USTEM/SCRC Mars Space Challenge 2016

Rules to Space Challenge
The Space Challenge consists of seven missions. All of them deal with setting up your space base, using the equipment, or launching a satellite that can help you explore planets even farther away. The seven missions are:

- Launch the Satellite into Orbit
- Return the Rock Samples
- Free the MSL Robot
- Activate Communications
- Secure Your Power Supply
- Assemble Your Crew
- Initiate Launch

You can do as many or as few missions as you want. The last mission you must complete is the Initiate Launch mission, as this brings all of the challenges to an end. It also means that it’s time for the referee to add all the badges together to see how you did.

Achievement Badge

For each challenge, you get an achievement badge to honor your work. Each of these badges is set at a different level, so you know how well you did.
These are the three different badges:

Master - 5 points
Congratulations! Not only did you tackle the task, but you and your team did it perfectly and with perfect results. Give yourself a massive pat on the back and put your feet up in the new space station!
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Expert - 4 points
Everything didn’t go perfectly, and maybe there were a few mistakes or accidents along the way, but you still battled on to the end of the task. You’ll make a space explorer yet!

Perseverance – 3 points
You did the best you could under difficult circumstances. And you know what? Space exploration is all about trying, failing, and then doing it better next time, so you’re part of a long line of space heroes.

If you don’t get the badge you want the first time around, you can try the task again and see if you do better—but don’t forget that time is limited. Would you be better off tackling the task again, or moving on? It’s up to you.

There are ten golden rules to Space Challenge. Make sure you know them all before you start so that you can plan your missions well:

• Complete as many missions as you can in the allotted time of 2 minutes.
• You decide in which order you try the missions.
• You can try each mission more than once.
• You must attempt the Initiate Launch mission.
• Your robot must always start a mission from the base area.
• The robot must leave the base area before carrying out a mission.
• A successful robot return occurs when any part of the robot crosses over any part of the base area line.
• Touching your robot while it is outside the base area is not allowed.
• If you touch the robot while it is completely outside the base
area and it is holding an object, the object must be reset to its original position.

• The referee decides which achievement badges you will be awarded.

Missions

• **Activate Communications**
  The scientists want to upload a whole load of raw data to the space base in order to get it up and running. Right now, we can’t seem to do the upload. What we need is a robotics expert who can get the communications station online quickly and effectively. We have been told that you and your team are the people we need to speak to. Do everything you can with your robot to get the station online.

• **Launch the Satellite into Orbit**
  This satellite is a key part of the mission and will be responsible for making sure that the space base can communicate with Earth. If the satellite doesn’t launch and there are problems with the space base, you could end up with a serious problem. For this reason, you need to place a broadband communication satellite into low Earth orbit. The satellite has to go into the marked area to make sure that it can communicate quickly and clearly and send secure unlimited real-time flow of data to and from Earth. Make sure that you program the robot so that it places the satellite in the marked area. We are depending on you!

• **Return the Rock Samples**
  The purpose of the Mars expedition isn’t just to see if it is possible to get there. It’s also a scientific expedition, so your task here is to collect three rock samples. Two of the required rock samples are from the Martian soil, and a third is from a nearby asteroid called Vesta.
If you get these samples, scientists will have the chance to investigate the rocks in more detail, which could lead to some amazing new scientific discoveries. While they’re setting up their racks of test tubes and firing up the mass spectrometer, program the robot to get the samples and return them to the base area for further investigation.

• **Free the MSL Robot**
While it was climbing one of the steeper slopes on the Martian terrain, the MSL robot got stuck. Although there is enough power to turn the wheels, the faster they turn, the more they dig into the surface. If the MSL robot can’t free itself . . . then it’s up to you.
Program your robot to free the MSL robot from the slope so it can continue on its mission to study the Martian surface. This is an expensive robot, so we need your help urgently!

• **Secure Your Power Supply**
The space base is nearly up and running. The living quarters have been set up, all the life support systems are connected, and the living quarters have been pressurized, so we will be able to breathe in there. You’ve all done really well and for the first time in days, it looks like this really has potential as a space base.
Before the rocket leaves, there’s just one more job that we need to do. We need to unfold and set up the solar arrays, which will provide the space base with power and get all of the complex systems up and running. Using one of the robots that you have to help you, program it to rotate the handle, unfold the solar array, and start power running to the station.

• **Assemble Your Crew**
It’s almost time to take off for Mars. It has been a huge achievement, and everybody is really proud of you. Now for the next stage.
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You need to assemble your flight crew for the journey. One of the most important members of the crew is the flight commander, so you’ll need to collect her from the lunar flight base where she has been preparing for the flight and set her down at the base area. Can you program your robot to do this?

- **Initiate Launch**
  Welcome to the launch site.
  The crew members are all here and the preflight checks have been conducted. What you need to do is have the launch pad robot press the launch button outside to send this craft streaking into orbit.
  And that’s where you come in. Program your robot to press the launch button and start the launch sequence to bring the first crew to explore Mars.

**General**

Team members must make all decisions and do all the work on the Robot Game and Project. This includes deciding on strategy, building, programming, researching, choosing a problem and innovative solution, and presenting at a tournament.

Anyone who works with the team (coaches, mentors, topic experts, parents, etc.) may teach team members new skills, handle logistics for the team, ask questions to get team members thinking, and remind them of the rules. Adults play an important role in coaching and supporting their team, but the team’s robot and project should be the work of team members.

Teams should have at least two supervising adults.
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responsible for only that team.

Teams must participate in the robot performance rounds as well as all three (3) judging sessions (Mars Challenge, Robot Design, and Project I & I) in order to be eligible for the overall Innovator Award.

All team members present at an event are expected to participate in all three (3) judged sessions, in addition to showing up as a team for the Robot Game.

All teams and those associated with the team are expected to uphold and display Gracious Professionalism at all times, not just during judging sessions.

Only tournament officials (judges, referees, and other tournament workers) may direct team members while judging sessions and robot matches are in progress. Any other person instructing, prompting, heckling, or otherwise interfering with a team or tournament worker during judging sessions or robot matches may be asked to leave by tournament officials. In severe cases, these activities may also affect the team’s eligibility for awards and/or participation in the tournament.

Coach
• Teams must have a Coach employed by their school district or registered with another organization with a current background check.

Team Members
• Each team may have up to ten (5) students. No student may be a member of more that 1 team.
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- No team member may exceed the maximum allowed age of 18 for high school.

**Robot Game**

Each team’s robot must be built using only parts from the Mindstorms NXT education kit 9797 and 9695 or EV3 45544 and 45560.

**Project**

Teams must demonstrate completion of all three (3) steps of the SCRC Project (identify a problem, develop an innovative solution, and share with others) as part of their presentation and fulfill any other requirements as defined in the I&I Project document.

**Competition**

The Space Center Houston Robotics Challenge is a middle- and high-school robotics competition based on the LEGO brand Mindstorms robotics platform. This competition is presented by Urban STEM and Space Center Houston; their mission is the improvement of teaching and learning in the areas of Science, Technology, Engineering and Mathematics.

**General Competition Rules**

There are two competition areas: NXT and Vex (2017). Novice teams may program in NXT G and/or robotC. Novice teams are those that have no experience with NXT G. There is not a Novice designation for robotC. Schools may enter up to two teams, per category. If space is available, schools may be allowed to register...
more than 2 teams.

**Team Structure**

Teams are the sole builders and programmers of the robots in the SCRC Robotics Challenge. All efforts are made by team members, with the sponsors or teachers providing support and mentorship.

Coaches must submit a team roster at check-in before the competition, and only students on the team roster may compete. Additions to the team must be submitted before the opening rounds of the competition begins.

Teams must designate one student member to be the TEAM CAPTAIN. The team captain is the only person from a team who can review and/or initial score sheets or contest field setup with the referees.

Students in grade levels 3rd – 8th may compete in either Novice (no prior robotics experience) or Advanced level competition.

Students in grade levels 9th – 12th may ONLY compete in Advanced level competition.

**Section 2**

**Competition Format**

The Space Center Mars Challenge game is a head-to-head challenge where two teams are separately competing on identical physically adjacent competition areas. Teams work to complete their tasks as efficiently and effectively as possible.
Tournament Scheduling

A tournament is scheduled in rounds; in the first round, all teams play one match versus another randomly selected team. Once all teams have played at least one match, the round is over, and the tournament takes a 15 minute break. In the second round, all teams play another match against different teams until all teams have played at least twice. The same goes for the third round, where all teams play against a different opponent than previously played until all teams have played at least three times. The tournament should attempt to maintain a minimum amount of time between matches for each team to allow teams time to tweak their robots and programs between rounds.

Teams have 3 attempts, or rounds, in which to play to earn points.

Each match is 2 minutes (120 seconds) in duration.

Rounds should not occur in immediate succession for any team.

When practical, no two teams play across from each other twice. Place-holder teams may be used in order to fill holes in the schedule.

If any teams play more than three rounds, as in the case of surrogates, only the team’s first match in each round counts for points.

At the end of the seating rounds the top 8 teams will choose one team to form an alliance. Each team in an alliance must compete equally in the final rounds.
Match Procedures

Prior to each match, the referees or table reset crew will place game pieces on the field as according to the rules. Teams must inspect the field and ensure that all game pieces are correctly placed. Team members ARE NOT allowed to move game pieces themselves; if the team wishes to contest the placement of game pieces prior to the end of their setup time, the team must request the referee to correct the placement. Teams may begin to set up their robots on the table when instructed by the referees.

Teams have one minute to set up their robots prior to the start of the match.

After one minute of setup time has elapsed, if referees have determined that both robots are legal and meet all robot requirements, referees may start the match whether the teams are ready or not – teams MUST be able to set their robots up quickly.

If a referee determines that a robot is not legal, the team must bring the robot into compliance before starting; if a team cannot bring its robot into compliance with all robot rules, the team may be disqualified.

Each match begins when indicated by SCRC/USTEM personnel, head referee, or individual field referee; this may be done with any means indicated to teams prior to the beginning of the tournament.

Once the match begins, teams are allowed to initiate action to start their robots (starting their programs, pressing a touch sensor, waving hands across an ultrasonic sensor, etc.).
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Robots must begin the match in accordance to all rules, including but not limited to robot size, robot location, and any other rules defined in this document. Once the match starts, robots may exceed any robot size limitation for the duration of any fully-autonomous play.

While the match is in play, robots are fully autonomous. Robots may not be controlled or influenced by outside interaction.

The match continues until the match timer expires or the referee (or other designated official) calls the end to the match.

The match timer NEVER pauses.

Once the match ends, teams must turn off their robots. Teams MAY NOT remove their robot from the field of play, nor move their robot from its final condition, until instructed or allowed by the referee.

The referee will complete a score sheet indicating the condition of the field (and the robot) at the moment the game ended.

Any action taken by the robot after time expires is not valid, and any such action will be reversed by the referee to restore the field state to the condition present at the end of the match.

The score sheet might indicate the number of points a team has accumulated during a match, or it might only indicate the specific field condition; in situations where the score sheet only indicates field conditions and NOT point values, the final score will be calculated by the scorekeeper and will not be calculated for teams before leaving the playing field. The completed score sheet must be initialed by the referees AND the team captain prior to leaving the field. The score sheet is then the ONLY and FINAL indicator of
the results of the match, and CANNOT be contested EXCEPT when the score sheet itself is in clear violation of the game rules (i.e. the score sheet indicates invalid field conditions or a score that is impossible).

**Team Ranking**

Teams are ranked based on their performance in the game. Eligibility for awards and advancement is based on a team’s ranking score and any tie breakers (if necessary).

At competition, the top two (2) scores will be averaged together to form the ranking score.

In the event that two or more teams have the same ranking score at the end of the tournament, the lowest of the team’s 3 scores will be used as an initial tie breaker; the highest tie breaker score wins.

For teams still tied for first, second, or third places ONLY, a sudden-death playoff match can be played to break any remaining ties. Ties are broken with a single round of competition played by each tied category (with first place being evaluated first, then second place if necessary, then third place if necessary). The score earned during the sudden-death round and amount of time required to earn that score (based on when the team captain indicates the end of the match and stops the robot, or the total match time, whichever is less) will be the factors used to break ties, ranked in order based on the score earned and then the amount of time used. During the tiebreaker match, teams score points as normal based on normal game rules, but the team captain must clearly indicate (by raising a tournament flag located on table) to the referee when the team members have completed the match and would like for their
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time to be recorded; when a team indicates to the referee that it has completed the match, the team MUST stop its robot, and no further action may be taken by the robot. If the team does not clearly indicate the completion of their match (prior to the normal end of the match) and completely stop the robot, the team’s time will be recorded as the full length of time for the match. Tiebreaker points are ONLY used to break ties and are not eligible to be factored into a team’s Ranking Score.

Teams will form 2 team alliances for the final rounds. They will compete in three rounds with the highest score from the rounds being the winner. Each alliance must play all teams in the rounds. The alliance will choose the team competing in the third match of the final round.

**General Robot Rules**

Teams are given the game rules in advance of the tournament, and teams design, prototype, build, program, and test their robots prior to arriving at the competition site. With these built and programmed robots, teams compete against one another in the tournament.

The SCRC competition is a LEGO Mindstorms/EV3 and (Vex 2017) competition, and so all robots must use the LEGO Mindstorms/EV3 or Vex products to build and execute their robot design.

Teams are allowed to use exactly ONE LEGO Mindstorms/EV3 programmable processing unit; this could be an EV3 or NXT or (Vex controller 2017). “Slave” devices are not allowed - teams that elect to use a LEGO
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Mindstorms EV3 programmable processing unit MAY NOT have anything plugged into the USB Host port on their EV3 at any time.

NXT/EV3 Teams are allowed to use any number of LEGO-branded sensors (regardless of the actual vendor of the sensor) on their robots, except sound sensors, infrared sensors or magnetic / compass sensors. Teams are NOT allowed to use sensor multiplexing devices. Teams may use as many unmodified LEGO wires and/or converter cables as necessary for their sensors.

NXT/EV3 Teams are allowed to use any number of LEGO-branded motors on their robots. Motor signals and power MUST originate from motor ports on the programmable processing unit; robots with motors using sensor ports will not be allowed to compete. Teams are NOT allowed to use motor multiplexing devices. Teams may use as many unmodified LEGO wires and/or converter cables as necessary for their motors.

These electrical parts limitations of LEGO-branded devices is important – ONLY LEGO-branded devices outside the disallowed classes are allowed to be used.

There are no restrictions on the quantities or sources of non-electric LEGO elements, except that factory-made wind-up/pull-back “motors” are not allowed. Pneumatics ARE allowed.

Teams are not allowed to melt, deform, cut, bend, glue, solder, or otherwise alter LEGO elements (plastic and electrical) for use in their robots – the only exceptions are that LEGO tubing or LEGO string may be bent and/or cut to length.
Teams are not allowed to incorporate non-electrical non-LEGO parts on their robots to enhance functionality. Teams may incorporate non-electrical non-LEGO parts as decorations, but there is no requirement to do so.

Extra items may not be used to enhance the structural stability of your robot, only aesthetics. Extra items (such as tape, string, etc.) cannot be used to reinforce the LEGO structure — they may ONLY be used to attach other objects; glue or any permanent (or chemically altering) adhesive is NEVER allowed to be used on LEGO parts for any reason.

Bluetooth must be disabled on the devices at all times.

No computers are allowed in the competition area within 10 feet of any robot or programmable controller. Teams are strictly forbidden from bringing any computers into the competition area at all — with the only exception of security reasons, and in those situations the computer must be OFF at all times when in the competition area.

Light detecting, color detecting, and Ultrasonic sensors are allowed, but realize that no consideration will be made for ANY interference to them.

Ultrasonic interference at the competition must be expected. Please consider carefully your choice to use an ultrasonic sensor, as your opponent’s ultrasonic sensor will most likely cause your ultrasonic sensor to incorrectly function (and vice versa).

However, please observe Gracious Professionalism in this matter; if it is determined by any referees or competition staff that your robot is using an ultrasonic sensor in a way specifically designed to subvert the use of an ultrasonic sensor by your opponent, the
companion staff may ask that you remove the sensor from your robot.

Teams should make every effort to minimize the likelihood and impact of physically contacting or interfering with an opposing team’s robot, but robots should expect a high probability of contact with the opposing robot near the center of the field – this is normal and expected and will not be deemed “interference.” However, if a robot’s actions or design are deemed deliberately malicious to the opposing team (either intentionally by design or by lack of prevention), that robot may be disqualified for the round at the discretion of the Head Referee.

At the conclusion of each match, teams should inspect their robot and ensure that all pieces are accounted for. Robot parts left at the table are not guaranteed to be returned, even though all reasonable efforts will be made to do so.