
| <input type="checkbox"/> Team Biography (250-500 words) | May 3, 2011 |
| <input type="checkbox"/> Head Count Form | May 3, 2011 |