National Aeronautics and Space Administration

HUMAN EXPLORATION ROVER CHALLENGE

2026 HANDBOOK

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ALIGNMENT WITH NATIONAL STANDARDS IN ENGINEERING AND SCIENCE

The NASA Human Exploration Rover Challenge (HERC) is a rigorous and continuously evolving activity which engages students in hands-on engineering design related to NASA's missions. HERC aims to meet established educational objectives and provide continuous program improvement that satisfy the needs of its participants.

Through participating in HERC, students will develop a deeper understanding of content and enhance their communication, collaboration, inquiry, problem-solving, and flexibility skills that will benefit them throughout their academic and professional lives.

HERC aligns with the Next Generation Science Standards (NGGS), Career and Technical Education Framework, and Accreditation Board for Engineering and Technology (ABET) criteria outlined below:

Next Generation Science Standards (NGSS) — Middle School (6–8)

MS-ETS1-1 Engineering Design

Define the criteria and constraints of a design problem with sufficient precision to ensure a successful solution, taking into account relevant scientific principles and potential impacts on people and the natural environment that may limit possible solutions.

MS-ETS1-2 Engineering Design

Evaluate competing design solutions using a systematic process to determine how well they meet the criteria and constraints of the problem.

MS-ETS1-3 Engineering Design

Analyze data from tests to determine similarities and differences among several design solutions to identify the best characteristics of each that can be combined into a new solution to better meet the criteria for success.

MS-ETS1-4 Engineering Design

Develop a model to generate data for iterative testing and modification of a proposed object, tool, or process such that an optimal design can be achieved.

Next Generation Science Standards (NGSS) — High School (9–12)

HS-PS2-1 Motion and Stability: Forces and Interactions

Analyze data to support the claim that Newtons second law of motion describes the mathematical relationship among the net force on a macroscopic object, its mass, and its acceleration.

HS-PS2-2 Motion and Stability: Forces and Interactions

Use mathematical representations to support the claim that the total momentum of a system of objects is conserved when there is no net force on the system.

HS-PS2-3 Motion and Stability: Forces and Interactions

Apply scientific and engineering ideas to design, evaluate, and refine a device that minimizes the force on a macroscopic object during a collision.

HS-PS3-1 Energy

Create a computational model to calculate the change in the energy of one component in a system when the change in energy of the other component(s) and energy flows in and out of the system are known.

HS-PS3-3 Energy

Design, build, and refine a device that works within given constraints to convert one form of energy into another form of energy.

HS-ETS1-1 Engineering Design

Analyze a major global challenge to specify qualitative and quantitative criteria and constraints for solutions that account for societal needs and wants.

HS-ETS1-3 Engineering Design

Evaluate a solution to a complex real-world problem based on prioritized criteria and trade-offs that account for a range of constraints, including cost, safety, reliability, and aesthetics as well as possible social, cultural, and environmental impacts.

HS-ETS1-4 Engineering Design

Use a computer simulation to model the impact of proposed solutions to a complex real-world problem with numerous criteria and constraints on interactions within and between systems relevant to the problem.

Career and Technical Education Framework – Clusters and Sub-Clusters

Digital Technology

Software Solutions
Unmanned Vehicle Technology

Advanced Manufacturing

Engineering
Industrial Machinery
Production & Automation
Robotics
Safety & Quality Assurance

Construction

Construction Planning & Development
Skilled Trades

Accreditation Board for Engineering and Technology (ABET) — Criteria 3. Student Outcomes

- An ability to identify, formulate, and solve complex engineering problems by applying principles of engineering, science, and mathematics
- An ability to apply engineering design to produce solutions that meet specified needs with consideration of public health, safety, and welfare, as well as global, cultural, social, environmental, and economic factors
- An ability to communicate effectively with a range of audiences
- An ability to recognize ethical and professional responsibilities in engineering situations and make informed judgments, which must consider the impact of engineering solutions in global, economic, environmental, and societal contexts
- An ability to function effectively on a team whose members together provide leadership, create a collaborative and inclusive environment, establish goals, plan tasks, and meet objectives
- An ability to develop and conduct appropriate experimentation, analyze and interpret data, and use engineering judgment to draw conclusions
- An ability to acquire and apply new knowledge as needed, using appropriate learning strategies.

1. BACKGROUND: THE NASA HUMAN EXPLORATION ROVER CHALLENGE

Since its inception in 1994, NASA's Human Exploration Rover Challenge (HERC) has been hailed as one of the agency's most exciting student challenges. HERC culminates each year with an in-person event in Huntsville, AL, near NASA's Marshall Space Flight Center. Formerly known as the Great Moonbuggy Race, the challenge was conceived in the spirit of NASA's Apollo missions to the Moon and the Apollo Lunar Roving Vehicle that carried the first humans in history across the lunar surface. Students designed and built vehicles – dubbed "moonbuggies" – to address real engineering obstacles, mimicking the challenges that NASA Marshall engineers addressed in preparation for Apollo 15.

Through the Artemis campaign, NASA will send astronauts to explore the Moon for scientific discovery, economic benefits, and to build the foundation for the first crewed missions to Mars -- for the benefit of all. The next humans to land on the Moon will use innovative technologies to explore more of the lunar surface than ever before. Building on the uncrewed Artemis I and crewed Artemis II flight tests, humankind will land on the Moon's South Pole for the first time ever with Artemis III.

HERC is an engineering design challenge engaging students worldwide in the next phase of human space exploration. HERC draws inspiration from both the Apollo and Artemis missions, emphasizing designing, constructing, and testing technologies, as well as traversing unique environmental terrain. HERC encourages the next generation of scientists and engineers to engage in the design process by providing innovative concepts and unique perspectives. HERC also continues the agency's legacy of providing valuable experience to students who may be responsible for planning future space missions, including crewed missions to other worlds.

In 2026 teams will choose to participate in either the traditional Human-Powered (HP) or Remote-Controlled (RC) divisions. This change not only better aligns HERC with current NASA missions, but it also expands the reach of the program to include more STEM disciplines and grade levels.

To learn more about the Artemis missions, including specific plans for how to achieve these goals, visit: https://www.nasa.gov/specials/artemis/

2. HERC NARRATIVE AND OBJECTIVE

HERC 2026 Narrative

“What do you think, Commander?”

Your head snaps up. Daydreaming through a web meeting is one thing, but this is Mission Control!

“Say again, Houston,” you reply.

“Which rover will you be using?”

It was a simple question with a complex answer – like every decision that needs to be made on the Moon.

“Standby,” you announce.

The room you’re in is enormous, much roomier than the original Apollo Lunar Module. This lander isn’t just for transportation, it’s home sweet home for the duration of the surface mission. Glancing out the windows, which prompted your earlier daydreaming, you are in awe of the lunar South Pole’s scenery. The colorless landscape is pocketed with enormous craters in permanent shadow, full of unexplored science.

As your eyes tilt downward, you see two rovers gleaming in the sunlight. Your crewmate is lost in a microscope, but after a few knocks on the wall and a quick conversation, you’re both suited up and checked for safety.

“Houston, this is Lunar Mission 8. Checking status on the rovers before we decide which to use.”

“Copy that. Both are showing fully operational on this end.”

Double-checking the information display inside the lander, you confirm the rover’s full operational status. Data relay is paramount to lunar missions. Everything happening on the surface is communicated through the lander back to Earth, either directly or through assets orbiting the Moon and our home planet.

Stepping through the airlock door, you ponder the question at hand – which rover should you take? Both can perform the mission but in entirely different ways. You consider each vehicle’s unique challenges and benefits. You begin to descend to the lunar surface. It’s time to decide.

HERC 2026 Mission Objective

The primary objective of HERC is for student teams to design, develop, build, and test a rover capable of traversing challenging terrain while completing various mission tasks. Teams choosing to compete in the HP division will focus on the development of a safe and functional human-powered vehicle, as well as a separate mission task tool, while RC division teams will work to solve scientific mission tasks onboard, with a purpose-built remote-controlled vehicle.

Teams earn points by successfully completing design and readiness reviews, designing and assembling a rover that meets all challenge criteria, and successfully completing course obstacles and mission tasks. The team with the highest number of points accumulated throughout the project year in each category will be the winner of their respective division (middle school/high school and college/university).

The HP competition course requires two student pilots, at least one female, to use the student-designed vehicle to traverse a half-mile course that includes a simulated field of asteroid debris, boulders, erosion ruts, crevasses, and an ancient streambed. The challenge's weight and size requirements encourage the rover's compactness and stowage efficiency. Just as in real lunar surface missions, teams must make real-time decisions about which mission objectives to attempt and which to leave behind — all driven by a limited, virtual eight-minute (HP Division) or twelve-minute (RC Division) supply of oxygen.

In order to explore more of the Moon than ever before, rovers will play a vital role in both traversing and conducting research on the lunar surface. Rover-collected sample and measurement data will be used to help determine suitable sites for future crewed landings.

Future Artemis missions will use two types of rovers to explore the lunar surface. The first is an unpressurized rover that allows suited crew members to perform experiments and explore the surface much faster than they could on foot. Known as an LTV (Lunar Terrain Vehicle), it is the successor to the Apollo LRV (Lunar Roving Vehicle) and the inspiration for HERC HP vehicles.

The second rover to explore the surface of the Moon will be a pressurized rover. This rover will allow astronauts to live and work on the lunar surface by providing a home for astronauts away from the base camp for extended periods of time. The mission for the pressurized rover goes beyond what the crew inside can do. Since the rover will be equipped with its own sensors, it may be able to operate both remotely and autonomously when needed.

You are part of a future mission to the lunar surface. Choose your rover and travel to three sites to collect samples, test them, and report your findings back to scientists on Earth. HP rover teams will play the role of two astronauts in an LTV and must use a custom-built task tool to be operated by the crew to manually collect samples needed for testing. RC rover teams will act as a pressurized rover, and the rover itself will contain the tools necessary to collect and test samples onboard.

3. TIMELINE

Dates Are Subject to Change. All Deliverables are due by 8AM CT on appointed date.

August 21, 2025	Proposal Expectations Webinar
September 15, 2025	2026 HERC Proposal Due by 8AM CT
September 30, 2025	Selected HERC 2026 Teams Announced
September 30, 2025	NASA STEM Gateway Registration Opens for Selected Teams
October 7, 2025	Kickoff and Design Review Expectations Webinar
October 7, 2025	Team's Social Media Link Due by 8AM CT
October 30, 2025	NASA STEM Gateway Team Member Registration Completed
November 24, 2025	Design Review Reports & Slide Presentations Due by 8AM CT
December 1-19, 2025	DR Team Presentations (Design Completed & Construction in Progress)
February 5, 2026	Final Travel Roster of Team Members Due by 8AM CT
February 5, 2026	Team Photo Due by 8AM CT
February 23, 2026	Operational Readiness Review Report & Slide Presentation Due by 8AM CT
February 23, 2026	Photos of Completed Rover for Verification Due by 8AM CT
March 2 – 23, 2026	ORR Team Presentations (Rover/Tool Completed and Testing in Progress)
April 9, 2026	Competition Day 1
April 10, 2026	Competition Day 2
April 11, 2026	Competition Day 3

4. GLOSSARY OF TERMS AND ACRONYMS

Assembly Tools
Any tools, straps, etc., that teams need to contain the rover in the 5-ft. cube configuration or to assemble the rover, but not needed for traversing the course or completing the tasks. These assembly tools may be left in the designated tool area adjacent to the assembly area as part of the timed assembly process.

AC
Aviation Challenge - Location at U.S. Space & Rocket Center where event is held in April.

Bubble
Location at AC where MRR/ERR, team photos, and scorekeeping are located during culminating event.

CAD
Computer Aided Design - the use of computers (or workstations) to aid in the creation, modification, analysis, or optimization of a design.

Challenge Ready Configuration
Both pilots seated in the rover with all task materials and PPE, including seat restraints, fixed in place, feet on drive input devices, and hands up to signal completion.

CT
Central Time Zone – the second easternmost time zone in the U.S.

DR
Design Review - demonstrates that the maturity of the design is appropriate to support proceeding with full-scale fabrication, assembly, integration, and test. It determines that the technical effort is on track to complete the mission operations, meeting mission performance requirements within the schedule constraints.

ERR
Excursion Readiness Review - event that occurs prior to any course excursion and include safety and task material inspection. The ERR will be combined with the MRR for the first excursion.

ESDMD
NASA's Exploration Systems Development Mission Directorate - defines and manages systems development for programs critical to the agency's Artemis program and planning for NASA's Moon to Mars exploration approach. ESDMD manages the human exploration system development for lunar orbital, lunar surface, and Mars exploration.

Excursion
An attempt to traverse the course tasks and complete challenges to accumulate points. Teams will have two excursion opportunities (weather permitting). Final rankings are based on the greater point total of the two possible excursion attempts and points accumulated during design and readiness reviews. Teams are not required to attempt excursions both times.

FMEA
Failure Modes and Effect Analysis – a systematic, step-by-step approach used to identify and prioritize possible failures in a design, manufacturing, or assembly process.

Hangar Bay
Location at Aviation Challenge where teams eat lunch.

HERC Management Team
NASA employees, both contractor and civil servant, who design, plan, and execute the NASA HERC program.

HP
Human-Powered – rover division in which rovers are piloted by human drivers.

HLS
Human Landing System - the mode of transportation Artemis astronauts will use to be safely transported from lunar orbit to the surface and back, in preparation for future crewed missions to Mars.

MRR
Mission Readiness Review – requirements check that occurs the morning before excursion runs. This includes the volume constraint, weighing the vehicle and unfolding/assembling the vehicle. The MRR will be combined with the ERR for the first excursion.

NASA
National Aeronautics and Space Administration – independent U.S. governmental agency established in 1958 for the research and development of vehicles and activities for the exploration of space within and outside Earth's atmosphere.

NASA STEM Gateway
Comprehensive tool designed to allow individuals to apply to NASA STEM engagement opportunities. The information collected will be used by the NASA Office of STEM Engagement (OSTEM) and other NASA offices to review applications for participation in NASA STEM engagement opportunities and to fulfill federally mandated performance reporting on these activities.

ORR
Operational Readiness Review - examines the actual system characteristics and procedures used in the system or end product's and establishes that the system is ready to transition into an operational mode through examination and analysis.

Overall Score
The total cumulative points awarded to a team, including DR, ORR, MRR, plus the Obstacles and Tasks Competition.

PPE
Personal Protective Equipment – equipment worn to minimize exposure to hazards that cause injuries and illnesses.

PER
Post-Excursion Review - occurs after course completion and includes task completion inspection.

Pilot
Synonymous with crew - one or both student team members (at least one female) that propels the vehicle over the course.

Pit Crew & Machine Shop
Employees of the NASA Metallic Materials and Processes Division of the Materials and Processes Laboratory and Jacobs Engineering utilizing a machine shop to assist with repairs.

RC
Remote-Controlled - rover division in which rovers are piloted by remote control.

Requirements
The set of standard rules for all participants that must be followed to compete in HERC.

ROVR
Remote Operated Vehicular Research — the RC rover division in HERC STEM.

SOMD
NASA's Science Operations Mission Directorate - maintains a continuous human presence in space for the benefit of people on Earth.

STEM
Science, Technology, Engineering and Mathematics – a set of disciplines that are essential for innovations and understanding the world around us.

Student Safety Officer
Student team member who maintains a safe and secure environment for team members during the entirety of the project.

Student Team Lead
Student team member who leads the school's team. They, along with the Team Advisor, are the main points of communication during the HERC competition. Student Team Leads are also responsible for turning in all deliverables during competition.

Task Materials
Task materials include all equipment needed for completing the tasks on the course. This may include items such as collection tool, storage containers, etc.

Team Advisor
School or institution faculty/staff member who leads and mentors the HERC team. They, along with the Student Team Lead, are the main points of communication during the HERC competition.

Team Lead
NASA STEM Gateway designation for the person who oversees the team's Gateway information. This person will be the primary contact if Gateway issues arise. This person cannot be changed once the team is entered into Gateway.

Team Mentor
Experts that give guidance and assistance to student team members to support them through the process of learning during the competition. Graduate students and industry partners are examples of mentors who work with student teams.

Team Pit Area
The designated workspace for preparing the team's vehicle and task components. Only team advisor and student team members permitted in the area.

USSRC
U.S. Space & Rocket Center - Official Visitor Center of NASA Marshall Space Flight Center and location of HERC culminating event.

Vehicle
Synonymous with rover, the vehicle is the student-built rover designed to traverse the course during excursions.

To learn more about NASA's acronyms, visit the official site: Acronyms | Science Mission Directorate (nasa.gov)

5. GUIDELINES AND REGULATIONS

5.1 General Regulations

- **5.1.1** Individuals or teams may be excluded from participation at the discretion of NASA for unauthorized behavior, including but not limited to (i) impersonating a NASA official whether intentionally or in a manner that results in confusion; (ii) misuse of the logos or identifiers of NASA, any sponsoring organization, or any infringement of a commercial logo or trademark; (iii) failure to abide by competition rules, directives or instructions from the competition host or organizer; and (iv) asserting or implying a NASA affiliation or sponsorship where none exists. NASA Images and Media
- **5.1.2** Additionally, the NASA Human Exploration Rover Challenge does not host pre-competitions or competitions conducted by any organization other than NASA Marshall Space Flight Center's Office of STEM Engagement. This NASA competition is neither affiliated with, nor sponsors or endorses any Rover Challenge competition other than the NASA Human Exploration Rover Challenge. Outside competitions have no bearing on the NASA Human Exploration Rover Challenge qualification or registration process, and representation to the contrary is strictly prohibited. No competition may imply any affiliation with NASA or use the NASA logo without permission of NASA Headquarters. Any assertions made by organizations that represent themselves as "NASA Outreach Program Europe Director," "Official NASA Rover Ambassador," "International Judge," or any similar titles suggesting a tie to NASA are unauthorized. Representations or suggestions that any organization or individual can assure teams of being accepted for registration or participation in the challenge are unauthorized. All requirements for participation in the NASA Human Exploration Rover Challenge are outlined in this handbook.
- **5.1.3** Participants hereby waive any claims against NASA, its employees, its related entities (including, but not limited to, contractors and subcontractors at any tier, grantees, investigators, volunteers, customers, users, and their contractors and subcontractors at any tier), and employees of NASA's related entities for any injury, death, or property damage/loss arising from or related to the NASA Human Exploration Rover Challenge, whether such injury, death, or property damage/loss arises through negligence or otherwise, except in the case of willful misconduct.
- **5.1.4** All team members shall be currently enrolled students from a middle school, high school, an accredited institution of higher learning, or an institution such as a science center, museum, planetarium, or youth-serving organization. Multi-institutional teams are permitted for same level of education, i.e., two or more high schools on one team. Students from middle schools, high schools, and college/university shall not be combined to make a team.
- **5.1.5** Middle School teams shall be composed of students ages 11 through 14. Team members must be of the appropriate age at the submission of the proposal.
- **5.1.6** High School teams shall be composed of students ages 14 through 19. Team members must be of the appropriate age at the submission of the proposal.
- **5.1.7** Accredited institutions of higher learning (college/university) teams shall be composed of only undergraduate students. Graduate students may serve as mentors for the team but shall not participate as team members.
- **5.1.8** Accredited institutions of higher learning (college/university) undergraduate teams will be composed of students ages 18 and older. Students who are younger than 18 may require age and enrollment verification.

- **5.1.9** Youth-serving organization teams can be a mixture of middle school and high school students and must abide by General Regulations 5.1.5 and 5.1.6. Youth serving organization teams shall compete at the highest level based on the above age ranges. No combination of middle school/high school and college/university students is allowed.
- **5.1.10** Age and enrollment verification may be requested at any time.
- **5.1.11** Each team, regardless of division, shall identify and be accompanied by an adult age 21 or older to serve as an advisor. The advisor shall be identified at the time of proposal submission. The identified advisor shall be employed by the registered institution or organization.
- **5.1.12** All team members are required to be engaged in the design and build of the rover. Each person must have an active role that must be communicated to the NASA panel during Design Review (Dr) and Operational Readiness Review (ORR) presentations. Teams will identify two team members as pilots (at least one female) to propel the vehicle through the course.
- **5.1.13** Students on the team will do 100% of the project to include design, construction of the vehicle and task components (including performing work that is supported by a professional machinist for the purpose of training or safety), written reports, presentations, and competition preparation. Any team found in violation of this will be disqualified.
- **5.1.14** Excessive re-use of prior material (vehicles, reports, presentations, etc., from previous HERC challenge years), determined at any milestone during the competition year, will result in disqualification. Teams should identify vehicle components that are re-used in their Design Review.
- **5.1.15** Any team member or advisor found to be exhibiting unsportsmanlike conduct may result in the disqualification of the individual and/or team from the challenge.
- **5.1.16** Teams not meeting all requirements listed may be disqualified.
- **5.1.17** All scoring decisions for the reviews, excursions, and other deliverables are final. During excursions, if an appeal is warranted, the Team Advisor or the Student Team Lead shall submit the appeal in writing for consideration to the Activity Lead within 30 minutes of the posting of score(s) in question. The final decision of the Activity Lead and Technical Coordinator shall prevail.

5.2 Deliverable Guidelines and Information

- **5.2.1** All times listed in connection to deliverables, webinars, office hours, presentations, and events will be either Central Standard Time (UTC-6) or Central Daylight Time (UTC-5) depending on the time of the year. HERC is supported by Marshall Space Flight Center located in Huntsville, Alabama.
  - Daylight saving time occurs from the second Sunday of March to the first Sunday of November. During daylight saving, Central Time Zone is only 5 hours behind Coordinated Universal Time (UTC-5), as opposed to the usual UTC-6. All deliverables are due NLT 8 AM CT.
- **5.2.2** All potential teams are required to submit a proposal to compete. A written proposal submission shall follow and answer the requirements outlined in Deliverable, Proposal section 7.1.
- **5.2.3** The Student Team Lead will submit the team's proposal for consideration via email to HERC@mail.nasa.gov. Please follow proper deliverable nomenclature (Institution Name_Activity Year_Division_Deliverable Type).

- **5.2.4** Team proposals will be scored based on a rubric developed from the Proposal Requirements.
- **5.2.5** Only ***ONE*** team per school or institution may submit a proposal for consideration per division —HP and RC. Schools or institutions submitting a proposal for both divisions, must have teams made up of separate individual students. A student team member cannot be on both an HP and RC team.
- **5.2.6** Proposals shall be written solely by the student team members.
- **5.2.7** Proposals submitted after the deadline (date and time received) will not be considered.
- **5.2.8** Top scoring proposals will be selected to compete. Registration of all team members will be required for the competition through NASA STEM Gateway. Student Team Leads (college/university), and Team Advisors (MS/HS) will need to complete their own application in the system, then they will receive an offer email from NASA STEM Gateway and will need to accept the offer. Once accepted, the Student Team Lead/Team Advisor will send invitations through NASA STEM Gateway to each team member to register as part of the team. The HERC Management Team will send out a detailed email on September 30, 2025, to those selected teams with detailed instructions.
- **5.2.9** ***Each*** team member must complete a NASA STEM Gateway application for the registration to be valid. Individuals who are not fully registered in Gateway shall not be considered part of the team and shall not be permitted to participate in the culminating event in Huntsville, AL.
- **5.2.10** A team member's registration shall be confirmed via Gateway email upon approval of registration. Registration is not confirmed by the HERC Management Team. Student Team Leads/Advisors have the capability to see the registration status of all team members for verification.
- **5.2.11** While no endorsement exists or should be implied, teams in the past have found that either Chrome or Edge web browsers work best with NASA STEM Gateway.
- **5.2.12** Each team shall submit a DR report and presentation and participate in a virtual presentation that, together, will make up 20% of the team's overall score. The DR Milestone must be completed to the satisfaction of the HERC Management Team and Review Panel to progress onto the ORR portion of the challenge. Successful completion of each milestone and promotion to the next milestone is determined solely at the discretion of the HERC Management Team and Review Panel.
- **5.2.13** Each team shall submit an ORR report and presentation as well as participate in a virtual presentation which together will count towards 20% of the team's overall score. The ORR Milestone must be completed to the satisfaction of the HERC Management Team and Review Panel to progress onto the excursion portion of the challenge. Successful completion of each milestone and promotion to the culminating event (excursion) is determined solely at the discretion of the HERC Management Team and Review Panel.
- **5.2.14** Each high school/college/university team shall fulfill an Engagement Requirement by submitting either a STEM Industry Plan and Summary, or a Community STEM Engagement Plan and Summary.
- **5.2.15** Late submissions of DR or ORR deliverables shall be accepted up to 24 hours after the submission deadline but shall incur a 10% penalty. Deliverable submissions shall not be accepted after the 24-hour penalty period. Teams that fail to submit a deliverable shall be ineligible for awards and may be eliminated from the competition.

5.3 Competition Guidelines, Regulations, and Information

- **5.3.1** Rovers may be shipped to the U.S. Space & Rocket Center (USSRC) in advance of the competition via the following address (the USSRC is not required to receive any rovers that do not have pre-paid return shipping documents with their rover equipment). Drop off window is Monday through Friday from 9 AM CT to 4 PM CT. If you have shipping questions, please send your questions to warehouseops@spacecamp.com

  Shipping Address: U.S. Space & Rocket Center

  1 Tranquility Base

  Huntsville, Alabama 35805

  Attn: Warehouse Manager

- **5.3.2** By the end of Competition Day 3 rovers shall be fully packaged in an appropriate crate by the team and include all necessary label(s) for return shipping pickup. Information required, but not limited to, includes school name, full address, point of contact name, and mobile number, as well as BOL (Bill of Lading). Pick up window is Monday through Friday from 9 AM CT to 4 PM CT.
- **5.3.3** Neither the USSRC nor the HERC Management Team or staff shall provide a facility, tools, or equipment for assembling or disassembling rovers (in any condition), and/or opening crates.
- **5.3.4** The consumption of alcoholic beverages and/or controlled substances is strictly prohibited by HERC teams on USSRC grounds, and use of or possession by any HERC participant or affiliate at any time during the event is grounds for disqualification of the team and/or other repercussions.
- **5.3.5** U.S. federal, Alabama state, and Huntsville city laws and regulations solely define what is legally permitted on the grounds. As such, firearms and other weapons are not permitted to be carried by facility visitors on USSRC property.
- **5.3.6** In accordance with Federal Aviation Administration (FAA) regulations, the use of drones during any HERC activity is strictly prohibited.
- **5.3.7** Driving the rover on the course, or in the parking lot, in a reckless or unsafe manner is not permitted, and may result in disqualification.
- **5.3.8** Participant safety is our biggest priority. Pilots who are injured, bleeding, or incapacitated will be safely attended to and receive any necessary medical attention. Injuries may occur when adjusting vehicle components, such as the drive-train components, during the excursion. Each team must develop a signal system between the two pilots to ensure safety hazards are clear before proceeding. Pilots will be asked to describe their communication plan before the excursion.
- **5.3.9** Using poles or other devices to propel or push the rover is not allowed. A pilot's use of his or her hands on the wheels is not permitted to facilitate vehicle movement.
- **5.3.10** Obstacles must be attempted from a seated position on the rover.
- **5.3.11** Upon successful completion of Mission Readiness Review (MRR)/Excursion Readiness Review (ERR), teams are permitted two excursions of the course if time permits.
- **5.3.12** Pilots must be on the vehicle, with safety belt fastened, and all PPE in place before driving their rover during an excursion attempt.

- **5.3.13** HP Teams have a total of 8 minutes to complete each excursion. Teams must complete at least one of the two excursions in 8 minutes or less to be considered for overall awards and ranking.
- **5.3.14** RC Teams have a total of 12 minutes to complete each excursion. Teams must complete at least one of the two excursions in 12 minutes or less to be considered for overall awards and ranking.
- **5.3.15** The excursion time stops when a team either crosses the finish line or reaches the time limit, whichever comes first. Teams will be allowed to finish their excursion via taking bypasses if it isn't impeding progress of successive teams.
- **5.3.16** Course judges may make pilots aware of their unofficial excursion times periodically; however, teams are encouraged to use their own timing devices as unofficial timers while on the vehicle for strategic on- course decisions. Teams should not be reliant on excursion times announced by judges. The timing judges will maintain the official excursion time.
- **5.3.17** The pilots for the first excursion shall be the same as those who conducted MRR/ERR. Pilot substitutions, if needed, may be made for the second excursion.
- **5.3.18** Communication devices are allowed if at least one pilot can hear ambient sounds/instructions from judges.
- **5.3.19** Indirectly approaching an obstacle, getting off the vehicle (pushing, pulling), or veering from an obstacle will be considered an unsuccessful attempt.
- **5.3.20** Traversing the entire course is required for a successful excursion. A team pushing or carrying their rover between obstacles will not be allowed to resume the excursion attempt to complete remaining obstacles or tasks.
- **5.3.21** The course is comprised of 10 obstacles. Obstacles will have a bypass, where teams can strategically choose to either attempt the obstacle for points or bypass it for zero points.
- **5.3.22** Judges have the authority to remove a disabled or temporarily suspend a slow rover from the course when it will affect the excursion time of the next successive rover. The excursion time for the slow vehicle halts at the point of suspension and resumes once the successive vehicle has passed.
- **5.3.23** Individuals (team members and/or supporters) may not run with the rover around the course during the excursion time. Teams seen violating this safety precaution could face penalties up to and including elimination from the event.
- **5.3.24** Official team numbers will be provided in the event packet and shall be affixed to the front and left side of the HP rover, in an unobstructed view for the judges.
- **5.3.25** While at the HERC event, NASA's MSFC volunteers are posted in various locations at Aviation Challenge for your team's safety. Listen to their instructions when provided. Teams seen violating this safety precaution could face penalties up to elimination from the event.
- **5.3.26** Loud noise, as well as noise makers, are not permitted around any of the judging spaces. Pit areas may have some music or celebratory noise, but it must be respectful to the neighboring pit teams. Teams violating this safety precaution could face penalties up to and including elimination from the event.

Miscellaneous:

- Transportation:
    - Huntsville International Airport (local), Birmingham-Shuttlesworth (AL) International Airport (less than 2 hours)

- Nashville (TN) International Airport (2 hours)
- Hartsfield-Jackson Atlanta (GA) International Airport (3 hours, 30 minutes)

Huntsville has few vehicles rental options so reserve early if needed. Uber and Lyft are available. Teams are responsible for all transportation to and from the event location. Parking will be in the west parking lot at USSRC, with shuttle buses available each day.

– Lodging:

- Huntsville has many hotels within a 10-mile radius of U.S. Space & Rocket Center, as well as many short-term, home-stay options that can be booked through apps

– Weather:

- Huntsville weather is very unpredictable in April
- Be prepared for any type of weather and check before traveling to our event

5.4 Team Pit Area Guidelines and Regulations

- **5.4.1** Each HP team is provided a 16 ft. x 18 ft. marked area for their team's pit and must fit all equipment and/or trailers needed in the space provided. All other vehicles and/or trailers shall be parked in the designated general parking area. Teams seen violating this safety precaution could face penalties up to and including elimination from the event. RC pit areas may be smaller as space permits — exact information will be released before the event. Team pit areas are considered work zones, so only team members and faculty advisors are allowed in pits.
- **5.4.2** If the team's rover was shipped to USSRC within the proper time frame, it will be located in the team's pit area NLT 12 PM on the Thursday prior to the event.
- **5.4.3** Teams will be able to unload all equipment on Thursday in preparation for the event. Once the vehicles are unloaded, the team must vacate and return to the Davidson Center parking lot. Team members are to ride the shuttle bus back down to the team pit area. Bus service will start NLT 12 PM on Thursday.
- **5.4.4** On Friday and Saturday, ALL team members and supporters are to ride the buses down to Aviation Challenge due to all activity occurring in this location. Supplies and snacks will need to be transported on the buses and not delivered to the pit area. HP rovers are to stay in the team pit area once they arrive at the event. RC rovers can be transported back and forth but must be transported on the bus. Teams seen violating this safety precaution could face penalties up to and including elimination from the event.
- **5.4.5** After the award ceremony on Saturday, teams will be able to retrieve their equipment from the pit areas. Teams must make sure that their pit areas are cleaned of all debris before leaving their location. Teams seen violating this safety precaution could face penalties.
- **5.4.6** Teams shall exercise appropriate safety precautions during the design, build, and test phases of this competition and utilize appropriate PPE when performing construction activities, whether at school or the HERC event, such as: welding (which can be done at the event with NASA MSFC Pit Crew assistance), handling metal components, and using tools anywhere on the USSRC property or neighboring areas. Only pilots are to be on HP rovers at any time. Failure to follow proper safety procedures may result in disqualification.

- **5.4.7** Be weather aware. Team pits are in an open location with various terrain. Teams are permitted and encouraged to bring canopies to provide protection from the weather.
- **5.4.8** Loud noise, as well as noise makers, are not permitted around any of the judging spaces. Pit areas may have some music or celebratory noise but must be respectful of neighboring pit teams. Teams violating this safety precaution could face penalties up to and including elimination from the event.

5.5 Mission Readiness Review Guidelines

- **5.5.1** Teams will complete MRR during the predetermined time window on Competition Day 2. Time windows, and the method for obtaining a time window, will be communicated to teams in advance of the competition.
- **5.5.2** Teams must arrive on time and ready to participate in their MRR as scheduled. Failure to arrive on time or perform MRR as scheduled will result in a penalty to the team's overall score.
- **5.5.3** HP Vehicles shall be inspected for the 5 x 5 x 5-ft. volume constraint in the stowed configuration during MRR.
- **5.5.4** RC vehicles must fit fully within a 2.5 ft. x 2.5 ft. x 2.5 ft. cube in excursion-ready state.
- **5.5.5** Modifications to the rover are not permitted during MRR. Team members are not permitted to access the rover during MRR, unless directed by HERC personnel.
- **5.5.6** Tapes, straps, and/or other devices may be used to confine the rover in the collapsed or stowed configuration. However, all such devices shall be included in the total weight measurement of the rover.
- **5.5.7** There are no constraints for the overall height and length of the assembled rover. However, a rover with pilots that is found to have too high of a center of gravity and/or found to have a weight imbalance will be assessed and may not be allowed to traverse the course if judges determine the risk of tipping over is too high.
- **5.5.8** The vehicle shall be weighed in the stowed position with all necessary mission components. Point breakdown for weight categories is listed in Section 8.
- **5.5.9** From the stowed position, a signal shall be given, and a timer shall start for the two pilots to unfold and/ or assemble their rover. The timer stops when the vehicle is in challenge-ready configuration with pilots in place, and all assembly tools and implements properly stowed on the rover, or in the marked tool area adjacent to the assembly location. Point breakdown for assembly time is listed in Section 8.
- **5.5.10** The MRR shall be combined with the ERR for the first excursion.

5.6 Excursion Readiness Review Guidelines

- **5.6.1** Teams must arrive on time and ready to participate in their ERR as scheduled. Failure to arrive on time or perform ERR as scheduled shall result in a penalty to the team's overall score.
- **5.6.2** Judges shall photograph each vehicle and conduct an inspection of safety requirements.
- **5.6.3** Communication plans between pilots may be discussed during ERR.
- **5.6.4** The ERR shall be combined with the MRR for the first excursion.

6. REQUIREMENTS

6.1 Safety Equipment Rules

- **6.1.1** HP Team pilots shall always wear appropriate PPE when on their rover during the event. PPE required but not limited to is listed below:

    6.1.1.1 – Commercially manufactured head protection (e.g., bicycle helmet).

    6.1.1.2 – Full-fingered gloves.

    6.1.1.3 – Long-sleeved and long-torso shirts.

    6.1.1.4 – Long pants (dangling pants shall be wrapped and/or taped down).

    6.1.1.5 – Long Socks.

    6.1.1.6 – Enclosed shoes (shoelaces shall be wrapped and/or taped down).

    6.1.1.7 – No apparatuses, such as stilts, may be used on the feet of the pilots.

- **6.1.2** RC Team pilots shall always wear appropriate PPE when on the course or interacting with the rover during the event. Up to two pilots are allowed to follow the rover on the course. PPE required but not limited to is listed below:

    6.1.2.1 – Full-fingered gloves.

    6.1.2.2 – Enclosed shoes.

6.2 Communication & Documentation Requirements

- **6.2.1** All verbal and written communication shall be in English. This includes communication with the HERC Management Team and between team members during DR and ORR presentations and office hours.
- **6.2.2** Communication with the HERC Management Team shall be through the team advisor and/or Student Team Lead. All communication shall be sent via email to HERC@mail.nasa.gov. The subject line shall include the subject matter of the communication and school name (Subject Description – Your School's Name).
- **6.2.3** Teams shall establish a social media presence to inform the public about day-to-day team activities. Teams are encouraged to update their social media accounts weekly. TikTok is not accessible by NASA personnel.
- **6.2.4** Accepted teams shall submit all deliverables via Box links provided to teams prior to deadlines specified in the handbook. All deliverables shall be submitted in PDF file format and meet all requirements outlined in this handbook. File names must follow the nomenclature: Institution Name_Activity Year_ Division_Deliverable Type.
- **6.2.5** The DR and ORR reports shall follow the format and outline guidance found in Deliverable Guidelines and Information, Section 7.

- **6.2.6** The team must have access to necessary computer equipment to perform a videoconference with the NASA Review Panel during DR and ORR presentations. This includes, but is not limited to, a computer system, video camera(s), speakers, and a stable internet connection. Presentations that are unable to be held due to technical difficulties on behalf of NASA or the participating team shall be rescheduled. Presentations that are unable to begin on-time due to technical difficulties on behalf of the team may require rescheduling.
- **6.2.7** All deliverables must be submitted by deadlines for a team to be considered for awards

6.3 Vehicle Requirements — Human Powered

- **6.3.1** Vehicles, inclusive of pilots, shall have a center of gravity low enough to safely handle slopes of 30 degrees front-to-back and side-to-side.
- **6.3.2** Vehicles shall be capable of a turning radius of 10ft or less.
- **6.3.3** The competition-ready rover shall be no wider than five feet at any point.
- **6.3.4** Rovers with pilots in position shall have clearance greater than or equal to 12 inches between the ground and the lowest point of the pilot's appendage, as shown in Figure 1.
- **6.3.5** Teams shall design and fabricate non-pneumatic wheels, inclusive of the outer surface contacting the terrain (treads) and the supporting structure (rims, spokes, etc.). The only commercial wheel component that can be used as part of a team's wheels are wheel hubs containing bearings and/or bushings.

Figure 1: Vehicle Height Requirement.

- **6.3.6** Vehicles shall be human-powered. Energy storage devices, such as springs, flywheels, or batteries are not allowed to be used as part of the drive train.
- **6.3.7** Each rover shall have robust, practical seat restraints for each of the pilots. The restraints must be capable of preventing the pilots from being ejected from their seats should the vehicle be forced to a sudden stop. The preferred method of restraint is a 3-point motor vehicle seat belt. Seat restraints shall always be worn when the vehicle is being driven on or off the course. A vehicle shall be stopped by an official or judge if either pilot is not secured by the seat restraint while the vehicle is in motion. Vehicles shall be held in the stopped position until the required restraint(s) are firmly in place.
- **6.3.8** Each rover shall have at least one adequate mechanical braking system. Braking system(s) shall be able to hold the rover and accompanying pilots when placed in-line on a 30-degree incline. Braking system(s) can be cable, hydraulic, or other mechanical mechanism that applies or translates a braking force to the rotating member(s) of the rover. No use of hands or body can be used on the wheels and/or drive train to slow or stop the rover from motion during regular excursion activity.
- **6.3.9** Teams shall design to eliminate or guard against any sharp edges or, as necessary, to ensure the safety of the pilots, participants, and HERC Staff. The final evaluation will be made by the safety judge at the HERC event.
- **6.3.10** HP Rover Teams shall adhere to the requirements for task execution below, if choosing to attempt the Task Tool Mission.

  6.3.10.1 – Teams may perform the tasks autonomously or manually.

6.4 Vehicle Requirements — Remote Controlled

- **6.4.1** Vehicles shall be battery powered. The use of flammable liquids is not permitted.
- **6.4.2** Teams are allowed to use the control system from a commercially available RC vehicle (controller, circuitry, radio components, etc.).

  6.4.2.1 – Middle school/high school teams are allowed to use a commercially available chassis and drive system to include suspension. However, wheels and tires must be designed and manufactured by the team.
- **6.4.3** Primary drive controls (forward, reverse, steering) shall be on a commercially made controller. Tasks may be performed with a custom-built controller.
- **6.4.4** Vehicles shall have a top speed no faster than 5 mph (8 km/h) during excursions. Software or mechanical limiters are required for vehicles that can exceed this.
- **6.4.5** Vehicles shall weigh 60 lb. or less.
- **6.4.6** Batteries shall be in an electrically insulated enclosure separate from other components.
- **6.4.7** Rovers with an electrically conductive chassis shall have a fuse or circuit breaker on the main battery connection.
- **6.4.8** All rovers shall have a “crew area” at least 2”x2”x2”. Teams shall collect life-support data from within the crew area during the excursion to include temperature and G-forces sustained.
- **6.4.9** Velocity, battery level, and GPS positioning data at least twice per minute shall be collected during the excursion to be shown at the PER.
- **6.4.10** RC Rover Teams shall adhere to the requirements for task execution below, if choosing to attempt the Task Tool Mission.

  6.4.10.1 – College/University teams shall perform the tasks autonomously. Pilots are allowed to steer the rover into position manually, but sample collection and testing must be done with a single command/button press (at each task site).

  6.4.10.2 – Middle/High School teams shall choose to perform the tasks autonomously (see requirement above) OR manually. Pilots are allowed to steer the rover into position manually.

Failure to meet any of the rules or requirements listed above may result in penalties, including but not limited to ineligibility for awards and prizes or complete disqualification from the competition at the discretion of the HERC Management Team.

7. DELIVERABLES

7.1 Proposal

The purpose of the proposal is to demonstrate that the team has the knowledge, resources, and administrative support to participate in the HERC program effectively and completely. Emphasis is placed on a team's available facilities, financial and technical support from the educational institution and community, and the team's ability to plan and schedule appropriately for the commitment HERC demands. The designs in this section are expected to be conceptual sketches and ideas.

Student Team Lead shall submit the proposal on the team's behalf via email to HERC@mail.nasa.gov by the deadline specified in the handbook. Proposal File name must follow the nomenclature: Institution Name_ Activity Year_Division_Proposal. (Example: Creekview High School – 2026 – High School HP – Proposal)

At a minimum, the proposing team shall identify the following in a written proposal due by the date specified in the timeline:

Format

- Proposals must be submitted in a PDF format
- Size 12 Times New Roman font or similar
- 8.5 in. × 11 in. paper size with 1-in. margins
- A cover page that includes:
  - The name of the middle school/high school, college/university, or institution along with full mailing address
  - Division: Middle School or High School or College/University, and HP or RC
  - Date
  - Name, Title, and Email Address of:
    - The Team Advisor
    - The Student Team Lead
    - The Studen Safety Officer
    - List of participating student team members (inclusive of the Student Team Lead and Safety Officer) who will be committed to the project and their proposed duties

Rubric

Percentages given are an estimate of the total weight out of 100% for each section.

- Introduction: 5%
- Facilities/Equipment: 40%
- Safety Plan: 15%
- Design: 10%
- Project Plan: 30%

Proposal Outline

Page Limit: Proposals will only be scored using the first 10 pages of the report (not including cover page and table of contents.) Any additional content will not be considered while scoring.

1. Facilities and Equipment

1.1 Description of the facilities, equipment, and supplies that are required to design and manufacture the vehicle components. Identify hours of accessibility, training, and necessary personnel that are required for any facilities.

1.2 Provide a description of the level of non-material support and sponsorship your school is providing (e.g., is this a school sponsored club or a Capstone course?)

2. Safety

2.1 Provide a Safety Plan.

2.1.1 – Detail how your team will perform Hazards Analysis, including identification of hazards, ranking and categorizing of risk, and mitigation of those hazards.

2.1.2 – Detail how your team will manage Safety in the various locations that will be utilized for the activities of your program, including: Design, Fabrication, Storage, and Testing.

2.1.3 – Provide a preliminary list of Safety Data Sheets (SDS) for materials and chemicals your team anticipates will be used. The entire SDS need not be copied into the Proposal. A series of hyperlinks, documents on a cloud storage, or sample screenshots is sufficient.

2.1.4 – This section is NOT a Hazards Analysis. This section is intended to address HOW your team will institute safety during your design, build, and operation.

2.2 Describe Student Briefings the team has planned. These should include subject, timeframe, and any necessary personnel.

2.3 Describe plans (when and how) to include the use of proper PPE during fabrication, testing, and competition.

3. Technical Design

3.1 A basic design overview of the rover concept and components.

3.2 Wheel design ideas and fabrication plans.

3.3 Drivetrain concept and design with fabrication plans.

3.4 Identify task sites the team plans to attempt and provide preliminary designs for associated task tool.

3.5 Address major technical challenges and possible solutions the team will face during the engineering design and manufacturing phase.

4. Project Plan

4.1 Provide a detailed development schedule/timeline covering all aspects necessary to meet all milestones and complete the project successfully.

4.2 Provide a budget to cover all aspects necessary to complete the project successfully, inclusive of team travel. The budget should include both materials and supplies the team already has on hand, and those the team will need to purchase.

4.3 Provide a funding plan including sources of funding and estimated (or confirmed) amounts.

4.4 Include any endorsements from the school to include anticipated or awarded grants, awards, donations, etc.

5. Engagement

5.1 Include a STEM Industry Engagement Plan OR Community STEM Engagement Plan. (1 page maximum) (see Section 7.6)

6. Appendix

6.1 Attach a brief institutional support letter acknowledging that your school or institution is aware and supportive of the team's intent to propose and enter the HERC challenge if accepted.

7.2 Design Review (DR) — Human Powered

The purpose of the DR is to demonstrate that the overall design meets all requirements with acceptable risk, within the cost, schedule, and technical performance constraints, and establish the basis for proceeding with fabrication, assembly, and integration. It should show that the correct design options have been selected and interfaces have been identified. Full baseline cost and schedules, as well as all risk assessment, management systems, and metrics, should be presented.

- The DRR accounts for 20% of the overall score for the competition
- The DR Presentation will be worth 10% of the total DR points

Teams shall submit their DRR and DR Presentation via Box link. Submit by the deadline specified in the handbook. The Design Review file name must follow the nomenclature: Institution Name_Activity Year_ Division_DR Deliverable. (Example: Tanner College – 2026 – University HP – DR Presentation)

Format

- Design Review must be submitted in a PDF format
- Size 12 Times New Roman font or similar
- 8.5 in. × 11 in. paper size with 1-in. margins
- A cover page that includes:
  - The name of the middle school/high school, college/university, or institution along with full mailing address
  - Division: Middle School or High School or College/University and HP or RC
  - Date
  - Name, Title, and Email Address of:
    - The Team Advisor
    - The Student Team Lead
    - The student Safety Officer
    - List of participating student team members (inclusive of the Student Team Lead and Student Safety Officer) who will be committed to the project and their proposed duties.

DR Presentation: It is expected that the team participants deliver the report in a professional manner and answer all questions to the best of their ability. The advisor may attend but shall not deliver the presentation or answer any questions pertaining to the project. The entire presentation is to be delivered in English.

- Presentation time is limited to 30 minutes; a 15-minute feedback discussion will follow the presentation
- Presentation should include an overview of each section of the DR report, emphasizing key points
- Presentation should be engaging and well-structured in a logical order, with a clear introduction, body, and conclusion

Rubric

Percentages given are an estimate of the total weight out of 100% for each section.

- Vehicle Criteria: 30%
- Task Tool Criteria: 10%
- Performance Predictions: 10%
- Safety (PHA/FMEA): 15%
- Project Plan (Requirements, Timeline, Budget): 25%
- Presentation: 10%

Design Review Report Outline

Page Limit: DRs will only be scored using the first 30 pages of the report (not including cover page and table of contents). Any additional appendix content, such as tables and full-size images, must be appropriately referenced within the report to be considered while scoring.

1. Table of Contents

2. Vehicle Criteria — Selection, Design, and Rational of Vehicle Design

2.1 Identify design criteria from the handbook (Section 6, Section 9, etc.).

2.2 Review the design at a system level (i.e. chassis, wheels, drivetrain, suspension, steering, braking, seats, etc.), going through each system's alternative designs, and evaluating the pros and cons of each alternative.

2.2.1 – For each alternative, briefly present research on why the alternative should not be chosen. These should be objective choices based on numerical data.

2.2.2 – After evaluating all alternatives, present the chosen vehicle design.

2.3 Describe the function of each subsystem and the components within those subsystems.

2.4 Describe how the design meets size, weight, volume, assembly, and clearance constraints.

2.5 Provide dimensional drawings of the leading design overall and by system.

3. Task Tool Criteria – Selection, Design, and Rational of Task Tool Design

3.1 Identify design criteria from the handbook (Section 6, Section 9, etc.).

3.2 Review the design at a system level (i.e. Tasks 1, 2, 3) going through each system's alternative designs, and evaluating the pros and cons of each alternative.

3.2.1 – For each alternative, briefly present research on why the alternative should not be chosen. These should be objective choices based on numerical data.

3.2.2 – After evaluating all alternatives, present the chosen task tool design.

3.3 Describe the function of each subsystem and the components within those subsystems.

3.4 Provide dimensional drawings of the leading design.

4. Analysis of Design

4.1 Discuss rover and task tool performance expectations based on quantitative data.

4.2 Provide analysis of the rover and task tool, and any subsystems demonstrating design sufficiency, for expected obstacle/task performance requirements.

4.2.1 – Analysis should be based on expected load cases specific to the HERC course shown with calculations or simulations.

4.3 Include a course management plan with a discussion of how the chosen designs will perform.

4.4 Estimate the mass of the overall rover and task tool using masses of individual parts or subsystems.

5. Safety

5.1 Provide a preliminary Personnel Hazard Analysis (PHA). This should include all phases of operation, including construction/fabrication, testing, and performance/competition.

5.2 Provide a preliminary Failure Modes and Effects Analysis (FMEA) of the proposed design of the vehicle and components. This is best organized by rover subsystem.

5.3 The focus of the safety analyses at the design review is identification of hazards/failure modes, their causes, and the resulting effects.

5.4 Preliminary mitigations and controls should be identified, but do not need to be implemented at this point unless they are specific to the construction of the vehicle or components (i.e., cost, schedule, personnel availability). Rank the risk of all hazards and failure modes for both likelihood and severity.

6. Project Plan

6.1 Confirm requirements verification to demonstrate all requirements in section 6.3 of this handbook have been met. Include the method of verification and validation.

6.2 Provide a timeline update to demonstrate that the team is on schedule to meet the requirements of this project. Include deliverables, fabrication, assembly, and testing dates. Schedule should encompass the full term of the project.

6.3 Provide a budget update to demonstrate that the team is within budget. Include funding updates since the proposal period.

6.4 Include a full list of all materials and services needed to be purchased (bill of materials), vendors, travel and lodging expenses for the event, and describe the material acquisition process.

7.3 Operational Readiness Review (ORR) — Human Powered

The ORR examines construction, tests, demonstrations, and analyses to determine the overall rover and task tool readiness for a safe and successful excursion. The rover is expected to be complete and begin the testing phase. Performance data should be included to validate the analyses from DR and confirm that the team is ready to safely compete in the in-person competition.

- The ORR Report accounts for 20% of the overall score for the competition.
- The ORR Presentation will be worth 10% of the total ORR points.
- The ORR Report and Presentation should be given as a stand-alone deliverable. No information from the DR should be assumed as known by the scorers and panel participants. All relevant design information should be stated again.

Teams shall submit their ORR Report and ORR Presentation via Box link. Submit by the deadline specified in the handbook. ORR file name must follow the nomenclature: *Institution Name_Activity Year_Division_ORR Deliverable*. (Example: *Iowa State University – 2026 – University HP – ORR Report*)

Format:

- ORR Report must be submitted in a PDF format.
- Size 12 Times New Roman font or similar.
- 8.5 in. × 11 in. paper size with 1-in. margins.
- A cover page that includes:
  - The name of the middle school/high school, college/university, or institution along with full mailing address
  - Division: Middle School or High School or College/University
  - Date
  - Name, Title, and Email Address of:
    - The team advisor.
    - The student team lead.
    - The student safety officer.
    - List of participating student team members (inclusive of the Student Team Lead and Student Safety Officer) who will be committed to the project and their proposed duties.

ORR Presentation: It is expected that the team participants deliver the report in a professional manner and answer all questions to the best of their ability. The advisor may attend but shall not deliver the presentation or answer any questions pertaining to the project. The entire presentation is to be delivered in English.

- There is a 30-minute time-limit for presentation. A 15-minute feedback discussion will follow the presentation.
- Presentation should include an overview of each section of the ORR report emphasizing key points
- Presentation should be engaging and well-structured in a logical order, with a clear introduction, body, and conclusion

Rubric

Percentages given are an estimate of the total weight out of 100% for each section.

- Vehicle Criteria: 25%
- Task Tool Criteria: 10%
- Performance Predictions: 15%
- Safety: 20%
- Project Plan (Requirements, Testing, Timeline, Budget): 20%
- Presentation: 10%

Operational Readiness Review Report Outline

Page Limit: ORRs will only be scored using the first 30 pages of the report (not including the cover page and table of contents). Any additional appendix content, such as tables and full-size images, must be appropriately referenced within the report to be considered while scoring.

1. Table of Contents

2. Vehicle Criteria – Design and construction of the vehicle

2.1 Describe the major design considerations and how the rover was designed to meet them.

2.2 Provide a final design summary of the as-built rover. Include dimensioned drawings, materials, and masses of all major subsystems.

2.3 Describe any major changes to the rover subsystems from the DR and explain why those changes are necessary. Justify subsystems not requiring changes. Prove that any changes meet the design considerations established in the handbook.

2.4 Prove that the vehicle is fully constructed and explain the construction process for major subsystems.

2.5 Include updated schematics and images of the completed rover and major subsystems.

3. Task Tool Criteria – Design and construction of the Task Tool

3.1 Describe the major design considerations and how the task tool was designed to meet them.

3.2 Provide a final design summary of the as-built task tool. Include dimensioned drawings, materials, and masses of all major subsystems. Describe how it functions to complete each task.

3.3 Describe any major changes to the task tool from the DR and explain why those changes are necessary. Prove that any changes meet the design considerations established from the handbook.

3.4 Prove that the task tool is fully constructed and explain the construction process.

3.5 Include updated schematics and images of the completed task tool.

4. Excursion Performance Predictions

4.1 Describe a strategy for optimizing points earned by your team's excursion performance on the course.

4.2 Estimate how long it will take to complete each obstacle to be included in your excursion strategy. Provide rationale for time estimates.

4.3 Explain how the rover will overcome each obstacle and task your team plans to attempt. This should include the physical aspect or parameter of each obstacle that is most important to complete it. Explain how your rover interfaces with those aspects or parameters. Explain how the task tool is utilized at each task site.

4.4 Identify parts or subsystems of that rover that are most critical (i.e., greatest potential for failure). Provide data showing these systems will perform successfully under nominal conditions.

4.5 Include contingency planning. How and why might your rover team adjust your excursion strategy while on the course?

5. Safety

5.1 Update the Personnel Hazard Analysis and the Failure Modes and Effects Analysis to include:

5.1.1 – Finalized hazard descriptions, causes, and effects of the vehicle and mission components the team has built.

5.1.2 – A completed list of mitigations addressing the hazards and/or their causes.

5.1.3 – A completed list of verifications for the identified mitigations. This should include methods of verifying the mitigations and controls are (or will be) in place, and how they will serve to ensure mitigation.

5.1.4 – Include all procedures and checklists. This should include those for competition days, packing, troubleshooting, pilot health, etc.

6. Project Plan

6.1 Update the requirements verification plan demonstrating that all requirements from Section 6.3 in this handbook are met. Include verification and validation methods.

6.2 Discuss testing to include dates, results, and purpose. Include additional testing still to be done with estimated dates of completion.

6.3 Discuss the final budget and expense report. The requirements for this section are the same as the DR but should include updates and changes.

6.4 Include a STEM Industry Engagement Summary OR Community STEM Engagement Summary. (1 page maximum) (see Section 7.6)

7.4 Design Review (DR) — Remote-Controlled

The purpose of the DR is to demonstrate that the overall design meets all requirements with acceptable risk, within the cost, schedule, and technical performance constraints, and establish the basis for proceeding with fabrication, assembly, and integration. It should show that the correct design options have been selected and interfaces have been identified. Full baseline cost and schedules, as well as all risk assessment, management systems, and metrics, should be presented.

- The DRR accounts for 20% of the overall score for the competition
- The DR Presentation will be worth 10% of the total DR points

Teams shall submit their DRR and DR Presentation via Box link. Submit by the deadline specified in the handbook. The Design Review file name must follow the nomenclature: Institution Name_Activity Year_ Division_DR Deliverable. (Example: Tanner College – 2026 – University HP – DR Presentation)

Format

- Design Review must be submitted in a PDF format
- Size 12 Times New Roman font or similar
- 8.5 in. × 11 in. paper size with 1-in. margins
- A cover page that includes:
  - The name of the middle school/high school, college/university, or institution along with full mailing address
  - Division: Middle School or High School or College/University and HP or RC
  - Date
  - Name, Title, and Email Address of:
    - The Team Advisor
    - The Student Team Lead
    - The student Safety Officer
    - List of participating student team members (inclusive of the Student Team Lead and Student Safety Officer) who will be committed to the project and their proposed duties.

DR Presentation: It is expected that the team participants deliver the report in a professional manner and answer all questions to the best of their ability. The advisor may attend but shall not deliver the presentation or answer any questions pertaining to the project. The entire presentation is to be delivered in English.

- Presentation time is limited to 30 minutes; a 15-minute feedback discussion will follow the presentation
- Presentation should include an overview of each section of the DR report, emphasizing key points
- Presentation should be engaging and well-structured in a logical order, with a clear introduction, body, and conclusion

Rubric

Percentages given are an estimate of the total weight out of 100% for each section.

- Vehicle Criteria: 30%
- Task Tool Criteria: 10%
- Performance Predictions: 10%
- Safety (PHA/FMEA): 15%
- Project Plan (Requirements, Timeline, Budget): 25%
- Presentation: 10%

Design Review Report Outline

Page Limit: DRs will only be scored using the first 30 pages of the report (not including cover page and table of contents). Any additional appendix content, such as tables and full-size images, must be appropriately referenced within the report to be considered while scoring.

1. Table of Contents

2. Vehicle Criteria — Selection, Design, and Rational of Vehicle Design

- **2.1** Identify design criteria from the handbook (Section 6, Section 9, etc.).
- **2.2** Review the design at a system level (i.e. chassis, wheels, drivetrain, suspension, steering, braking, seats, etc.), going through each system's alternative designs, and evaluating the pros and cons of each alternative.

  2.2.1 – For each alternative, briefly present research on why the alternative should not be chosen. These should be objective choices based on numerical data.

  2.2.2 – After evaluating all alternatives, present the chosen vehicle design.
- **2.3** Describe the function of each subsystem and the components within those subsystems.
- **2.4** Describe how the design meets size, weight, volume, assembly, and clearance constraints.
- **2.5** Provide dimensional drawings of the leading design overall and by system.

3. Task Tool Criteria – Selection, Design, and Rational of Task Tool Design

- **3.1** Identify design criteria from the handbook (Section 6, Section 9, etc.).
- **3.2** Review the design at a system level (i.e. Tasks 1, 2, 3) going through each system's alternative designs, and evaluating the pros and cons of each alternative.

  3.2.1 – For each alternative, briefly present research on why the alternative should not be chosen. These should be objective choices based on numerical data.

  3.2.2 – After evaluating all alternatives, present the chosen task tool design.
- **3.3** Describe the function of each subsystem and the components within those subsystems.
- **3.4** Provide dimensional drawings of the leading design.

4. Analysis of Design

- **4.1** Discuss rover and task tool performance expectations based on quantitative data.
- **4.2** Provide analysis of the rover and task tool, and any subsystems demonstrating design sufficiency, for expected obstacle/task performance requirements.

  4.2.1 – Analysis should be based on expected load cases specific to the HERC course shown with calculations or simulations.
- **4.3** Include a course management plan with a discussion of how the chosen designs will perform.
- **4.4** Estimate the mass of the overall rover and task tool using masses of individual parts or subsystems.

5. Safety

5.1 Provide a preliminary Personnel Hazard Analysis (PHA). This should include all phases of operation, including construction/fabrication, testing, and performance/competition.

5.2 Provide a preliminary Failure Modes and Effects Analysis (FMEA) of the proposed design of the vehicle and components. This is best organized by rover subsystem.

5.3 The focus of the safety analyses at the design review is identification of hazards/failure modes, their causes, and the resulting effects.

5.4 Preliminary mitigations and controls should be identified, but do not need to be implemented at this point unless they are specific to the construction of the vehicle or components (i.e., cost, schedule, personnel availability). Rank the risk of all hazards and failure modes for both likelihood and severity.

6. Project Plan

6.1 Confirm requirements verification to demonstrate all requirements in section 6.3 of this handbook have been met. Include the method of verification and validation.

6.2 Provide a timeline update to demonstrate that the team is on schedule to meet the requirements of this project. Include deliverables, fabrication, assembly, and testing dates. Schedule should encompass the full term of the project.

6.3 Provide a budget update to demonstrate that the team is within budget. Include funding updates since the proposal period.

6.4 Include a full list of all materials and services needed to be purchased (bill of materials), vendors, travel and lodging expenses for the event, and describe the material acquisition process.

7.5 Operational Readiness Review (ORR) — Remote – Controlled

The ORR examines construction, tests, demonstrations, and analyses to determine the overall rover and task tool readiness for a safe and successful excursion. The rover is expected to be complete and begin the testing phase. Performance data should be included to validate the analyses from DR and confirm that the team is ready to safely compete in the in-person competition.

- The ORR Report accounts for 20% of the overall score for the competition.
- The ORR Presentation will be worth 10% of the total ORR points.
- The ORR Report and Presentation should be given as a stand-alone deliverable. No information from the DR should be assumed as known by the scorers and panel participants. All relevant design information should be stated again.

Teams shall submit their ORR Report and ORR Presentation via Box link. Submit by the deadline specified in the handbook. ORR file name must follow the nomenclature: *Institution Name_Activity Year_Division_ORR Deliverable*. (Example: *Iowa State University – 2026 – University HP – ORR Report*)

Format:

- ORR Report must be submitted in a PDF format.
- Size 12 Times New Roman font or similar.
- 8.5 in. × 11 in. paper size with 1-in. margins.

- A cover page that includes:
  - The name of the middle school/high school, college/university, or institution along with full mailing address
  - Division: Middle School or High School or College/University
  - Date
  - Name, Title, and Email Address of:
    - The team advisor.
    - The student team lead.
    - The student safety officer.
    - List of participating student team members (inclusive of the Student Team Lead and Student Safety Officer) who will be committed to the project and their proposed duties.

ORR Presentation: It is expected that the team participants deliver the report in a professional manner and answer all questions to the best of their ability. The advisor may attend but shall not deliver the presentation or answer any questions pertaining to the project. The entire presentation is to be delivered in English.

- There is a 30-minute time-limit for presentation. A 15-minute feedback discussion will follow the presentation.
- Presentation should include an overview of each section of the ORR report emphasizing key points
- Presentation should be engaging and well-structured in a logical order, with a clear introduction, body, and conclusion

Rubric

Percentages given are an estimate of the total weight out of 100% for each section.

- Vehicle Criteria: 25%
- Task Tool Criteria: 10%
- Performance Predictions: 15%
- Safety: 20%
- Project Plan (Requirements, Testing, Timeline, Budget): 20%
- Presentation: 10%

Operational Readiness Review Report Outline

Page Limit: ORRs will only be scored using the first 30 pages of the report (not including the cover page and table of contents). Any additional appendix content, such as tables and full-size images, must be appropriately referenced within the report to be considered while scoring.

1. Table of Contents

2. Vehicle Criteria – Design and construction of the vehicle

2.1 Describe the major design considerations and how the rover was designed to meet them.

2.2 Provide a final design summary of the as-built rover. Include dimensioned drawings, materials, and masses of all major subsystems.

2.3 Describe any major changes to the rover subsystems from the DR and explain why those changes are necessary. Justify subsystems not requiring changes. Prove that any changes meet the design considerations established in the handbook.

2.4 Prove that the vehicle is fully constructed and explain the construction process for major subsystems.

2.5 Include updated schematics and images of the completed rover and major subsystems.

3. Task Tool Criteria – Design and construction of the Task Tool

3.1 Describe the major design considerations and how the task tool was designed to meet them.

3.2 Provide a final design summary of the as-built task tool. Include dimensioned drawings, materials, and masses of all major subsystems. Describe how it functions to complete each task.

3.3 Describe any major changes to the task tool from the DR and explain why those changes are necessary. Prove that any changes meet the design considerations established from the handbook.

3.4 Prove that the task tool is fully constructed and explain the construction process.

3.5 Include updated schematics and images of the completed task tool.

4. Excursion Performance Predictions

4.1 Describe a strategy for optimizing points earned by your team's excursion performance on the course.

4.2 Estimate how long it will take to complete each obstacle to be included in your excursion strategy. Provide rationale for time estimates.

4.3 Explain how the rover will overcome each obstacle and task your team plans to attempt. This should include the physical aspect or parameter of each obstacle that is most important to complete it. Explain how your rover interfaces with those aspects or parameters. Explain how the task tool is utilized at each task site.

4.4 Identify parts or subsystems of that rover that are most critical (i.e., greatest potential for failure). Provide data showing these systems will perform successfully under nominal conditions.

4.5 Include contingency planning. How and why might your rover team adjust your excursion strategy while on the course?

5. Safety

5.1 Update the Personnel Hazard Analysis and the Failure Modes and Effects Analysis to include:

5.1.1 – Finalized hazard descriptions, causes, and effects of the vehicle and mission components the team has built.

5.1.2 – A completed list of mitigations addressing the hazards and/or their causes.

5.1.3 – A completed list of verifications for the identified mitigations. This should include methods of verifying the mitigations and controls are (or will be) in place, and how they will serve to ensure mitigation.

5.1.4 – Include all procedures and checklists. This should include those for competition days, packing, troubleshooting, pilot health, etc.

6. Project Plan

6.1 Update the requirements verification plan demonstrating that all requirements from Section 6.3 in this handbook are met. Include verification and validation methods.

6.2 Discuss testing to include dates, results, and purpose. Include additional testing still to be done with estimated dates of completion.

6.3 Discuss the final budget and expense report. The requirements for this section are the same as the DR but should include updates and changes.

6.4 Include a STEM Industry Engagement Summary OR Community STEM Engagement Summary. (1 page maximum) (see Section 7.6)

7.6 Engagement

Engagement Requirement Option 1 – STEM Industry Engagement

Provide a plan for how your team will engage with industry professionals and community leaders to enhance your project's impact and educational value while developing meaningful connections that could lead to future workforce opportunities for your team members. Your plan should be no more than 1 page maximum.

Proposal Requirement - STEM Industry Engagement Plan

1. Audit local community and create a list of potential partners and alignment with project goals. Consider technical expertise, mentorship, skills development, certifications or resources sought to advance project goals.

2. Your plan should assess the team's Professional Development Strategy (choose at least one from this category).

    a. Summarize mentorship arrangements your team plans to target with industry experts/partners.

    b. Identify skills development and certification opportunities your team members plan to seek with industry partners (e.g. welding, safety training, electrical, software).

    c. Explain how your team's industry connections would support team members' career goals.

    d. Identify potential internship, fellowship, apprenticeship, or career opportunities your team members plan to seek.

3. Your plan should assess the team's Community Leadership Outreach (choose at least one from this category).

    a. Describe how your team engage with local civic and community leaders.

    b. Summarize the method your team will use to raise awareness about your NASA challenge participation.

    c. Identify and outline connections your team has and/or will seek with community leaders and industry partners.

Operational Readiness Review Requirement - STEM Industry Engagement Summary

1. Provide a list of partners you engaged with this activity year. Identify the area in which you engaged with them: technical expertise, mentorship, skills development, certifications or resources sought to advance project goals.
2. Your summary should assess the team's Professional Development Strategy (choose at least one from this category).

    a. Summarize any mentorship arrangements your team developed with industry experts/partners.

    b. Identify skills development and certification opportunities your team members received through industry partners (e.g. welding, safety training, electrical, software).

    c. Explain how your team's industry connections supported team members' career goals.

    d. Identify internship, fellowship, apprenticeship, or career opportunities your team members have received or will receive.

3. Your summary should assess the team's Community Leadership Outreach (choose at least one from this category).

    a. Describe how your team engaged with local civic and community leaders.

    b. Summarize the method your team used to raise awareness about your NASA challenge participation.

    c. Identify and outline connections your team has or developed with community leaders and industry partners.

Engagement Requirement Option 2 – Community STEM Engagement

Provide a plan for how your team will engage with local schools, educational institutions, and your community to enhance your project's impact and educational value while developing meaningful connections to inspire the next generation of space explorers. Your plan should be no more than 1 page maximum.

Proposal Requirement - Community STEM Engagement Plan

1. Audit local schools, and community educational institutions, and create a list of potential opportunities for your team to host or implement STEM Engagement events.
2. Your plan should assess the team's STEM Engagement and Outreach Strategy (include all three from this category)

    a. Identify a goal for your team to reach with your STEM Engagement and Outreach Strategy.

    b. Summarize activities, or events, the team plans to host or implement in for STEM Engagement.

    c. Provide potential dates or schedule for your plan.

Operational Readiness Review Requirement - Community STEM Engagement Summary

1. Provide a list of local schools, and/or community educational institutions your team partnered with for STEM Engagement activities and events.
2. Your summary should assess the team's STEM Engagement and Outreach Strategy (include all three from this category)

    a. Summarize how your team reached your goal with your STEM Engagement and Outreach Strategy.

    b. Summarize each activity, or event your team implemented.

    c. Include the table below with dates, groups, and participant breakdown for each of your events or activities. Add extra lines to the table as needed.

Event Date	Name of Group	In-person or Virtual	Number of participants Preschool – 4 grade	Number of participants 5 – 8 grade	Number of participants 9 – 12 grade	Under-graduates	Educators	Adult (non-educators)

8.1 POINTS BREAKDOWN AND ALLOCATION — HUMAN POWERED

Points Breakdown – HP

Points Breakdown	Points	Weight (%)
DR	20	20%
ORR	20	20%
MRR	10	10%
OBSTACLES	40	40%
TASKS	10	10%
TOTAL POSSIBLE POINTS	100	100%

Mission Readiness Review – HP

Item	Description	Possible Points	Summary of Points Breakdown
MRR Late Penalty	Teams arriving outside their time window for MRR, or not being ready for the MRR.	5-point penalty (–5 Points)	Penalty can be assessed once at MRR and will carry over in the MRR score for both excursions.
MRR Readiness Penalty	Teams not able to demonstrate the vehicle is ready to proceed to ERR, not being ready to compete.	5-point penalty (–5 Points)	Penalty can be assessed once at MRR and will carry over in the MRR score for both excursions.
Volume Constraint (This point total is carried over both excursions.)	Vehicle measured to fit inside 5 x 5 x 5-foot volume constraint.	3	3 points for success 0 points for failure
Weight (This point total is carried over both excursions.)	Vehicle will be weighed.	5	5 points for less than 130 lbs. 3 points for 131 – 170 lbs. 1 point for 171 – 210 lbs. 0 points for more than 210 lbs.
Unfolding/Assembly (This point total is carried over both excursions.)	Teams will be assessed on the amount of time it takes to unfold/assemble and ready the vehicle for course excursion.	2	2 points for 0:00 – 0:30 seconds 1 point for 0:31 – 1:00 minutes 0 points for more than 1:00 minutes

Excursion Readiness Review – HP

Item	Description	Points	Summary of Points Breakdown
Late Penalty	Teams arriving outside their time window, not being ready for excursions.	5-point penalty (–5 Points)	Penalty can be assessed once per excursion for arriving outside their excursion window or not being ready to compete.
ERR Inspection	Teams will be inspected for safety requirements and task material requirements. Photos of Rover taken. The MRR will be combined with ERR for the first excursion.	N/A	See each task for point reference earned at ERR.
Post-Excursion Review	Inspection	N/A	See each task for point reference earned at PER.

* Detailed point breakdown included in each obstacle task description. (TS – Judged at Task Site; PER – Judged at Post-Excursion Review)

Challenge Obstacle – Human-Powered

Obstacle	Description	Points	Points Breakdown
1	Ice Geyser Slalom	4	4 points for successful completion 1 point for attempt 0 points for bypass/no attempt
2	Undulating Terrain	3	3 points for successful completion 1 point for attempt 0 points for bypass/no attempt
3	Pea Gravel	3	3 points for successful completion 1 point for attempt 0 points for bypass/no attempt
4	High Butte	6	6 points for successful completion 1 point for attempt 0 points for bypass/no attempt
5	Crevasses	4	4 points for successful completion 1 point for attempt 0 points for bypass/no attempt
6	Bouldering Rocks	5	5 points for successful completion 1 point for attempt 0 points for bypass/no attempt
7	Lunar Ravine	4	4 points for successful completion 1 point for attempt 0 points for bypass/no attempt
8	Crater with Ejecta	3	3 points for successful completion 1 point for attempt 0 points for bypass/no attempt
9	Loose Regolith	3	3 points for successful completion 1 point for attempt 0 points for bypass/no attempt
10	Transverse Incline	5	5 points for successful completion 1 point for attempt 0 points for bypass/no attempt

* Detailed point breakdown included in each obstacle task description. (TS – Judged at Task Site; PER – Judged at Post-Excursion Review)

8.2 POINTS BREAKDOWN AND ALLOCATION — REMOTE-CONTROLLED

Points Breakdown – RC

Points Breakdown	Points	Weight (%)
DR	20	20%
ORR	20	20%
MRR	10	10%
OBSTACLES	20	20%
TASKS	30	10%
TOTAL POSSIBLE POINTS	100	100%

Mission Readiness Review – RC

Item	Description	Possible Points	Summary of Points Breakdown
MRR Late Penalty	Teams arriving outside their time window for MRR, or not being ready for the MRR.	5-point penalty (–5 Points)	Penalty can be assessed once at MRR and will carry over in the MRR score for both excursions.
MRR Readiness Penalty	Teams not able to demonstrate the vehicle is ready to proceed to ERR, not being ready to compete.	5-point penalty (–5 Points)	Penalty can be assessed once at MRR and will carry over in the MRR score for both excursions.
Volume Constraint (This point total is carried over both excursions.)	Vehicle measured to fit inside 5 x 5 x 5-foot volume constraint.	5	5 points for success 0 points for failure
Weight (This point total is carried over both excursions.)	Vehicle will be weighed.	5	5 points for less than 20 lbs. 3 points for 20 – 30 lbs. 1 point for 30 – 60 lbs. 0 points for more than 60 lbs.

Excursion Readiness Review – RC

Item	Description	Points	Summary of Points Breakdown
Late Penalty	Teams arriving outside their time window, not being ready for excursions.	5-point penalty (–5 Points)	Penalty can be assessed once per excursion for arriving outside their excursion window or not being ready to compete.
ERR Inspection	Teams will be inspected for safety requirements and task material requirements. Photos of Rover taken. The MRR will be combined with ERR for the first excursion.	N/A	See each task for point reference earned at ERR.
Post-Excursion Review	Inspection	N/A	See each task for point reference earned at PER.

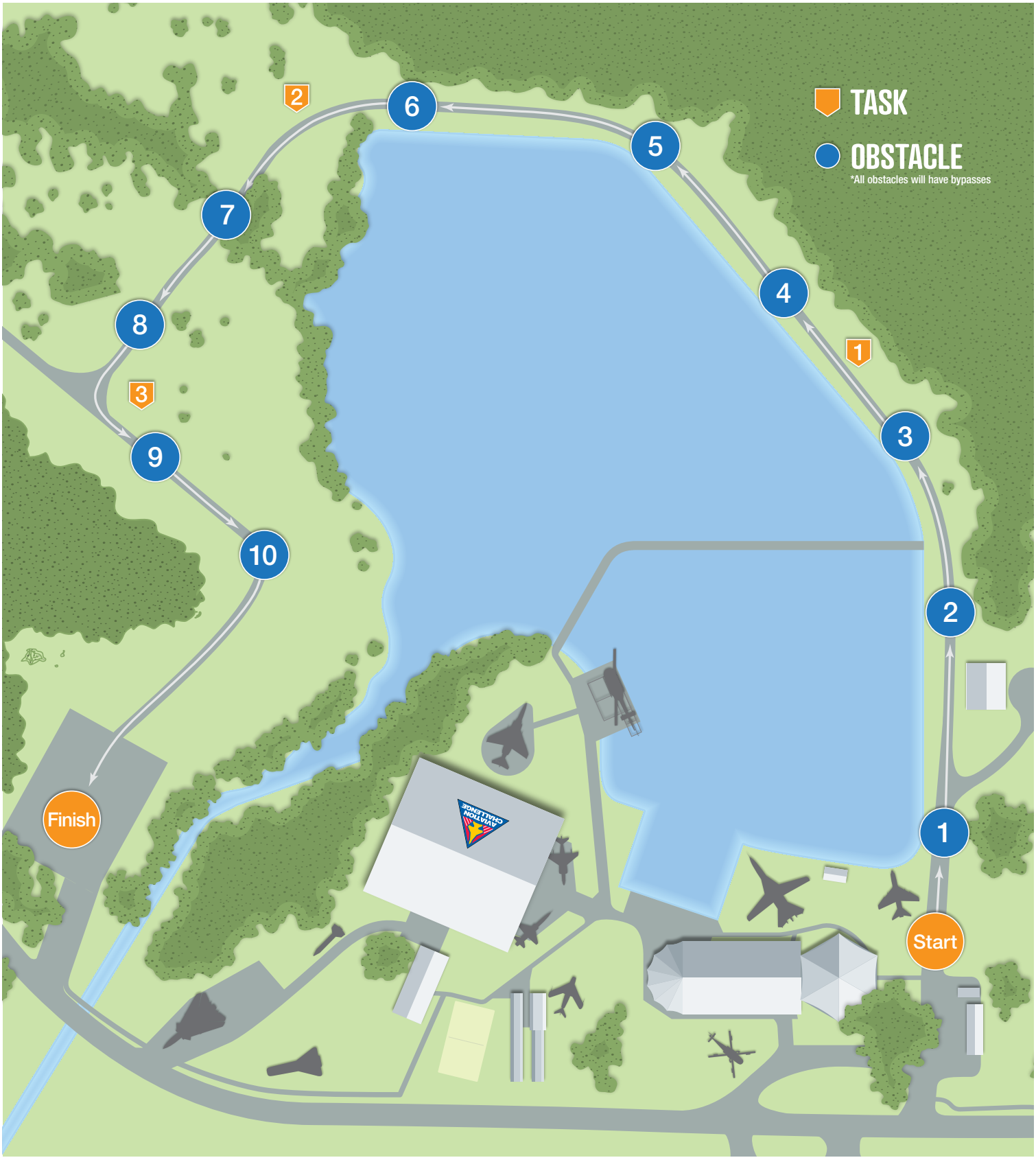
* Detailed point breakdown included in each obstacle task description. (TS – Judged at Task Site; PER – Judged at Post-Excursion Review)

Challenge Obstacle – Remote-Controlled

Obstacle	Description	Points	Points Breakdown
1	Ice Geyser Slalom	2	2 points for successful completion 0 points for bypass/no attempt
2	Undulating Terrain	2	2 points for successful completion 0 points for bypass/no attempt
3	Pea Gravel	1	1 point for successful completion 0 points for bypass/no attempt
4	High Butte	3	3 points for successful completion 0 points for bypass/no attempt
5	Crevasses	2	2 points for successful completion 0 points for bypass/no attempt
6	Bouldering Rocks	3	3 points for successful completion 0 points for bypass/no attempt
7	Lunar Ravine	2	2 points for successful completion 0 points for bypass/no attempt
8	Crater with Ejecta	2	2 points for successful completion 0 points for bypass/no attempt
9	Loose Regolith	1	1 point for successful completion 0 points for bypass/no attempt
10	Transverse Incline	2	2 points for successful completion 0 points for bypass/no attempt

* Detailed point breakdown included in each obstacle task description. (TS – Judged at Task Site; PER – Judged at Post-Excursion Review)

9. COURSE MAP


TASK
OBSTACLE
*All obstacles will have bypasses
Start
Finish
1
2
3
4
5
6
7
8
9
10

10. COURSE DESCRIPTIONS AND DESIGN

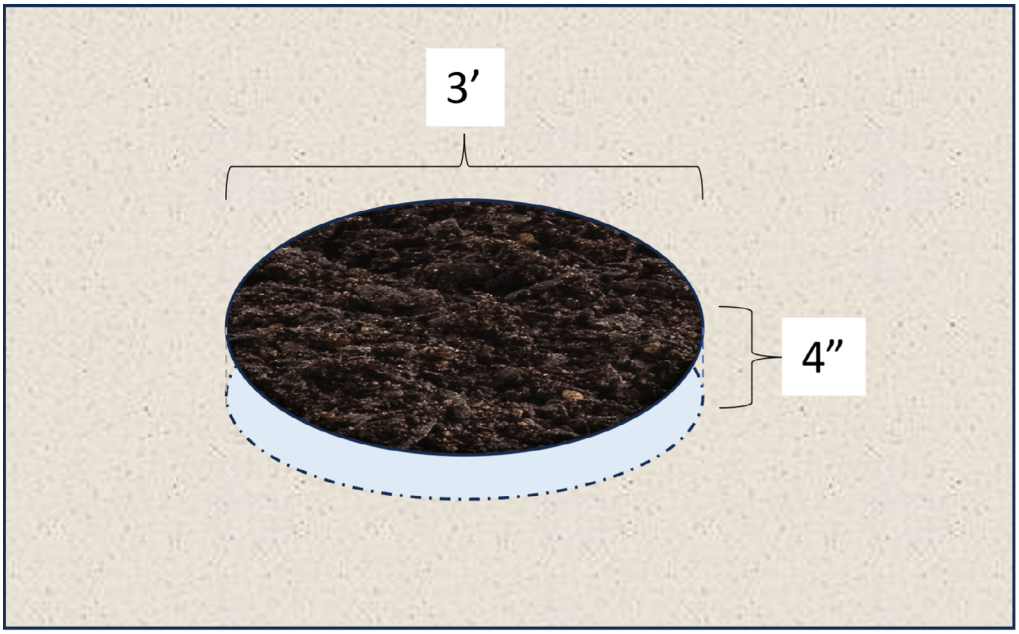
Note: All course obstacles and tasks outlined below are subject to change. Photos and drawings are provided for illustration purposes only and may or may not represent actual course design.

HP Teams may design a single task tool to complete up to 3 of the tasks outlined below (see section 6.3 for requirements)

RC Teams may choose to design onboard task tool(s) to complete up to 3 of the tasks outlined below (see section 6.4 for requirements)

TASK 1

SOIL SAMPLING

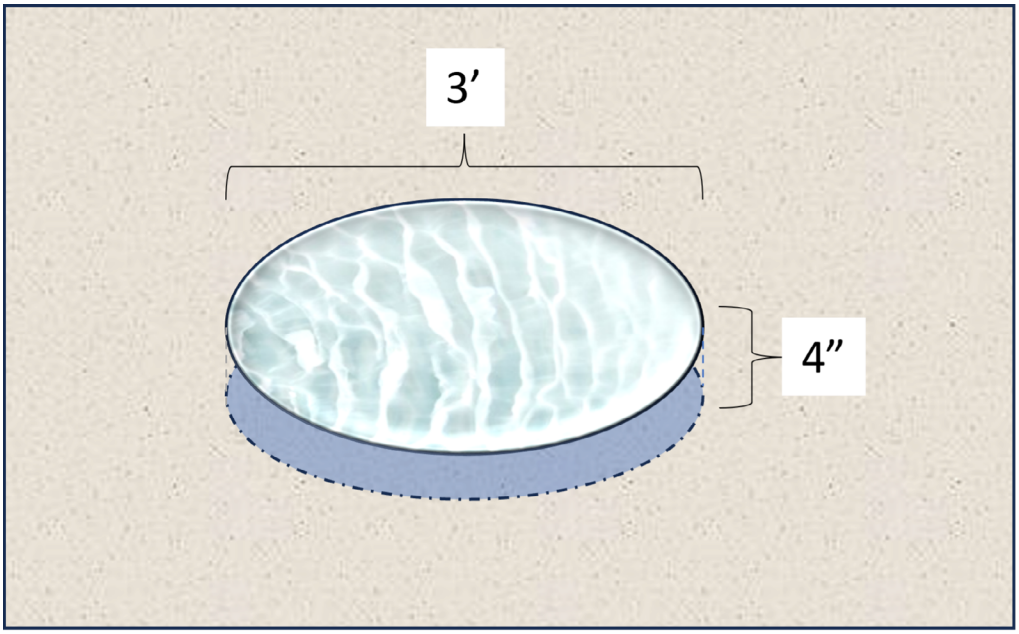


TASK SITE 1: Soil Sampling

A 3ft diameter circular container 4” deep will be buried flush with the ground and filled with soil. Teams will collect at least 1 tablespoon (15 mL) of soil and safely transport it to the end of the excursion. Teams will analyze the soil for moisture content and report their results at the PER. Note: The soil collected does not need to be the soil that is analyzed. Note RC Rovers are allowed to drive onto the soil.

TASK 2

WATER SAMPLING

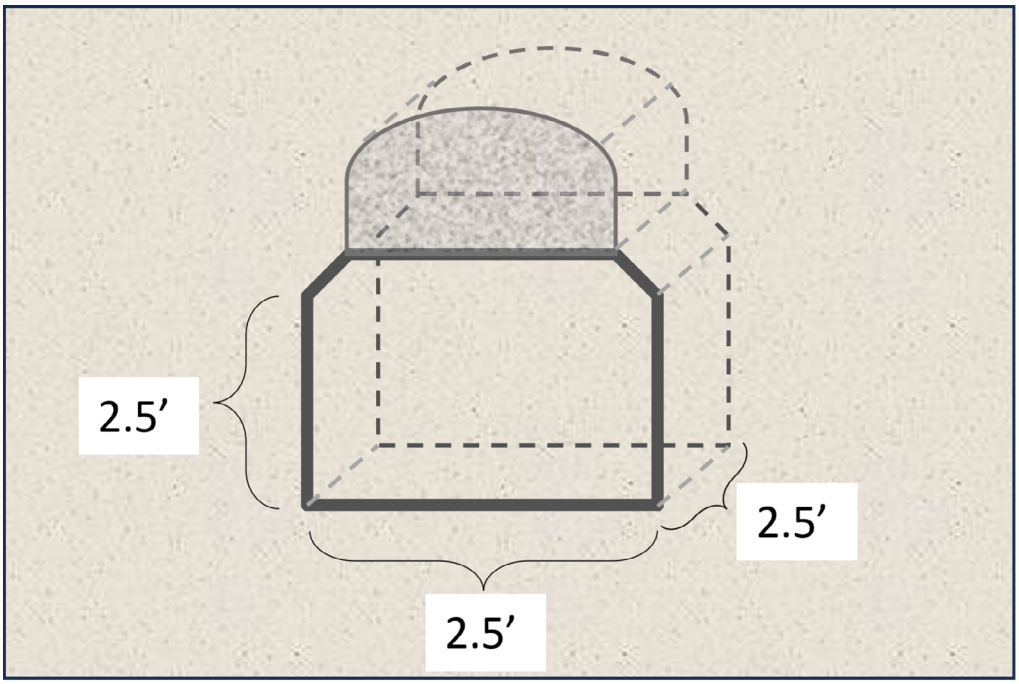


TASK SITE 2: Water Sampling

A 3ft diameter circular container 4” deep will be buried flush with the ground and filled with water. Teams will collect at least 1 tablespoon (15 mL) of water and safely transport it to the end of the excursion. Teams will analyze the water for pH and report their results at the PER. Note: The water collected does not need to be the water that is analyzed. Note RC rovers are allowed to drive into the water.

TASK 3

AIR SAMPLING



TASK SITE 3: Air Sampling

An atmospheric sample container will be elevated above a rigid base. The base will have a 2.5 x 2.5 ft opening on two opposing sides. All teams will test the air sample for carbon dioxide content. No samples need to be collected. RC rovers will drive into the opening in the base and sample the air inside the container, while HP rovers will use their task tool to enter one of the openings to sample the air.

OBSTACLE 1

Ice Geyser Slalom

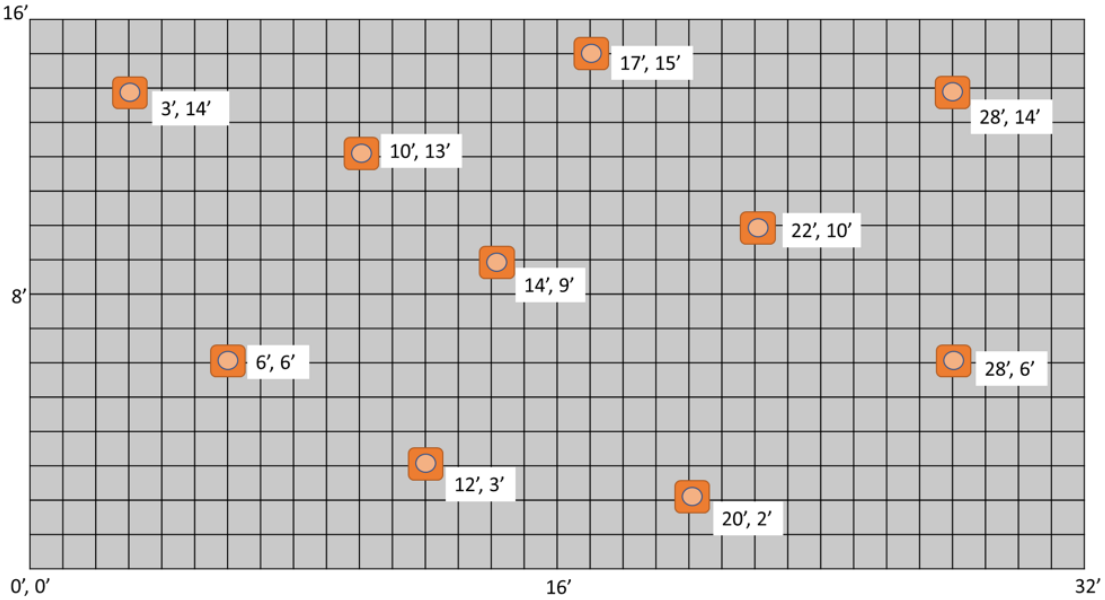


Figure 1. Obstacle 1 — Ice Geyser Slalom

A series of simulated ice geysers impede the path. This obstacle requires that teams carefully navigate the course without encountering any of the geysers. The approximate placement of the ice geysers as well as approximate total length and width of obstacles are shown in Figure 1. Steering systems will be of utmost importance to do this.

This obstacle will have a 1/3 scale version for the RC division.

OBSTACLE 2

Undulating Terrain

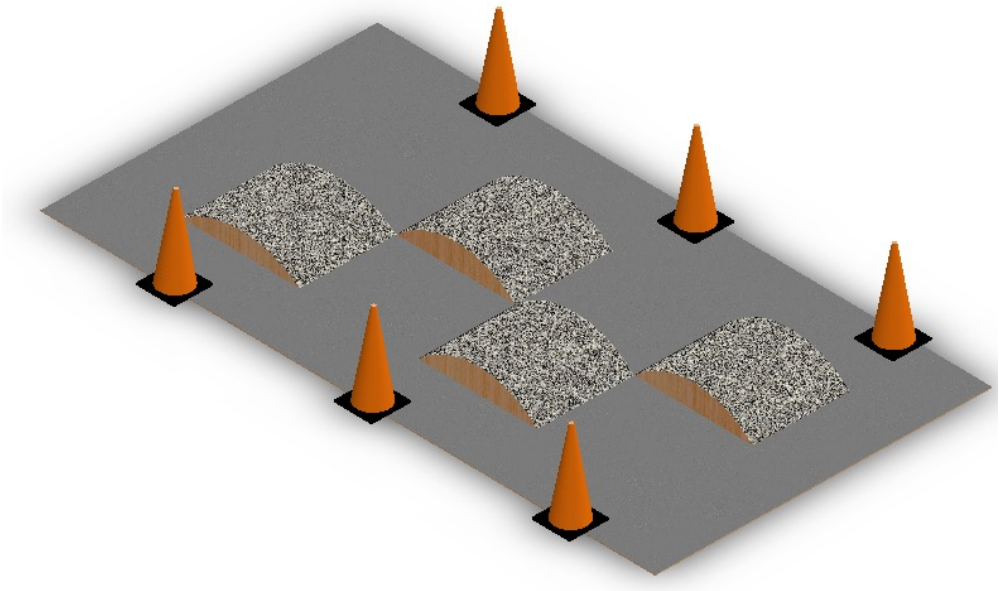


Figure 2. Obstacle 2 — Undulating Terrain

This gently uneven surface is replicated by four wooden ramps located in an alternating pattern causing the rover to be tilted to the right or to the left as only the wheels on one side of the rover are elevated at a time. The ramps range from 6 – 12 in. in height with gradual ingress and egress slopes, all covered with gravel. The length of each ramp is about 5 ft. long and the width is about 4 ft. as shown in Figure 2.

OBSTACLE 3

Pea Gravel

Figure 3. Obstacle 3 — Pea Gravel

This ancient stream bed consists of fine, rounded pebbles deposited to a depth of about 6 in. Rover wheels might sink in this smooth obstacle material. The total length of the obstacle is 10 ft. and the width is about 6 ft.

OBSTACLE 4

High Butte

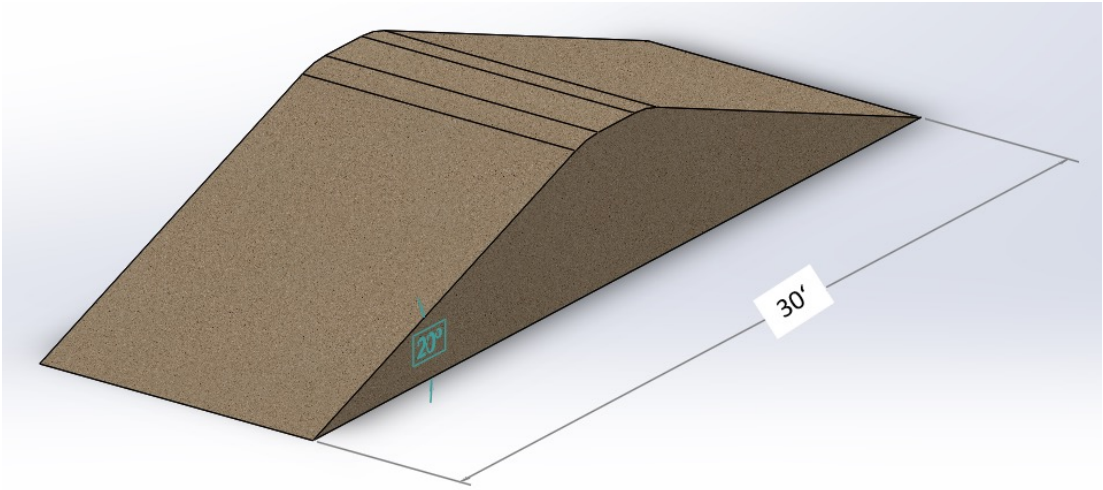


Figure 4. Obstacle 4 — High Butte

This obstacle is a test of the rover's climbing ability. This butte is 5 ft. high with a 20-degree incline before and after the peak and a flat 2 ft. surface at the top. The butte is made from stone and soil. Figure 4 shows the dimensions of obstacle 4.

OBSTACLE 5

Crevasses

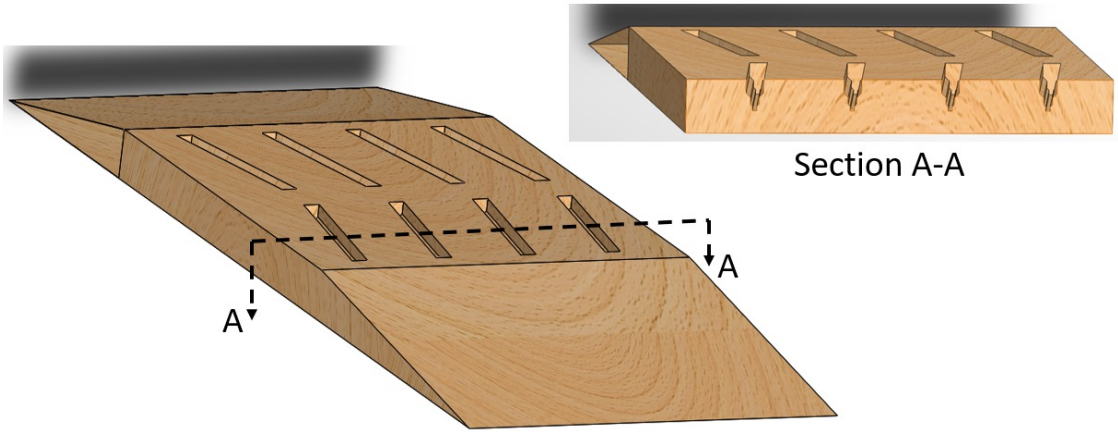


Figure 5. Obstacle 5 — Crevasses

Crevasses result from cracks in the surface regolith or from erosion by liquid and/or molten material which form ruts in underlying material. There are four sets of parallel cracks located along with the direction of rover traverse. Each crevasse consists of multi-level cracks. The depth of each crack varies between 4 – 7 in. and the width varies between 1 – 4 in. throughout as shown in Figure 5. The length of each set of cracks is about 4 ft. long, and the total length of the obstacles is about 12 ft. Teams shall design the wheel of the rover to avoid having the rover wheels stuck in these cracks.

This obstacle will have a 1/3 scale version for the RC division.

OBSTACLE 6

Bouldering Rocks

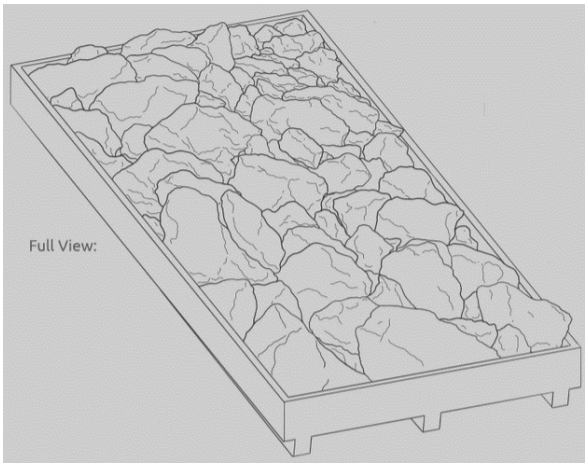


Figure 6. Obstacle 6 — Bouldering Rocks

Rovers shall navigate over this field of simulated asteroid debris (boulders). The asteroid fragments range in size from 3 – 12 in. and are situated close together. The total length of the obstacle is about10 ft., and the width is about 6 ft. Proceed with caution.

OBSTACLE 7

Lunar Ravine

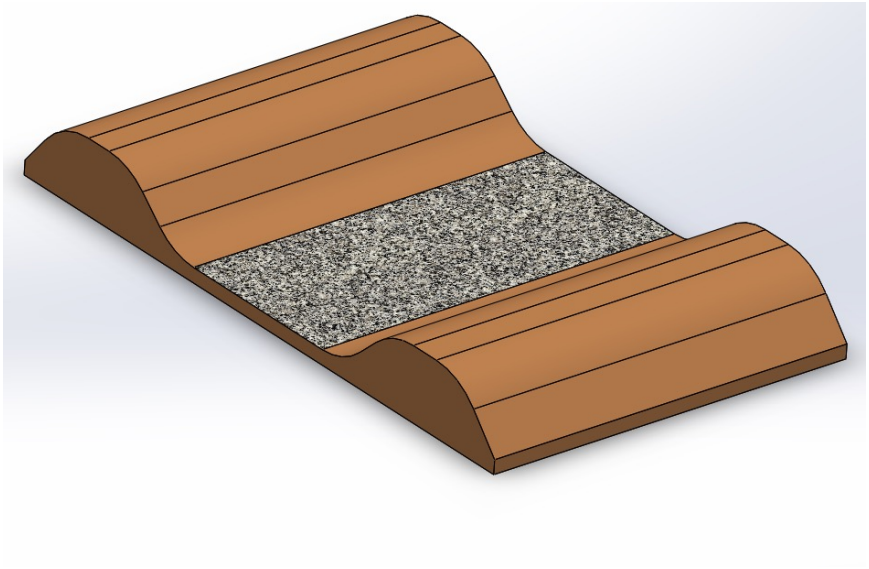


Figure 7. Obstacle 7 — Lunar Ravine

A remnant of an ancient erosion channel. This 2 ft. deep 8 ft. wide channel provided a conduit for liquid runoff on the Lunar surface. The bottom of the depression is filled with gravel to simulate the Lunar surface.

OBSTACLE 8

Crater with Ejecta

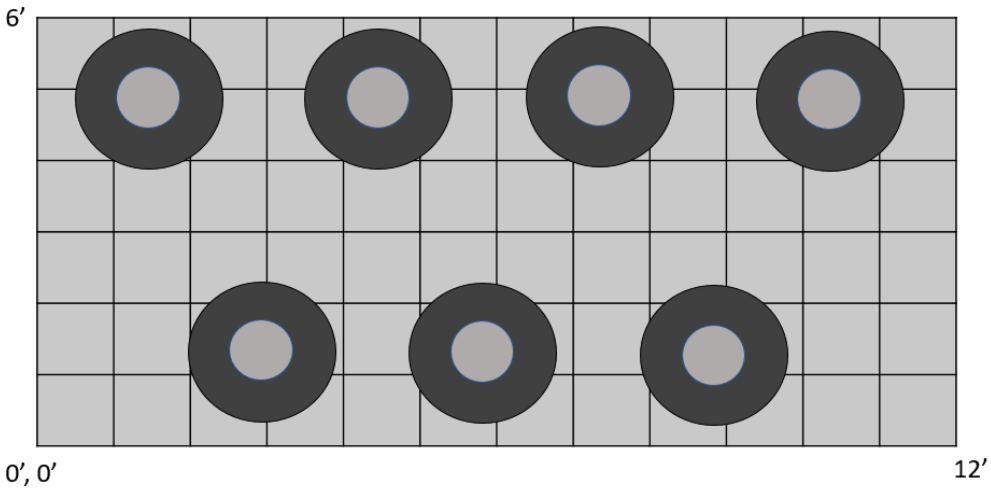


Figure 8. Obstacle 8 — Crater with Ejecta

The large craters are about 2 ft. in diameter with a vertical height of 8 in. The craters are located offset from one another on opposite sides. The schematic in Figure 8 is for illustration purposes only and may or may not represent actual course design. Ejecta, the material thrown out of the crater on impact, litters the entire obstacle. The length of the obstacle is about 12 ft. and the width is about 6 ft.

OBSTACLE 9

Loose Regolith

Figure 9. Obstacle 9 — Loose Regolith

Meteoroid collisions with extraterrestrial surfaces produce fine-grain material, which is difficult to traverse. Beach sand (rounded grains) simulates this material, which allows wheel penetration. The depth of this simulant is 6 – 8 in. The total length of the obstacle is 10 ft. and the width is about 6 ft.

OBSTACLE 10

Transverse Incline

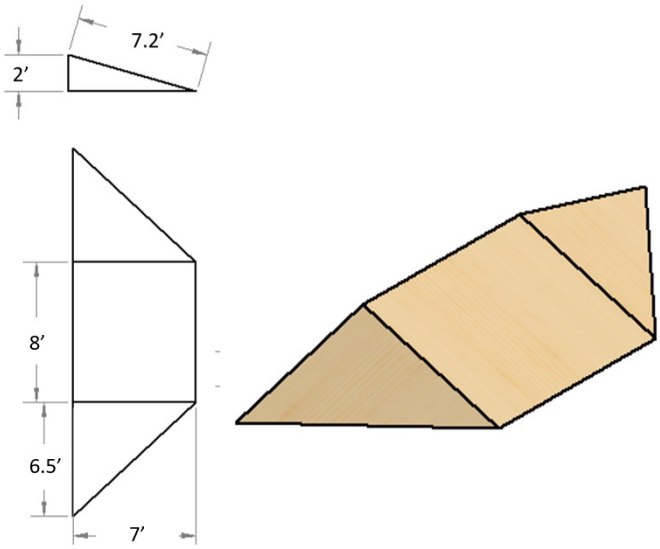


Figure 10. Obstacle 10 — Transverse Incline

The slope of this obstacle is perpendicular to the direction of rover traverse. The simulated lava or rock outcropping surface is smooth, and the angle of elevation of the incline is about 20 degrees. The total length of the obstacle is 21 ft. as shown in Figure 10

11. AWARDS

Award	Description of Award
Overall Winner	Awarded to teams placing first, second, and third per division. Top overall teams are decided from team reports, deliverables, safety, and a successful excursion will all factor into the Overall Winner.
STEM Workforce Engagement Award	Awarded to the team that is determined to have best inspired the study of STEM-related topics in their community.
Project Review Award	Awarded to the team that is deemed to have the best combination of written reviews and formal presentations.
Social Media Award	Awarded to the team that has the most active and creative social media presence throughout the project year.
Task Challenge Award	Awarded to the RC team that best meets the expectations of the task site challenges while also emphasizing efficiency and innovation.
Featherweight Award	Awarded to the team that best addressed the ongoing space exploration challenge of weight management, delivering an innovative approach to safe minimization of rover weight (only awarded to one HP team overall).
Pit Crew Award	Awarded to the team, as judged by NASA MSFC's Pit Crew staff, that best demonstrates resourcefulness, motivation, good sportsmanship, and team spirit while working independently from advisors doing repairs or working on their rover themselves during the culminating event.
Safety Award	Awarded to the team that best demonstrates a comprehensive approach to system safety as it relates to their vehicle, personnel, and operations.
Team Spirit Award	Awarded to the team, as judged by the attending teams, that best demonstrates outstanding dedication, positive attitude, teamwork, and cooperation during the culminating event.
Crash and Burn Award	Awarded to the team that embraces failure as a learning lesson for future success (only awarded to one HP team overall).
Pay It Forward Award	This Design Challenge award is given to the team that best conducts impactful educational engagement events in their community or further. Educational engagement includes instructional, hands-on activities where participants engage in learning a STEM-related concept by actively participating in an activity. Each challenge activity lead will choose the top teams from each challenge for consideration of final awardees.
Innovation Award	This Design Challenge award is given to teams that best create new, innovative ideas and/or solutions within the scope of their respective challenge. Ingenuity, creativity, and inventiveness in either technology or non-technology focused ideas are awarded for their original ideas, creating efficiency, effective results, and/or solving a problem. Each challenge activity lead will choose the top teams from each challenge for consideration of final awardees.
Other Awards	Awards will be given based on components of the competition and/or by sponsor support.

Note: Awards are given to a qualified team in various divisions (middle/high school, college/university, and HP/RC)
Awardscan be given to one team or various teams and are subject to change without notice.

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