



NASA's 15th Annual Great Moonbuggy Race:

Today's Students, Tomorrow's Engineers and Space Explorers



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 15th annual Great Moonbuggy Race, set for April 4-5 at the U.S. Space & Rocket Center in Huntsville, Ala., more than 60 high school and college teams will propel wheeled lunar rovers of their own design around a simulated moonscape – and perhaps launch their future careers as next-generation engineers, scientists and space explorers.

Nearly 400 students from 17 states, Puerto Rico, Canada, India and Germany, plus hundreds of event staffers, support volunteers and area spectators, are expected to gather for the 2008 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 their 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 a series of engineering problems similar to hurdles overcome by the original lunar rover development team at NASA's Marshall Space Flight Center in the late 1960s.

NASAfacts

Participating 2008 High School Teams

Alexandria High School, Alexandria, Ala.
Calloway County High School, Murray, Ky.
Carlisle County High School, Bardwell, Ky.
Cleveland High School, Cleveland, Tenn.
Coosa High School, Rome, Ga.
East Limestone High School, Athens, Ala.
East Technical Light House Academy, Cleveland, Ohio
Elk Valley High School, Longton, Kan.
Erie High School (two teams), Erie, Kan.
Fairhope High Schools (two teams), Fairhope, Ala.
German Space Education Institute, Leipzig, Germany
Graves County High School, Mayfield, Ky.
Huntsville Center for Technology (two teams), Huntsville, Ala.
Lima Senior High School (two teams), Lima, Ohio
Scotlandville Magnet High School, Baton Rouge, La.
Martin Luther King Jr. Career Campus High School, Cleveland, Ohio
Murray High School (two teams), Murray, Ky.
Niles Homeschool Hub, Niles, Mich.
Northeast High School, Oakland Park, Fla.
Pana High School (two teams), Pana, Ill.
Pinewood Preparatory School, Summerville, N.C.
Pleasant Valley High School, Jacksonville, Ala.
Puerto Rico East High School, Humacao, Puerto Rico
Puerto Rico High School, Humacao, Puerto Rico
Saks High School, Anniston, Ala.
Soddy-Daisy High School, Soddy-Daisy, Tenn.
Vestavia Hills High School, Vestavia Hills, Ala.

Participating 2008 College/University Teams

Alabama A&M University, Huntsville, Ala.
Cameron University, Lawton, Okla.
Carleton University, Ottawa, Ontario, Canada
Christian Brothers University (two teams), Memphis, Tenn.
Colorado School of Mines, Golden, Colo.
Delhi College of Engineering (two teams), Delhi, India
McMaster University, Hamilton, Ontario, Canada
Middle Tennessee State University (two teams), Murfreesboro, Tenn.
Murray State University, Murray, Ky.
Ohio State University, Columbus, Ohio
Pittsburg State University, Pittsburg, Kan.
Purdue University Calumet (two teams), Purdue, Ind.
Rochester Institute of Technology, Rochester, N.Y.
Southern Illinois University at Carbondale (two teams), Ill.
Southern University, Baton Rouge, La.
Tennessee Tech University, Cookeville, Tenn.
University of Alabama in Huntsville, Ala.
University of Central Florida (two teams), Orlando, Fla.
University of Evansville, Evansville, Ind.
University of Puerto Rico at Humacao, Puerto Rico
University of Utah, Salt Lake City
University of Wyoming, Laramie, Wyo.
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 1995. 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 Teledyne Brown Engineering, all of Huntsville.

Other contributors include the American Institute of Aeronautics and Astronautics; ATK Launch Systems, Inc.; Huntsville's CBS affiliate WHNT-TV; ITT Corporation; Jacobs Engineering Science Technical Service Group; Stanley Associates; Science Applications International Corp.; the Tennessee Valley chapter of the System Safety Society Inc.; the United Space Alliance, LLC; and the U.S. Space & Rocket Center.

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 terrain 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-square container, similar to transport conditions experienced by the original lunar rovers during their journeys from Earth to the moon. Unassembled moonbuggies then are carried by hand to the starting line, where they are assembled and readied for course testing by the drivers, and evaluated for safety by race judges.

The buggies race against the clock, rather than side-by-side. Judges mark their progress, ticking off points if 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 race's 15-minute time limit – a new rule in 2008.

Some 250 Marshall Center employees volunteer each year to assist with the moonbuggy race, serving as timekeepers, vehicle inspectors, obstacle site judges and crossing guards, maintaining safety at numerous busy spots on the race course, among other capacities.

The Course

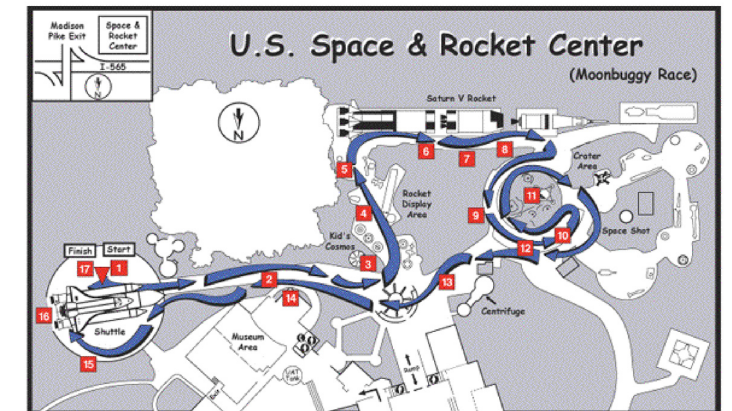
A crew of construction workers at the U.S. Space & Rocket Center spends two weeks prior to each year's competition laying the simulated lunar surface. It covers a half-mile of pathways that wind around the exterior of the popular Huntsville space museum and tourist attraction, twining through an atmospheric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

The 2008 course will include 17 unique obstacles built of plywood and old tires. Each obstacle, and other portions of the course, is covered with some 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 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 academic affairs officer supporting the annual race.

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.

The team from the University of Puerto Rico in Humacao braves wet weather and the challenging "lunar terrain" of the course to win second place in the 2007 college division. (NASA/MSFC)



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.



The challenging course keeps moonbuggy pit crews, like these 2001 racers, busy on race day, welding snapped struts and replacing bent wheels and broken sprockets. (NASA/MSFC)

The Repairs Tent

Student “pit crews” in NASA’s repairs tent stay busy on 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 repair crews 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.

The Prizes

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

National Aeronautics and Space Administration

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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 and Jacobs Technology. 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.

Marshall also gives commemorative plaques to the second- and third-place teams in the high school and college divisions, and presents each racer on the top three teams in both divisions a medallion and certificate. All members of the top three teams in both divisions also receive a duffel bag from United Space Alliance.

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

The Marshall Center’s Engineering Directorate each year awards a plaque for the Frank Joe Sexton Memorial Pit Crew Award to the team whose engineering ingenuity, resourcefulness and teamwork most successfully overcomes race-day obstacles. Sexton, who was 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; and prizes for most improved team and fastest rookie team of the year. 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 about NASA Great Moonbuggy Race, visit: <http://moonbuggy.msfc.nasa.gov>

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

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