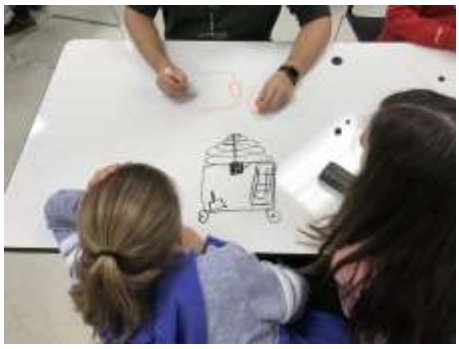
# Junior Solar Sprints Student Guidance



**Challenge:**
You and your team of engineers will design and build a solar powered vehicle. You will power your vehicle with only a solar panel (or a AA battery if weather is overcast).

**Goal:**
Design and build a vehicle that will travel a 66' race track with the greatest speed! Vehicles will also be evaluated on Craftsmanship, Engineering, Use of Recycled Materials.

The top four vehicles from each school will be eligible to attend the county wide Race Day competition.

**Requirements:**

Each team is responsible for:

1. Designing and building a solar powered vehicle (your vehicle will be powered by a solar cell but must contain a compartment to accommodate batteries should race day be overcast)
2. Keeping a Documentation Portfolio of your ideas, construction progress, testing results, modifications, and design analysis; the Documentation Portfolio will be submitted prior to Race Day.
3. Effectively utilize a solar panel to power their vehicle
4. Demonstrating an understanding of how alternative fuels work
5. Developing an appreciation for how they can improve our environment
6. Calculating their vehicle's speed and acceleration
7. Determining the force required to accelerate their vehicle with consideration given to the forces that slow down the vehicle

**Documentation Portfolio**

Each team is strongly encouraged to develop, and submit for judging, a **Documentation Portfolio** in which they provide the following:

- The scientific method process followed
    - State the problem
    - Brainstorm the team's ideas, hypothesis
    - Illustrate the team's original design: initial sketches
    - List materials needed & used
    - State Methods used (Construction & Testing process)
    - Test your vehicle and show results
        - Calculate speed, acceleration
        - Data supporting your gear ratio design
        - Testing results and revisions
    - Create a final diagram of the vehicle, label all parts
    - Include photographs taken during construction and testing
    - Draw a conclusion: Evaluate your solution
        - Did your vehicle work as planned?
        - What changes did you have to make?
        - How did the final product differ from the original design?

- An assessment of the force and friction on the vehicle

- An understanding of how solar panels work

- A demonstration of energy conversions used in their vehicle

- An understanding of alternative fuels

- An appreciation for how the use of alternative fuels can improve our air quality and environment

- A reflection (a few paragraphs) of your design & construction process

## Construction Materials

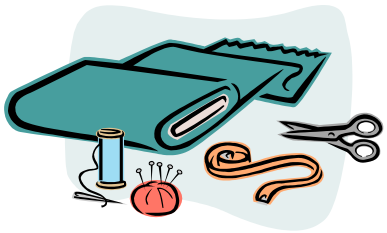
You will be <u>supplied</u> with the following materials:

- 1 Battery Pack Container per team
- 1 motor per team
- 1 set of gears
- 1 solar panel (to be shared with other groups)
- Wheels
- Axles
- 2 alligator clips

<u>You will need</u> to gather the following supplies:

- AA Batteries
- Building materials for the chassis
- Materials for decorating your vehicle
- An Empty Soda Can
- Box with lid to keep your vehicle supplies in

| **Suggested Building Materials** | **Suggested Tools** |
|---|---|
| Cardboard Sheets<br>Cardboard Tubes<br>1/8 rods<br>Foam<br>Styrofoam<br>Wire Hangers<br>Straws- no plastic<br>Washers<br>Stiff Wire<br>Elmer's Glue<br>Wire Nuts<br>Electrical Wire<br>Alligator Clips<br>Velcro<br>Decorating Supplies<br>Solder<br>Hot Glue<br>Tape: Masking, Duct, Electrical, Packing | Safety Goggles!<br>Scissors<br>Wire Cutters<br>Pliers<br>File<br>Rulers<br>Pencils<br><br>**Check with an adult before using the following tools:**<br><br>Hot Glue Gun<br>Soldering Iron<br>Small Saw<br>Exacto Knife |



# Looking For Build Materials?

| Part | Home Source | Outside Source |
|---|---|---|
| Wheels | Old toys, model car parts | Hardware store, garage sales, hobby shop |
| Axles | Wood rod, wire hanger, metal or plastic tubing, old toys | Hardware store, hobby shop |
| Bearings | Drinking straws, tubing | Grocery store, fast food restaurant, hobby shop |
| Pulleys | Thread spool, videocassette real, drawer pull | Hardware store, hobby shop |
| Gears | Spirograph parts | Garage sale, hardware store |
| Belts, Screws, Shafts | Old tape recorders, VCR | Garage sale, hardware store |
| Chassis | Foam core board, cardboard, corrugated cardboard, corrugated plastic, balsa wood | Craft store, hobby shop, garage sale, grocery store |

***NOTE: Please check with the owner of any source of materials before destroying it for parts!**

# Competition Rules 2020

**TEAM SIZE**: Each team must be made up of no less than 2 students; maximum 4 students per team

**VEHICLE DESIGN & CONSTRUCTION**: The vehicle must be of the students' own design and built during the current school year. No car or major component from a previous year will be allowed to compete. Solar panels, motors, and other individual parts may be reused in a new design. Each team must have a unique car design (no duplicate vehicles)

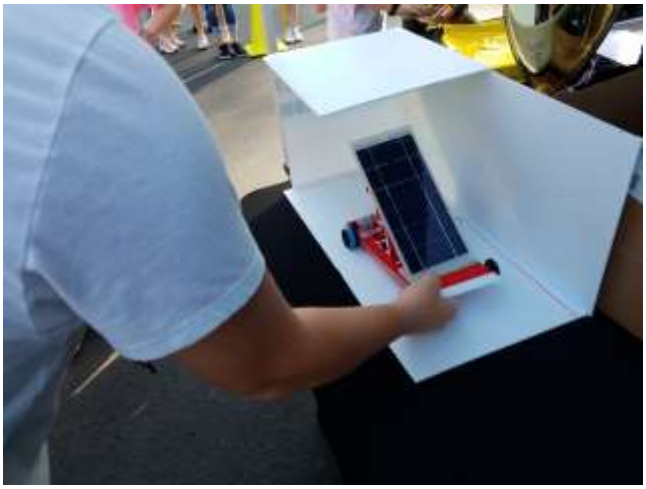
**PROVIDED MATERIALS:** Teams must use the Provided Materials, as follows

- SOLAR PANEL: The Ray Catcher Solar Panel sold by PITSCO, and provided by goHunterdon, is the only panel that may be used in the races. Panels may not be physically altered in any way. All panels should be returned to goHunterdon staff following the races.
- MOTOR: Motors supplied by goHunterdon are the ONLY motors that may be used in the competition.

Solar panels and motors must be used without modification to their functionality, though reflectors, supports, Velcro, and power leads may be added to the component as needed. One solar panel and one motor are allowed per car. The panel must be able to be easily disconnected and removed from your vehicle.

**USE OF OTHER MATERIALS:** The remainder of the materials used for the car is at the discretion of student teams. Students are encouraged to be creative in design while following all other regulations. For 2020, the USE OF PLASTIC STRAWS is DISCOURAGED. Biodegradable or reusable straws are encouraged in place of plastic straws.

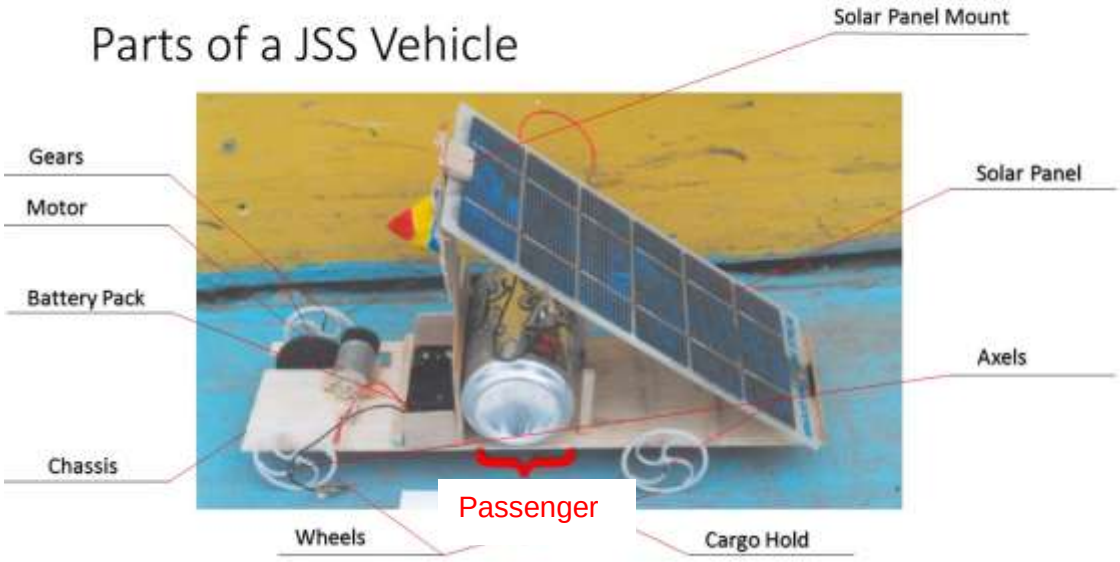
**VEHICLE SIZE:** The vehicle, including any attachments, may not be larger than 12 in. wide by 24 in. long and 12 in tall. All vehicles will be measured upon Check In on Race Day. Vehicles that are larger than the dimension noted will be disqualified from racing.



**“PASSENGER” COMPARTMENT REQUIREMENT:** The vehicle must carry a “passenger” [one empty 12 oz. conventional aluminum soda can. Juice or other types of cans are not permitted]. The can must not be structurally altered in any way (crushed, cut, etc), and application of adhesives to keep the passenger in the vehicle is not allowed.

The can must be able to be removed for judging verification should it be requested. The compartment for the passenger, including all components associated, must retain their shape with or without the passenger. Removal of the passenger from the car should not alter any part of the structure of the vehicle as the vehicle should retain its original shape.

The passenger must remain with the vehicle <u>at all times</u> during the race. The vehicle, including the solar panel support system, must be structurally sound without the panel or the passenger on/in the vehicle. The passenger may not support the solar panel or function as any other component of the vehicle’s structure.



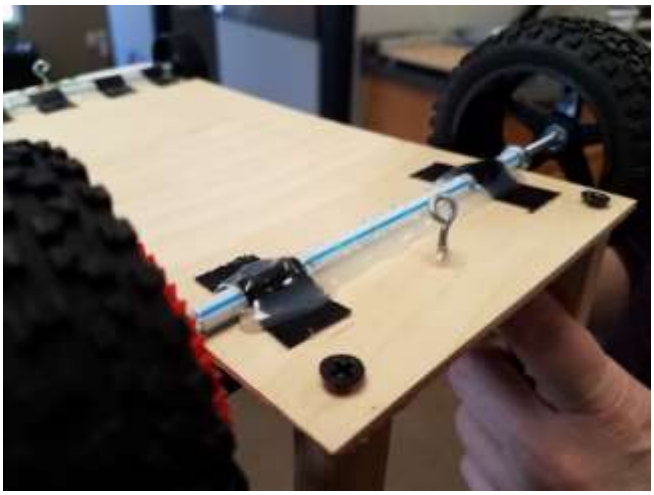

**POWER SOURCES:**

- **Solar Panel:** The vehicle with its solar panel 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. The solar panel must be able to be removed from the vehicle and easily disconnected from the motor

- **Battery:** If the sun’s energy is judged insufficient we will switch to a battery panel that utilizes a single AA battery. *NOTE: batteries are not provided.

**GUIDE-LINE:**

- For racing, the vehicle will be attached to a guide line (60# fishing line) that runs the length of the 66’ track. The vehicle must be attached to the guide line by a minimum of one attachment point. The vehicle must be easily attached and removed from the line without disconnecting the guide line.



**RACING:**

**Race Track:**

• Each race lane is 24-36 in wide and runs 66 feet in length. The track is a hard flat surface and the track may be oriented in any direction (e.g., NorthSouth, East-West) All effort will be made to conduct the race outdoors. In the event of inclement weather, race will be conducted indoors on a gymnasium floor.

**Conduct of the Race:**

- The races are run in a double elimination format. Each team will have a minimum of two opportunities to race before elimination from the competition.
- Only two members of the race ream will be allowed on the track during the race: one at the start line and one at the finish line. A non-team member may act as the catcher if necessary.
- Adults will not be allowed at the start or finish lines, line judges can help any students needing assistance.
- The vehicle will start behind the starting line with all wheels touching the track. [Drop starts will lead to a loss for the vehicle in question]
- Once initial setup and attachment is complete the vehicle should not be touched by the cover or by any member of the team.
- A team member will hold a supplied “cover” over the solar panel to be completely shaded
- When the judge signals the start of the race, the team member will remove the cover so the panel will be exposed to the sunlight.
- Once the race has been started, team members may not touch the vehicle, guide wire, or anything else associated with the vehicle until the race is finalized. Doing so will count as a **loss in the race.**
- Each team will have a maximum of 3-minutes to prepare their vehicle to race in their assigned lane. This should be sufficient time to prepare and attach your vehicle to the guide wire. The race will start at the end of the 3 minute preparation time regardless of whether a team is prepared to compete.
- Once the race has begun, team members may only touch their vehicle if it has crossed the finish line, and may not retrieve their vehicle on the race lines until the judges have determined that the heat is finished. **Pushing or touching the vehicle after the race has started will result in a loss for that race.**
- **Any car that leaves its lane will receive a loss for the heat**. If the car leaving its lane interferes with any other cars, those cars that have been disrupted will be allowed the opportunity to rerun their race.
- **Loss of a passenger during the race will result in a loss for the heat**. If the passenger is lost from this vehicle interferes with any other vehicle, those vehicles that have been disrupted will be allowed the opportunity to rerun their race.
- The winners of a heat is determined by the first 3 cars to cross the finish line OR the three cars that traveled the farthest down the track. Races with 4 or 5 cars will be restricted to the top 2 cars, and a 3 car race will be restricted to 1 car.

**VEHICLE REPAIR:** Students will make their own adjustments and car repairs as needed on Race Day~ with limited assistance provided at the Fix it Table. Adult work on a vehicle at the event may subject it to disqualification.

**JUDGING ON RACE DAY:**
Team members will present their vehicle without adult assistance to the judges to be scored in Engineering, Craftsmanship, and Upcycled Materials.

An overall winner will be given as well with the scores from each category being combined for the highest score.

A student documentation portfolio demonstrating progress and originality is optional, but will be a judged category. Without completion of this category it is not possible for a team to win the overall highest scoring team award.