



# NASA's 16th Annual Great Moonbuggy Race:

'Offworld' Racing With the Space-Age Engineers of Tomorrow



**A pair of racers representing the Huntsville Center for Technology in Huntsville, Ala., speed toward the 2007 high school division trophy in NASA's 14th annual Great Moonbuggy Race. (NASA/MSFC)**

At NASA's 16th annual Great Moonbuggy Race, set for April 3-4 at the U.S. Space & Rocket Center in Huntsville, Ala., as many as 88 student teams from 69 high schools, vocational schools, home schooling programs, colleges and universities will propel wheeled lunar rovers of their own design around a simulated moonscape—perhaps launching their future careers as next-generation engineers, scientists and space explorers.

More than 500 students from 21 states, Puerto Rico, Canada, India, Mexico, Germany and Romania are expected to gather for the 2009 race. Each team—which can include up to six students and a teacher/mentor—spent much of the preceding fall and winter designing, building and testing its lightweight moonbuggy. All the rovers are based on NASA's original lunar

vehicles, first driven on the moon's surface during the Apollo 15 moon mission in 1971.

Eight college teams participated in NASA's first Great Moonbuggy Race in Huntsville in 1994. That event commemorated the 25th anniversary of the Apollo 11 lunar landing. The race was expanded in 1996 to include high school teams, and has swelled each year since.

The competition opens Oct. 1 each year. NASA challenges high school, college and university students around the globe to begin designing a sturdy, collapsible vehicle that addresses engineering problems similar to hurdles overcome by the original lunar rover development team at NASA's Marshall Space Flight Center in Huntsville in the late 1960s.

**NASAfacts**

## Participating 2009 High School Teams

*Arab High School, Arab, Ala.*  
*Autauga County Technology Center (two teams), Prattville, Ala.*  
*Calhoun County Career Technical Center, Jacksonville, Ala.*  
*Cape Girardeau Career Technology Center, Cape Girardeau, Mo.*  
*Carlisle County High School, Bardwell, Ky.*  
*C.E. Byrd High School (two teams), Shreveport, La.*  
*East Limestone High School, Athens, Ala.*  
*East Puerto Rico High School, Humacao, Puerto Rico*  
*Elk Valley High School, Longton, Kan.*  
*Erie High School (two teams), Erie, Kan.*  
*Fairhope High School (two teams), Fairhope, Ala.*  
*Fajardo Vocational High School, Humacao, Puerto Rico*  
*Foundation Christian, La Habra, Calif.*  
*Gadsden High School, Anthony, N.M.*  
*German Space Education Institute, Leipzig, Germany*  
*Homeschool HUB, Buchanan, Mich.*  
*Huntsville Center for Technology (two teams), Huntsville, Ala.*  
*Lex La Ray Technical Center (two teams), Lexington, Mo.*  
*Lima Senior High School (two teams), Lima, Ohio*  
*Madison County Career Technical Center (two teams), Huntsville, Ala.*  
*New Britain High School, New Britain, Conn.*  
*Pana High School, Pana, Ill.*  
*Plainfield High School, Plainfield, Ind.*  
*Rama Devi Public School, Andra Pradesh, India*  
*Saks High School, Anniston, Ala.*  
*Scotlandville Magnet High School, Baton Rouge, La.*  
*SEMAA Cleveland High School, Cleveland, Ohio*  
*Soddy-Daisy High School (two teams), Soddy-Daisy, Tenn.*  
*Traveling Space Museum High School, Reseda, Calif.*  
*Tudor Vianu National High School of Computer Science (two teams), Bucharest, Romania*  
*University Gardens High School (two teams), San Juan, Puerto Rico*  
*Upper Valley Joint Vocational School, Piqua, Ohio*  
*Vestavia Hills High School, Vestavia Hills, Ala.*  
*Woodside High School, Newport News, Va.*

## Participating 2008 College/University Teams

*Alabama A&M University, Huntsville, Ala.*  
*Cameron University, Lawton, Okla.*  
*Carleton University, Ottawa, Ontario, Canada*  
*Central Connecticut State University, New Britain, Conn.*  
*Christian Brothers University, Memphis, Tenn.*  
*Colorado School of Mines, Golden, Colo.*  
*Delhi College of Engineering (two teams), Delhi, India*  
*Drexel University, Philadelphia, Pa.*  
*Government Engineering College Ujjain, Pradesh, India*  
*Kirorimal College, New Delhi, India*  
*Lake Michigan College, Niles, Mich.*  
*McMaster University, Hamilton, Ontario, Canada*  
*Middle Tennessee State University (two teams), Murfreesboro, Tenn.*  
*Murray State University, Murray, Ky.*  
*Netaji Subhas Institute of Technology (two teams), New Delhi, India*  
*Ohio State University, Columbus, Ohio*  
*Orissa Engineering College, Orissa, India*  
*Pittsburg State University (two teams), Pittsburg, Kan.*  
*Punjab Engineering College (two teams), Chandigarh, India*  
*Purdue University Calumet (two teams), Hammond, Ind.*  
*Rochester Institute of Technology, Rochester, N.Y.*  
*Ryerson University, Toronto, Ontario, Canada*  
*Southern Illinois University at Carbondale, Ill.*  
*Southern University (two teams), Baton Rouge, La.*  
*Tennessee Technological University (two teams), Cookeville, Tenn.*  
*Universidad Iberoamericana, Santa Fe, Mexico*  
*University of Alabama in Huntsville, Ala.*  
*University of Central Florida, Orlando, Fla.*  
*University of Evansville, Evansville, Ind.*  
*University of Puerto Rico, Humacao, Puerto Rico*  
*University of Utah, Salt Lake City*  
*University of Wyoming, Laramie, Wyo.*  
*Uttar Pradesh Technical University, Uttar Pradesh, India*  
*YMCA Institute of Engineering, Haryana, India*  
*Youngstown State University, Youngstown, Ohio*

The Great Moonbuggy Race is organized annually by the Marshall Center, and has been hosted by the U.S. Space & Rocket Center since 1996. The race is sponsored by NASA's Space Operations Mission Directorate in Washington, with additional corporate sponsorship by Northrop Grumman Corp., The Boeing Company and Jacobs Engineering Science Technical Service Group, all of Huntsville.

Other contributors include the American Institute of Aeronautics and Astronautics; ATK Launch Systems, Inc.; Huntsville CBS affiliate WHNT-TV; Stanley Associates; Science Applications International Corp.; the Tennessee Valley chapter of the System Safety Society Inc.; Teledyne Brown Engineering; the United Space Alliance, LLC; the U.S. Space & Rocket Center; the U.S. Navy "Seabees" Mobile Construction Battalion; and Northrop Grumman Information System Sector.

NASA's Great Moonbuggy Race is one of dozens of educational programs and initiatives the Marshall Center leads each year to help attract and inspire America's next generation of scientists, engineers and explorers—those who will carry on the nation's mission of exploration, to the moon and onward into the solar system.

## The rules

Teams selected as winners for the top three positions in both the high school and college divisions are judged based on the shortest total time to assemble their moonbuggies and complete the lunar obstacle course. Each team is permitted two runs of the course. The shortest course time, combined with assembly time, results in each team's final score.

Each vehicle must be solely human powered and piloted by two students, one female and one male, over the half-mile course. Every vehicle is required to have a specific set of parts—fenders, a flag and simulated mission hardware including batteries, a communications antenna, radio and TV camera.

To start, teams first must demonstrate that their unassembled moonbuggies will fit into a 4-foot-by-4-foot-by-4-foot cubic container, similar to transport conditions experienced by the original lunar rovers during their journeys from Earth to the moon. Folded moonbuggies then are carried by hand to the starting line, where they are assembled and readied for the course by the drivers, and evaluated for safety by the judges.



Student racers from the University of Evansville in Evansville, Ind., speed to victory in the college division of NASA's 15th annual Great Moonbuggy Race, held April 4-5, 2008, at the U.S. Space & Rocket Center in Huntsville, Ala. The team outraced 23 other college teams from around the United States, Puerto Rico, Canada, Germany and India. (NASA/MSFC)

The buggies race against the clock, rather than side-by-side. Judges mark their progress, assessing penalty points if the drivers' feet touch the ground, or if buggies lose their on-board equipment. The drivers push hard to conquer each obstacle without overturning the rover or exceeding the 12-minute time limit on the course.

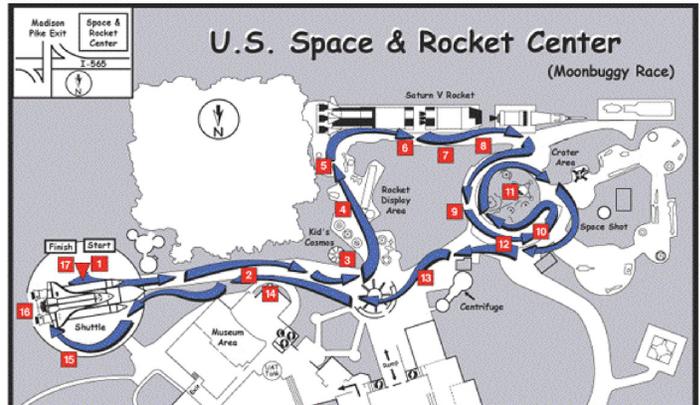
Some 350 Marshall Center employees and contractors volunteer each year to assist with the moonbuggy race, serving as timekeepers, vehicle inspectors, obstacle judges and crossing guards, maintaining safety at numerous busy spots on the race course, among other capacities.

### The course

A crew of construction workers at the U.S. Space & Rocket Center spends two weeks prior to each year's competition laying the simulated lunar course. It covers a half-mile of pathways that wind around the exterior of the popular Huntsville space museum and tourist attraction, twining through an atmospheric backdrop of famous American rockets and space vehicles.

The course includes 17 unique obstacles built of plywood and discarded tires. The obstacles and other portions of the course are covered with approximately 20 tons of gravel and 5 tons of sand. The material is carefully shaped into moon-like craters, basins and simulated "rilles," sharp furrows etched by lava during the moon's distant, turbulent past.

The unearthly landscape of the current course was designed in 1993 by Dr. Larry Taylor, a lunar geologist and professor at the University of Tennessee at Knoxville; Dr. J.M. Wersinger, a physics professor at Auburn University in Auburn, Ala.; and the Marshall Center's Dr. Frank Six, now Marshall's university affairs officer supporting the annual race.



### Course map

The Great Moonbuggy Race course and specific obstacles vary in detail from year to year. This outline gives participants a general idea of the course layout.

- The starting line is located under the space shuttle, near the "Pits" Area where moonbuggies are inspected and repaired. **Obstacle 1** is under the space shuttle.
- Next, the course slopes up slightly on a paved path that leads over a hill toward **Obstacle 2**, then travels downhill again to **Obstacle 3**.
- A sharp turn to the left leads through the U.S Space & Rocket Center's rocket display area to **Obstacle 4** and **Obstacle 5**.
- The course turns sharply to the right, remaining on asphalt and moving uphill to **Obstacle 6**, **Obstacle 7** and **Obstacle 8**.
- At the end of this straight section, a wide right turn brings participants to **Obstacle 9** and **Obstacle 10**, on the circular downhill path leading to the lunar crater area.
- Entering the crater area, the course veers left. Racers must take a complete 360-degree clockwise path across the lunar terrain. The largest crater is **Obstacle 11**, with its challenging 18-inch uphill grade
- Exiting the crater area, moonbuggies turn right toward **Obstacle 12**, **Obstacle 13** and **Obstacle 14**, on a path that starts flat, then slopes uphill. At the last of these obstacles, it slopes downward again. Speed bumps help slow descent.
- Finally, the course takes a left turn as racers enter the shuttle area and tackle **Obstacle 15**, **Obstacle 16** and **Obstacle 17** to conclude their runs.



**Student racers from Erie High School Team II in Erie, Kan., took first place in the high school division of NASA's 15th annual Great Moonbuggy Race in 2008. The Great Moonbuggy Race is one of dozens of education projects and initiatives NASA leads each year to inspire America's next generation of engineers, scientists and explorers. (NASA/MSFC)**

Over the years, the challenging course has been made as safe as possible. Every driver is required to wear a seatbelt during the race, and more than 175 hay bales line the drive path to protect speeding drivers and spectators alike.

### **The repairs tent**

Student "pit crews" make use of NASA's repairs tent throughout race day, welding snapped struts, replacing bent wheels and installing new chains and sprockets.

The tent includes work tables and benches, equipment and material supplies for pit crews working on up to six moonbuggies at a time. Team members make their own repairs, with oversight and guidance provided by Marshall Center engineers. All pit crew members are required to wear safety glasses in the work area, and welds are supervised by trained professionals.

Repair tent equipment, provided by the Metals Engineering Branch of Marshall's Engineering Directorate, includes a variety of welding machines, hand tools, electric tools, duct tape and epoxy, and a salvageable pile of scrap metal to replace or strengthen damaged vehicle parts. They also keep on hand detailed maps of local bicycle shops and area hardware stores, in case repairs require additional tools or parts.

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### **The prizes**

Top prizes are awarded to the three teams in the high school division and three in the college division that post the best assembly-and-race times.

In the high school division, the first-place team receives a trophy from the Marshall Center and a one-week trip to the Advanced Space Academy at the Space & Rocket Center, courtesy of ATK Launch Systems. In the college and university division, the first-place team receives a trophy from the Marshall Center and \$5,700 in cash from Northrop Grumman, Inc., to support a trip to witness a space shuttle launch.

Marshall also gives commemorative plaques to the second- and third-place teams in the high school and college divisions, and presents each team member of the top three teams in both divisions a medallion and certificate.

All participating moonbuggy teams receive a plaque from Science Applications International Corp.

The Marshall Center's Engineering Directorate each year presents the Frank Joe Sexton Memorial Pit Crew Award plaque to the team whose engineering ingenuity, resourcefulness and teamwork most successfully overcomes race-day obstacles. Sexton, a NASA machinist, worked on the original lunar rover and numerous other space vehicles until his death in 2000.

Additional prizes for each division include plaques from the Marshall Center for most unique moonbuggy and top team spirit; a \$1,000 cash award from the American Institute of Aeronautics and Astronautics for best moonbuggy design; an award for most improved team from Jacobs Engineering; and an award for fastest rookie team of the year from Northrop Grumman Corp. The American Institute of Aeronautics and Astronautics also awards a "Crash and Burn" plaque and cash prize to one college or university team that faces and resolves the most dramatic vehicle breakdown of the day's race.

For more information, visit: <http://moonbuggy.msfc.nasa.gov>

For information about other NASA education programs, visit: <http://education.nasa.gov>

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