

Ucp'Flgi q'Junior Solar Sprint Rules and Regulations for 4232

Spirit of the Sprint

The Junior Solar Sprint offers students an opportunity to learn by means of a friendly competition against their peers where students take responsibility for the design, construction, and performance of a model solar-electric vehicle.

The role of the adult is to nurture the spirit of excitement and the joy of discovery and learning that awaits students. Adults should let students assume the responsibility for design decisions, construction, and maintenance of their vehicle, performance at a race, and winning or losing.

Materials and vehicle specifications:

1. The JSS Solar Panel sold by Solar World may be used. Panels cannot be shaved, drilled or delaminated. The motors supplied with these panels (Mabuchi #280-2865 and Mabuchi #260-18130) may be used. Motors may not be re-wound or disassembled. Any other panels and motors may not be used in the competition. All parts mentioned here must be used without modification. One solar panel and one motor allowed per car. However, reflectors, supports, and power leads may be added to these components as needed.
2. The remainder of the vehicle may be made from any other materials.
3. The vehicle may not be larger than 30 cm. (12 in.) wide by 60 cm. (24 in.) long by 30 cm. (12 in.) high.
4. The solar vehicle must be structurally sound without the solar panel. The solar panel must be able to be removed from the vehicle, and easily disconnected from the motor.
5. Two 2 cm. x 2 cm. surfaces must be available for the car number, which should be easily visible when the vehicle is in the ready to race position.
6. All ducks are required to wear pants.
7. The vehicle must be powered solely by the sun's energy. No energy storage devices (e.g. flywheel battery etc.) may be used in conjunction with the solar panel.
8. If the sun's energy is judged insufficient, a battery pack will be furnished for each race. Motor power leads should be readily accessible for easy attachment to a battery pack.
9. The vehicle will be steered via a guide wire that runs the length of the track (typically fishing line). The vehicle must be attached to the guide wire by a minimum of 1 attachment point. The vehicle must be easily attached (and removed) from the wire without disconnecting the guide wire.
10. The vehicle must be of students' own design and manufacture from current school year; no car or major part thereof from a previous year shall compete. Each team from a given school must have a unique car design.

The Race Track:

11. The race lane is 60 cm. wide and 20 meters long. The track is a hard flat surface such as an asphalt tennis court or running track. The track may be oriented in any direction (e.g. North-South, East-West, etc.)
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12. The guide wire will be located in the center of the lane. The wire will be no higher than 1.5 cm. above the track surface. The wire will be small diameter line, such as fishing line (e.g. 60# test monofilament). There will be no free end on the guide wire, thus the cars must be hooked onto the wire, not strung onto it.

Conduct of the Race:

13. The races will be run in a double elimination format. Thus you will have a minimum of two opportunities to race before you are eliminated from competition.

14. Only two members of the race team will be allowed on the track during the race: one at the starting line and one at the finish line. A non-team member may act as a catcher if necessary. Student non-team members will be chosen over adult non-team members if possible.

15. Each vehicle must have an assigned student team captain. No student shall be assigned team captain to more than one vehicle. No team shall consist of more than four students.

16. The vehicle will start from behind the starting line with all wheels touching the track. The solar panel will be covered by an opaque sheet which will be held above the panel by a member of the race team to block the sunlight. The vehicle should not be touched by the sheet or any member of the team at this time. When the line judge gives the signal to start the race, the team member will remove the sheet so the panel will be exposed to the sunlight.

17. There will be a 5 minute time limit to prepare your vehicle to race in your lane. This should be sufficient time to attach the vehicle to the guide wire. The race will start at the end of this time limit regardless of whether the vehicle is ready to compete.

18. Once the race has begun, team members are not allowed to touch their vehicle or be on the race lanes until their vehicle has crossed the finish line and the judges have determined the heat completed. Pushing the vehicle after the race has begun may result in disqualification or a re-run of the race.

19. Any car that leaves its lane will be disqualified from the heat in question. However, the offending vehicle may compete in its second trial if not having done so already. If the car leaving its lane interferes with any other cars, those cars whose run was interfered with will be allowed an additional opportunity to run.

20. Loss of payload during a race will result in disqualification from the heat in question. However, the offending vehicle may compete in its second trial if not having done so already. If the loss of payload interferes with any other cars those cars whose run was interfered with will be allowed an additional opportunity to run.

21. Winner of a heat will be the first vehicle to cross the finish line or the vehicle to travel the furthest down the track. Generally speaking, the top two finishers will advance to the next heat. In the event of a tie, the judges may determine multiple winners, and admit additional cars to advance to the next round of competition.

22. Awards will be given for speed and design (i.e. technical merit, craftsmanship, innovation and student knowledge, etc.).

Craftsmanship		
	Max Score	Score
Integration of solar panel into car	5	
Strength of body joints with minimum weight gain	5	
Structural Stiffness Stiff = 5 Bends = 1	5	
Structural Strength Strong = 5 Weak = 1	5	
Vehicle attractiveness	5	
Materials chosen are appropriate as used	5	
How elegantly is cargo (can) carried?	5	
Judges discretionary bonus points	5	
TOTAL	40	

Craftsmanship

This category recognizes quality, thoughtfulness and care in design and assembly techniques, and planning and organization in selection and use of materials.

Craftsmanship can be demonstrated by factors such as neatness, precision, durability, balance, attention to detail, and the appearance of simplicity.

Scoring Items

1. Integration of solar panel into car – panel fits within the car’s “lines”, yet it can be easily detached and reattached.

Example Score 1 ... Looks like panel tacked on as an after thought with duct tape.

Score 5 ... Part of overall design ... Built into car not added on.

2. Strength of body joints with minimum weight gain – durability without excess bonding material

3. Structural Stiffness Stiff = 5 Bends = 1 – structural members are of optimal weight and are oriented and/or shaped to resist **bending** while handling a maximum load

4. Structural Strength Strong = 5 Weak = 1 - structural members are of optimal weight and are oriented and/or shaped to resist **braking** while handling a maximum load

5. Vehicle attractiveness – It looks good to you

Example Score 1 ... Excessive Glue, held together with masking tape.

Score 5 ... Very pleasant to look at, you would want to take it home.

6. Materials chosen are appropriate as used – don’t forget that scavenged materials can be highly desirable here

7. How elegantly is cargo (can) carried? - cargo fits securely within the car’s “lines”

Example Score 1 ... Holding the can was an afterthought very crude.

Score 5 ... Special holder built into car, well designed, well built.

Innovation		
	Max Score	Score
Creative appearance	5	
Creative use of solar panel	5	
Innovations in power train	5	
Innovations in wheel/guidance system	5	
Integration of all vehicle systems	5	
Is design simple yet effective	5	
Judges Choice	10	
TOTAL	40	

Innovation

Cars score high if they introduce something new and/or different. Recognize and encourage originality and uniqueness. Innovation can elicit feelings of freshness, marvel, and excitement.

Scoring Items

1. Creative Appearance – something more than a flat plate, or a square box
Example Score 1 ... A piece of cardboard with 4 wheels.
Score 5 ... Looks like a work of art (shape of rocket or fish or non-car like object).
2. Creative use of solar panel – panel may be mounted uniquely, or may serve as more than “just” the panel
3. Innovations in power train – may have new or different type or arrangement of gears or transmission Innovation is Power Train
Example Score 1 ... Direct drive motor to wheel.
Score 5 ... Continuously variable transmission, something not seen before, may not work.
4. Innovations in wheel/guidance system – may have an original style or look Innovation in Wheel/Guidance
Example Score 1 ... purchased wheels.
Score 5 ... Wheels made from something not usually thought of as wheels.
5. Integration of all vehicle systems – an elegant assembly
6. Design is simple yet effective – a slick package that will work

Power Train - Technical Merit		
	Max Score	Score
Motor mounted securely	5	
Low friction in power train alignment	5	
Friction reduction strategies (other than alignment)	5	
Design balance to distribute power to wheels	5	
Payload placement enhances traction	5	
Reliability of transmission as a system	5	
Judges discretionary bonus points	5	
TOTAL	35	

Power Train - Technical Merit

Purpose - System transfers power from the motor to the wheels.

Methods - Direct Drive (wheel's axle is also motor's output shaft, simple but not often practical).

Friction Drive (intimate physical contact with minimal slippage between input and output shafts, could use wheel tread to wheel tread at end of each shaft).

Belt Drive (V-belt or rubberband encircling different sized pulleys at shaft ends)
chain drive (like a bicycle chain).

Gears (gear teeth provide positive engagement).

Concepts – Speed vs. Torque, Gear Ratio, Input pulley size vs. Output pulley size

Power train design should recognize the relationship between the driving force available from the motor and the force necessary to turn the car's wheels under a range of conditions starting from a dead stop up to achieving maximum speed. A car equipped with large diameter wheels that give it a potential for high speed, may not have the torque necessary to overcome friction and inertia to get off the starting line. Also consider that each additional point of contact between moving parts adds the potential for more power robbing friction. Friction can often be reduced through use of lubricants, accurate and precise machining and construction, and by minimizing side and end loading on shafts.

Scoring Items

1. Motor mounted securely – will maintain intended position and optimum contact with drive train during race

Example Score 1 ... You don't want to touch it for fear it will fall off.

Score 5 ... Custom made, very rigid looking.

2. Low friction in power train alignment – any obvious gear impingement or binding, excessively tight belt or shaft loading is bad

3. Friction reduction strategies (other than alignment) – any use of bearings, lubricants or other device.

4. Design balance to distribute power to wheels – strategic use of gear ratios, don't over do it though.

5. Payload placement enhances traction – more weight placed over drive axle(s), centered side-to-side, not too high or too far past axle towards end of car.

6. Reliability of transmission as a system – it should meet the range of speed and torque conditions, and it looks sturdy.

Example Score 1 ...Looks too fragile to run, you wouldn't want to turn drive wheel by hand.

Score 5 ...Looks like built in a factory

7. Judges discretionary bonus points.

Solar Collection - Technical Merit		
	Max Score	Score
Solar panel adjustable left to right	5	
Solar panel adjustable front to back	5	
Enhanced energy collection (ie: reflectors)	5	
How solidly is solar panel connected to car?	5	
How precisely can solar panel be adjusted and hold a set position?	5	
Can student quickly describe how to set panel for maximum energy gain?	5	
Judges discretionary bonus points	5	
TOTAL	35	

Solar Collection - Technical Merit

Purpose – captures solar power, turns it into electrical power and delivers it to the motor.

Methods – solar panels are made of two sandwiched layers of semiconductor materials, which can produce an electrical current when lit by sunlight and attached through a closed circuit to an external load (motor).

Concepts - angle of incidence of light, power = voltage x current, excitement of electrons, lower and higher states of energy.

The power available from the sun is affected by the angle of the sun's rays when they strike the solar panel. When the rays that reach the solar panel are perpendicular to the face of the panel the angle of incidence is considered to be zero and the power potential will be at a maximum. As the rays' angle of the incidence increases the power potential decreases since fewer rays strike the panel. When the sun strikes a photovoltaic cell it causes electrons to jump to higher energy states. The more direct and intense the incident sunlight is the more electrons it can cause to jump, or the more current it can cause to flow. More current flow results in more power.

Scoring Items

1. Solar panel adjustable left to right – panel can be adjusted to improve the angle of incidence Adjustable Left to Right.

Example Score 1 ... Does not adjust.

Score 5 ... Adjusts easily and quickly without tools.

2. Solar panel adjustable front to back - panel can be adjusted to improve the angle of incidence.

3. Enhanced energy collection (reflectors) – methods to get more rays to strike the panel, which raises the potential to generate more power.

4. How solidly is solar panel connected to car? – How well the panel stays on.

Example Score 1 ... Looks like may fall off at any time.

Score 5 ... Solidly attached.

5. How precisely can solar panel be adjusted and hold a set position? – The panel should not flop out of adjustment How precisely can panel be adjusted?

Example Score 1 ... No adjustment.

Score 5 ... Adjusts easily in small increment and holds solid.

6. Can student quickly describe how to set panel for maximum energy gain?

7. Judges discretionary bonus points.

Wheel and Guidance Systems - Technical Merit		
	Max Score	Score
Drive wheel tread appropriate for track surface	5	
Non-drive wheel tread appropriate for track surface	5	
Presence of bearings	5	
Left/Right symmetry	5	
Vehicle resistance to "Crabbing"	5	
Guidance system is adequate with minimum friction	5	
Judges discretionary bonus points	5	
TOTAL	35	

Wheel and Guidance Systems - Technical Merit

Purpose – system provides means for putting the car in motion in an intended direction and supports the vehicle and payload.

Methods – model car wheels come in a variety of sizes (large or small diameter, narrow or wide) and various materials (rubber, plastic, wood, metal).

Concepts – friction, lubrication, weight distribution, tire traction, bearings, wheel alignment.

Wheel systems rely on use of two opposing concepts, friction and lubrication, to be effective. Friction or traction is necessary at the point of contact between car tires and the road. Friction allows the tires to grip the road and push the car forward. Lubrication or slipping is necessary between moving system components such as axles and bearings. This slipping allows the wheels to be turned with minimal loss of power or resistance to the forward motion.

The model solar car guidance system consists of “hooking” the car to a line stretched from one end of the track to the other, and depends on proper fore and aft alignment of the wheels to stay on a straight course.

Scoring Items

1. Drive wheel tread appropriate for track surface – a rubber tread usually works well on a smooth slippery surface, a lower friction material may be lighter and possibly better on a gritty surface.
2. Non-drive wheel tread appropriate for track surface – The tread should be adequate to hold the road, but not too heavy.
3. Presence of bearings – strategic placement of bearings can help optimize performance. Presence of Bearings.
Example Score 1 ... No bearings, wheels very sloppy or don't turn easily.
Score 5 ... Smooth turning, no shake any direction, feels like precision ball bearings.
4. Left/Right symmetry – space between wheels and car is same on left and right sides (space in front and back not necessarily the same), or distance of wheels from car centerline is balanced.
5. Vehicle resistance to "Crabbing" – car resists tracking sideways
Example Score 1 ... Obviously does not roll in straight line.
Score 5 ... Probably does not need line to keep it going straight.
6. Guidance system is adequate with minimum friction – hooks can be easily attached or detached from guide line and will not bind while traveling down the track. Guidance System (The hook that attaches the car to the line)
Example Score 1... Does this thing really work!
Score 5 ... Simple, smooth, clean, easy to use.
7. Judges discretionary bonus points.