Junior Solar Sprint Enrichment

Rules and Regulations

Note: For the latest rules, visit http://www.nrel.gov/education/student/natjss.html

Objective

The objective of the Junior Solar Sprint competition is to design and build a vehicle that will complete a race in the shortest possible time using the available power. Teams can purchase a kit containing a solar panel and a motor. Competitors will design and build a solar-powered vehicle that will race a 20-meter racecourse. The winner of the competition will be the team whose vehicles the top finisher in a series of head to head elimination races.

Vehicle Specifications

1. The vehicle must be safe for contestants and spectators (e.g. no sharp edges, projectiles, and so forth)
2. The vehicle must fit within the following dimensions: **30 centimeters wide (cm) x 60 cm long x 30cm high.**
3. Decals of sponsoring organizations (provided by JSS) must be visible on the side of the car’s body. A space of 3cm x 3cm must also be available on the side of the car where an assigned vehicle number can be placed.
4. Normally, sun light will be the only power source for the vehicle. **Two AA batteries can be used when sunlight is not available.**
5. Any energy-enhancing devices, like mirrors, must be attached to the vehicle.
6. The vehicle must be steered by the guide line using one or more eyelets affixed to the vehicle’s bottom. The vehicle must be easily removable from the guide line without disconnecting the guide line.
7. The car must have a chassis that is three-dimensional. Teams will NOT be allowed to bolt the axles and wheels of the car directly to the solar module. The solar module cannot be used as the chassis of the car. A shell-like body that is removable may be added to complete the solar vehicle.

Track Specifications

1. The length of the race course is 20 meters over a level terrain.
2. Racing lanes must be able to accommodate solar vehicle
3. A guide line will be located in the center of each lane of the track and will not be more than 1.5 centimeters above the track surface.
4. The track must be hard, level surface.
5. One member of each team must be at end of track to catch vehicle.
6. Team members may not touch vehicle while it is racing on the track.
7. Vehicles must be able to be removed from race track without removing the guide line.

**Solar Vehicle Kit Instructions**

Materials

1. The motor and solar panel contained in the kit must be used without modifications.
2. The remainder of the vehicle must be your own design and can be made from other materials.
* 1 Ray Catcher Solar Panel (2.76V , 1,100mA) ---teacher keeps this
* 2 balsa wood sheets or other material (10 ½ inches x 4 inches x 3/16 inches)

 \*\*\*\*other material can be substituted for the balsa wood

* 2 alligator clips
* 4 dragster wheels (2 narrow front wheels / 2 wide rear wheels) \*\*you may substitute other wheels
* 2 long eye screws or other means of connecting vehicle to racing guide line
* 1 motor
* 4 spacers ( these can be straws or plastic tubes cut to size)
* 2 metal axles
* 1 plastic gear font
* 2 rubber bands for front wheels
* 2 wide rubber bands for rear wheels

Tools that may be needed

* Soldering iron
* Jig saw or Coping saw and Drill Press
* Cool melt glue gun
* Needle nose pliers
* 12 inch ruler

Making the Chassis

1. Using a pencil, draw **Line A** down the center of the balsa wood sheet (Figure 1)

Turn over the balsa wood sheet.

|  |  |  |
| --- | --- | --- |
|  5 1/4  |   |  5 1/4  |
|   | Line A |   |
|   |  |   |
|   |   |   |
| Figure 1 |  |  |

Making the Chassis continued

1. Draw **Line B** ¾ inch from one end of the sheet (Figure 2)
2. At the same end, draw a 5/8 inch x 1 ½ inch notch 1 inch from the top of the sheet (Figure 2)
3. Draw **LINE C** 2 ½ inches from the other end of the same sheet of material (Figure 2).
4. Drill 1/8 inch holes at the corners of the 5/8 inch x 1 ½ inch notch
5. Using a saw, cut to the 1/8 inch holes. Continue cutting out the notch drawn in Step 3

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|  |   |   |   | **Line B** |   | 1" |
|  |   |   | **Line C** |  |   |  |
|  |   |   | 5/8 " |   |   |  |
| 4 " |   |   |  |  |   |  |
|  |   | 2 1/2" |  |  |   |  |
|  |   |   |  |  |   |  |
|  |   |   |  |  |   |  |
|  |   |   |  |  | ¾” " |  |
|  |   |   | **FIGURE 2** |   |   |  |
|  |  |  |  |  |  |  |
|  |  |  | 10 1/2 " |  |  |  |

1. **Locate the unused sheet of material**. Draw a line parallel to and 1 1/8” from one end of the narrow ends. Cut along the line to produce a 1 1/8” x 4” panel support member.
2. Using a cool-melt glue gun, run a small bead of glue along one of the 4” edges of the panel support member and attach it firmly at **LINE A (Figure 3).** After it is in place, run an additional bead of glue on each side of the joint between the chassis and the support member.



Wheels, Gears and Axles

Installing wheels and gears on axles can be difficult. If the fit is extremely tight, use a 1/8” drill bit to ream the hole in gears or wheels slightly. The gears and wheels should fit snugly on the axle and provide power to the wheels.

**Rear Axle Assembly**

1. Locate the plastic gear font. Detach **GEAR I** from the font.
2. Inspect the gear. Carefully remove any plastic flashing between the gear teeth.
3. Place the gear on a table. Insert one of the steel axles into the gear.
4. Carefully slide the gear 1 7/8 inch from one end of the axle. It should be 3 3/8 inch from the other end of the axle **(FIGURE 4)** .
5. Slide two plastic spacers onto the axle, one at each side of the gear.
6. Place one of the wide plastic wheels flat on the table. Keeping the spacers in place, insert one end of the axle into the wheel. Slide the axle into the wheel until it is flush with the opposite side of the wheel.
7. Lay the other wide wheel flat on the table. With spacers still in place, slide the free end of the axle into the wheel until it, too, is flush with the opposite side of the wheel.
8. Stretch a wide rubber band around each of the wide wheels. These act as tires and provide traction for your vehicle.



Front Axle Assembly

1. Place one of the two thin wheels flat on the table. Insert one end of the remaining steel axle into the wheel until the end of the axle is flush with the opposite side of the wheel.
2. Slide two nylon spacers onto the free end of the axle.
3. While keeping the spacers on the axle shaft, slide the free end of the axle into the other thin wheel until the end of the axle is flush with the opposite side of the wheel.

Attaching Axle Assemblies to Chassis

1. Position the notched chassis on the table so the notched end of the material is hanging over the table edge and **LINES B** and **C** are face up.
2. Carefully position the rear axle assembly so:
* Gear 1 is centered in the notched area of the chassis
* The axle is positioned along **LINE B** between the line and the end of the chassis.
* The nylon (or straw) spacers are positioned within 1/16 inch of each wheel.
1. When the rear axle is positioned as described in STEP 2, use a clamp or ask a friend to hold the rear axle assembly in the correct position.
2. While the rear axle is in the correct position, gently apply a bead of cool melt glue along the sides of the spacers where they contact the chassis.
3. Hold the rear axle assembly in place until the glue cools.
4. Place the front axle assembly along LINE C.
5. Position the axle so the wheels are equal distant from the chassis.
6. Slide the spacers to within 1/16 inch of each wheel.
7. Hold the assembly in place and gently apply a bead of cool melt glue along the sides of the spacers where they touch the chassis.
8. Hold the front axle assembly until glue cools.

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|  |   |   | 5/8 " |   |   |  |
| 4 " |   |   |  |  |   |  |
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|  |   |   | FIGURE 2 |   |   |  |
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Attaching Motor Assembly to Chassis

1. Find **GEAR F** on the plastic gear font.
2. Remove **GEAR F** from the font and cut off any excess plastic between the teeth of the gear.
3. Insert the shaft of the motor into **GEAR F** to within 1/8 inch of the body of the motor.
4. Set the chassis on the table with the axle assemblies facing down.
5. Using a cool melt glue gun, create a 1/2 “ x 1” rectangle of glue about 1/8 “ deep as illustrated in **FIGURE 5.**
6. While the glue is still liquid, place the motor on its side (with vent holes up) on the glue so GEAR F sits directly on top of and engages with **GEAR I** (FIGURE 5). Be sure not to obstruct or fill the vent holes with glue!
7. Hold the motor in place while glue cools.
8. Apply another bead of cool melt glue behind and in front of the motor (FIGURE 5). This will keep the motor in place if the vehicle comes to a sudden stop (crashes).
9. If the motor dislodges, use the tip of the glue gun to soften the glue on the chassis where the motor was. Add a small amount of glue and reattach the motor as you did before.

Solar Panel Assembly

1. Connect the alligator clips to the leads on the solar panel.
	1. Insert one of the two leads through the small hole in the alligator clip.
	2. Using a pair of pliers, bend the tabs on the alligator clip over the lead wire.
	3. Solder the lead wire to the alligator clip. Be sure to heat the metal around the lead thoroughly so solder flows freely and attaches to the clip. Remember it’s not the amount of solder that counts; it’s how well you melt and solder (attach) the wire to the clip!
2. Repeat Step 1 for the second lead of the panel.

Assembly with a Solar Panel

1. Using the cool melt glue gun, run a bead of glue on the top, extreme front of chassis. Allow glue to cool. This will provide a ledge on which the solar panel can rest.
2. Run another bead of glue along the front edge of the chassis to provide a bumper for your vehicle.
3. Position the solar panel on the chassis so it rests on the glue ledge at the front of the vehicle and on the 1 1/8 x 4 panel support member.
4. To temporarily attach the solar panel, attach the solar panel by stretching one of the No. 14 rubber bands around the front of the chassis and the solar panel. Then stretch the other No. 14 rubber band around the chassis and solar panel and position it at the center of the panel.
5. Connect the solar panel alligator clip with the red lead to the motor terminal that has a round dot.
6. Connect the solar panel alligator clip with the black lead to the other motor terminal.

\*\*\*Final Assembly with a battery pack instead of a Solar Panel

1. Using the cool melt glue gun, run a bead of glue on the top, extreme front of chassis. Allow glue to cool. This will provide a ledge on which the **fake hard board solar panel** can rest.
2. Run another bead of glue along the front edge of the chassis to provide a bumper for your vehicle.
3. Position the **fake hard board solar panel** on the chassis so it rests on the glue ledge at the front of the vehicle and on the 1 1/8 x 4 panel support member.
4. To temporarily attach the **fake hard board solar panel**, attach the **fake hard board solar panel** by stretching one of the No. 14 rubber bands around the front of the chassis and the panel. Then stretch the other No. 14 rubber band around the chassis and **fake hard board solar panel** and position it at the center of the panel.
5. Connect the alligator clip with the red lead to the motor terminal that has a round dot and the battery pack lead wire.
6. Connect the alligator clip with the black lead to the other motor terminal and one of the on / off switch lead wires. Attach another lead with clips applied to both ends to the other battery pack lead wire. Test it. Install two double AA batteries into battery pack. Turn switch on. If it works attach battery pack to car chassis. You are ready to race ☺

Troubleshooting

1. If the car does not move, check the following:
	1. Are all electric connections solid and soldered? If not, reconnect or solder and try again.
	2. Are the gears meshing freely? If not, pry the motor and glue from the chassis and reposition the motor.
2. If the car goes backwards, reverse the positions of the two alligator clips on the panel.
3. If the wheels do not spin freely, reposition them on the axles to provide clearance between the wheel and the spacers.
4. If the gears or wheels spin without the axle moving, use a spot of cool melt glue at the joint to connect them. If you are sure the position will not change, you can use CA glue (superglue) instead of cool melt glue to permanently bond them.
5. If the car does not go fast enough, try different gear combinations, wheels, and chassis styles. Try to make a car with front-wheel drive! Experiment and find out what works best!