



Solar Car Challenge

Specifications for Solar Car Race, MESA Competition

Level: Middle School/High School

Number of Teams: One team per school

Team Members: Three to six students per team

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Welcome to the exciting world of the QESST Solar Car Challenge! You have taken on a fun, exciting program that captures the imaginations and creativity of young people, while providing an opportunity for volunteers to share their skills and ideas. There may be some headaches along the way (especially if the sun doesn't shine), but the result will be a great sense of accomplishment. The feedback you will receive from the students, teacher/mentors, and volunteers that participate in this program will make all your hard work worthwhile.

Objective

To design and race a solar car using commonly available materials and certain supplied materials (solar panels, DC motors, etc.) in a head-to-head competition. Performance placement and design notebooks will be used to select finalists and overall winners.

Students will also be required to submit their design budget during specification check for review and scoring.



Materials

All materials are acceptable, except materials that allow the car to be controlled remotely. Judges reserve the right to reject designs that use materials that appear hazardous or may present safety issues, including but not limited to damage to facilities or injury to persons nearby.

Mandatory materials

One 'Junior Solar Sprint Kit' by Solar Made (includes the required solar panel & motor) will be provided to each school committed to participating. The rest is up to each team's imagination! <http://www.solarmade.com/JuniorSprint.htm>

Optional materials

To construct the body or other parts, teams should consider using a broad variety of low-cost, re-used materials (CDs, lids from food containers, straws, rubber bands, etc.).

Background

Sustainability is the defining challenge of our time. Unprecedented global growth and consumption have created dramatic impacts for society and our planet. How we respond will determine whether the 21st century is one of rebirth and prosperity or an unprecedented disaster for people and nature alike. In the coming decades, transportation in the U.S. is expected to change radically in response to environmental constraints, fluctuating oil availability, and economic factors. The transportation systems that emerge in the 21st century will need to be innovative and will depend on the imagination and skill of today's young people. As future scientists and engineers, you could lead the development of new vehicle and fuel technologies. To do so, you will need to consider mobility, environmental, and economical needs.



Rules

- 1) **Vehicle Dimensions.** The vehicle must fit within the following dimensions: 30 cm by 60 cm by 30 cm. The body of the car must be three-dimensional. The solar cell cannot be used as the body of the car (e.g. teams may not bolt the axles and wheels to the solar cell directly).
- 2) **Energy Sources.** The sun's light is the only energy source that may be used to power the vehicle. No other batteries or energy storage devices are permitted.
- 3) **Energy Enhancing Devices.** Energy-enhancing devices, such as mirrors, are permitted, but must be firmly attached to the vehicle.
- 4) **Safety.** Judges may disqualify any entry if, in their opinion, the design might create a safety hazard for spectators, team members, or property. For instance, there must be no sharp edges, projectiles, etc.
- 5) **Testing - Time Allotment.** Teams are allowed to make minor design adjustments, such as re-securing parts or adjusting the solar panel. Adjustments before the first trial must be made before the car is submitted for the specification check. In between heats, students will be given 2 minutes to make minor adjustments.
- 6) **Labeling.** All entries must be clearly labeled with the entrant's school.
- 7) **Materials.** Vehicles are strongly encouraged to be sustainable and should be designed and constructed with mostly recyclable parts. There is no maximum amount that can be spent on the solar car. A budget sheet will be required at the time of the race that lists all materials used for the construction of the solar car and the amount spent per item.
- 8) **Carabiner - For Guide Wire.** Vehicles should include a loop able to have a carabiner loop through. It is suggested that the loop jut off of the upper edge of the solar panel or any high point of the car. The carabiner will connect the car to a guide wire so that it avoids other cars.
- 9) **Post-Competition.** Teams may claim their cars after the entire solar car competition is officially over. Any cars remaining at the end of the competition will be reclaimed by Arizona MESA and QESST to be used for educational purposes.
- 10) **Modifications.** The only aspects of design that may be modified for competition are the angle of the solar panel and any components that need to be re-secured. Students are allowed to approach or set-down their design, and make the necessary adjustments within the time allotted for each trial.

Specification Check

- 1) Teams will submit their solar car and their design budget for review and scoring.
- 2) Immediately upon submission for the competition, each design will receive a specification check to determine whether it conforms to MESA rules. Any design which fails the specification check for these 5 areas will be disqualified: 1) Vehicle Dimensions, 2) Energy Sources, 3) Energy Enhancing Devices, 4) Safety, and 5) Budget for Materials.
- 3) **Impound.** All components will be impounded at specification check. No alterations will be allowed after this time, but fine-tune adjustments will be allowed later, within the allotted time frame.

Judging

- 1) **Tournament Style.** Competition is by process of elimination. Heats of at most 10 cars will be conducted. The first and second place winners will continue on the winner's side of the ladder and eight losers continue on the other side. A car is eliminated when it has two losses. A loss can occur by losing a heat or by not racing the designated heat. It's possible that a few cars won't have two losses before the final heat, but when the final race is run, the race is formally over.
- 2) **Gathering Vehicles.** Prior to each heat, teams will be given 1 minute to collect their vehicles from impound and enter the test area. Students will then be given 2 minutes to make their minor adjustments, if they are needed.
- 3) **Heat Inspections.** Judges may inspect all cars prior to the final heat or at anytime during and after the heats.
- 4) **Racing Procedure.**
 - a. **Step 1. Stage**
 - i. The lead judge will call for a heat to "STAGE".
 - a. The students will bring their cars to the start.
 - ii. The judges will check each car at the start line.
 - iii. The judge will indicate any "no shows".
 - b. **Step 2. Start**
 - iv. All spectators will be moved back and the announcement is made that the heat is about to start.
 - v. Two students will set their cars behind the start line, turn on the motor and shield the sun from the car's solar panel by using the "cover" provided by QESST.
 - vi. **Start Signal.** All vehicles will be started when the official signal is given by a judge. To indicate readiness, the judge will announce, "Drivers, remove your covers!" and the student will remove the cover from the solar panels. The judges will then drop a flag indicating the start of the race.
 - vii. If a car cannot get going on its own, it will be permissible to let the student gently push the car to start the momentum.
 - c. **Step 3. Race**
 - viii. Students that are racing cars are not to leave their position at the start, or end, of the track during the race, even if their car has become stuck or has stopped during the race.
 - ix. Judges cannot be distracted because they are required to watch every race thoroughly. Anyone interfering with a judge or the judge's eye contact with the race will be asked to leave or stay stand back during the race.
 - d. **Step 4. Finish (3-10 minutes)**
 - x. The winner will be the first vehicle to cross the finish line or the farthest car down the race track when the race is called.
 - xi. At the end of each race the judges will declare the first and second place finishers and will record the time of the first place finisher.
 - xii. The judge will announce the first and second winners, so as to avoid disputes later.
 - xiii. The judges will begin staging for the next heat.



- xiv. Should there be any disputes in each heat, the lead judge will briefly address the dispute with parties making the protest and the other judges at the time of the dispute.
- e. Repeat steps *a* through *d* for each subsequent heat
- 5) False Starts. An early or push start may result in either a disqualification or a re-run. The determination will be left to the judges. Judges will call a false start and restage the heat, if needed.
- 6) Member Positioning During Heats. At race time, the vehicle will be placed by exactly two team members behind the starting line. All wheels must be in contact with the ground. A small cover, provided by QESST, will be used to cover, but not touch, the solar panel until the race begins. One team member will hold this cover while the other holds the vehicle. At least one team member must wait at the finish line to catch the vehicle. The vehicle and team member must remain at the finish line until the order of the race has been established.
- 7) Interference. Team members may not accompany or touch the vehicle on the track. Vehicles stalled on the track may be retrieved after the race has ended.
- 8) Lane Changing. Lane changing or crossing will result in a disqualification for the particular heat. The track lanes will be marked with a physical barrier, such as pipes, so the cars may not cross the barrier.
- 9) Heat Winners. Judges will declare the heat winners.
- 10) Requests to Challenge Specific Teams. Challenges must be made before the judges begin the next heat. All challenges must come from the team members who are actively competing and must be directed to the judges. Teams may only ask questions concerning their own solar car and time placement. The decision of the judges is final.
- 11) Tie Breaking. In the event of a tie, a one-on-one race will take place. The first car to cross the finish line or the farthest down the track after 5 minutes will be named the winner.

Testing Conditions

- 1) Attendance. Three (3) team members are required to be present during testing.
- 2) Track Specifications. The length of the race course will be a wild card in this event. It is strongly encouraged that the solar cars be able to travel a distance of a basketball court. The race will be designated with a start line and finish line. The track lanes will be marked with a physical barrier, such as pipes. The track is a hard, flat, smooth surface such as a tennis court or pavement, although teams should be prepared to deal with imperfections in the surface (i.e. cracks).
- 3) Measurement. Time shall be recorded to the nearest tenth of a second.
- 4) Ranking Overall Event Winners.
 - a. The winner of the double elimination tournament will be declared the Champion Car.
 - b. The car with the fastest single heat run overall will be declared the Fastest Car.
- 5) Design Awards. Beyond the Champion Car and the Fastest Car, the car with the best design will be awarded the Best Car Design award and the car with the most sustainable design will be awarded the Most Sustainable Design award as determined through a quorum of all judges.
- 6) All participants will receive a QESST Solar Car Challenge Participant certificate.

Resources

These and other resources are available on the AZ MESA website at <http://azmesa.arizona.edu/Competition%20Resources>

Score Sheet

See next page.



School: _____

Student Names: _____

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| Specification Check: | Pass <input type="checkbox"/> | Fail <input type="checkbox"/> |
|--|--------------------------------------|--------------------------------------|
| The solar car is clearly labeled with the entrant's school? | Yes <input type="checkbox"/> | No <input type="checkbox"/> |
| The solar car is within the maximum dimensions? | Yes <input type="checkbox"/> | No <input type="checkbox"/> |
| The solar car body is not solely comprised of the solar cell? | Yes <input type="checkbox"/> | No <input type="checkbox"/> |
| No alternate sources of energy are used (e.g. batteries)? | Yes <input type="checkbox"/> | No <input type="checkbox"/> |
| Energy-enhancing devices, if used, are securely attached to the vehicle? | Yes <input type="checkbox"/> | No <input type="checkbox"/> |
| The solar car is safe to compete? | Yes <input type="checkbox"/> | No <input type="checkbox"/> |
| A budget sheet was provided for the materials used for the solar car? | Yes <input type="checkbox"/> | No <input type="checkbox"/> |

Performance Ranking:

| | | |
|-----------------------------------|------------------------------|-----------------------------|
| Tournament Champion Car | Yes <input type="checkbox"/> | No <input type="checkbox"/> |
| Final tournament rank | _____ | |
| Fastest single race time recorded | _____ | |
| Best Car Design | Yes <input type="checkbox"/> | No <input type="checkbox"/> |
| Most Sustainable Car Design | Yes <input type="checkbox"/> | No <input type="checkbox"/> |

Lead Judge Signature: _____

Comments/Suggestions:

