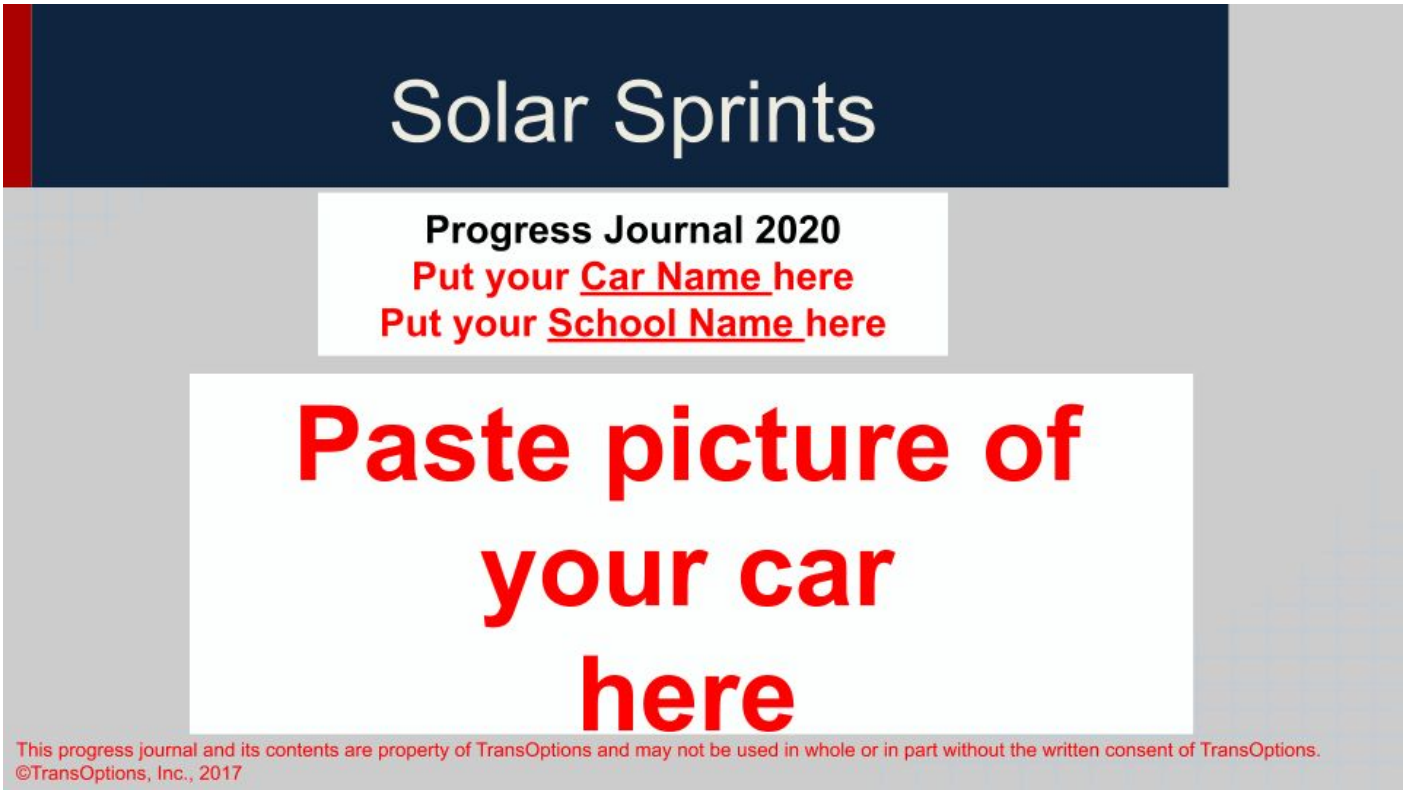


SOLAR SPRINT RACES

https://www.transoptions.org/jss-materials-and-resources

How to Use This Journal

Record keeping during the design process is an important part of Junior Solar Sprints. This document is here to help guide you through important investigations that will help your team understand the science behind your model solar car.

Red text indicates something for you to do, answer or fill in a white box.

Blue text indicates a hyperlink when viewing in "presentation mode." Click for hints!

This is a **template**. We **STRONGLY** encourage you to add additional related slides and to change the document's theme to adhere to the overall look of your car.
See next slide for scoring rubric.

To edit this document go to "**File,**" "**Make a Copy...**" and save file to your own Google Drive or computer hard drive. Feeling stuck? Email me with any questions or concerns at:
Ktomasicchio@transoptions.org

Progress Journal Scoring Rubric	Poor (0 -1)	Satisfactory (2-3)	Good (3-4)	Excellent (4-5)
CONTENT is interesting, original, striking and substantial.	No changes made to the template provided, blank slides, content missing.	Team completed provided slides.	Team changed template entirely (or almost) to reflect a theme or personality while retaining legibility and coherence	Team changed template entirely. They utilized an innovative approach to displaying their information and maintained concepts from the original template
ORGANIZATION is well structured and exhibits chronological order, spatial order, comparison/contrast, etc..	No apparent organization.	Team followed provided organization in template and presented their information coherently.	Team changed some of the provided organizational structure to fit their theme/personality and presented their information coherently.	Team changed the provided organizational structure entirely. Their unique organization resulted in information presented clearly and interestingly.
EXPERIMENTS, TESTING, CHANGES TO DESIGN, SCHEMATIC are organized, reasonable and coherent. Each supporting paragraph/description has a controlling idea, that is explored and results that are explained	No experiments were explored. No results were shown. No testing was explored. No design changes explored or explained. No schematic, drawing or image was presented.	Team completed at least 1 experiment from each Investigation category (Solar Power & Gears). Team provided at least 1 result for each experiment performed. Team completed some of the Materials chart. Team provided at least 1 design change. Team provided at least one schematic, drawing or image.	Team completed 2-3 experiments per Investigation category (Solar Power & Gears). Team provided results for each experiment listed. Team completed all of the Materials chart. Team provided at least 1 design change with explanation. Team provided multiple schematics, drawings or images.	Team completed 2-3 experiments per Investigation category (Solar Power & Gears) as well as additional experiments in categories not provided in template (Ex: Aerodynamics). Team completed all of the Materials chart. Team presented several design changes with explanations and provided multiple schematics, drawings or images.
GRAMMAR, SPELLING grammar, spelling, and mechanics	Contained mostly errors. No attempt at editing work made.	Contained some spelling, grammar or mechanics errors on no more than 50% of the total submitted work.	Contained few spelling, grammar or mechanics errors across total submitted work.	Contained no, or very minor spelling, grammar or mechanics errors across total submitted work.

Task 1 - Solar Sprint Races

In May Belleville participates in Solar Sprint Races. There are three phases. In the pre-phase students within our districts will build cars and compete in a district wide competition. Student Teams will then be selected to represent all seven elementary schools and the middle school in the next phase. In the regional phase students compete at regional events throughout the northern counties in New Jersey. If a team wins or places in the top three then we will also go to the State Competition. The State Competition is the last phase.

Students will work throughout the year on their cars. You should use this journal throughout the process. You can also take pictures or draw sketches and scan them into this journal. This process is to help you understand both the importance of solar energy but also engineering design.

Solar Sprint Races

Approximate Timeline

October - Teacher PD
October/November - Solar Sprint Workshop
January - Students should have teams, team name, and possible themes. Students should have completed section on solar panels and gear ratios.
January - Student Building Days - Students should bring a box - at least the size of a shoebox. In addition Mentors/Teachers should bring 1 paper box for each 3 students with the students names on them. before they have their building day they should have a preliminary sketch. On the building days students should weigh all materials in grams and mentors should look to the science kits for balances. Students should also read the rules and regulations along with viewing the gallery of pictures. Each student group should have three 12 oz soda cans that have been emptied, washed, and dried. Please weigh the soda cans and place a piece of masking tape with the weight on each of the cans.

Solar Sprint Races

Approximate Timeline

March/April - Second Building Day (if the mentor/teacher requests we can have a second building day at the home school

March/April - District Challenge - If possible we will try to have transoptions come in and have a district challenge.

May - Regional Challenge and State Challenge

Solar Sprint Workshop

Step 1 - Getting Started

Today you are going to work with a sample of a chassis, motor, and battery pack to make a car that moves or drives. Answer these questions after you discuss with your group:

1.) **How did you choose the gears you used in your car?**
2.) **How did you decide which gear went on your tire and which went on the motor?**
3.) **Did you change gears? If you did what happened?**
4.) **Did your car work right away? If it did not what did you do to make it work?**

Choosing your teams

Teams need to be no less than 2 and no more than 4 students. Students should realize that this is a year long project and that students can not break apart groups or change groups without approval.

School Name	Student Last	Student First	Grade

Team Name

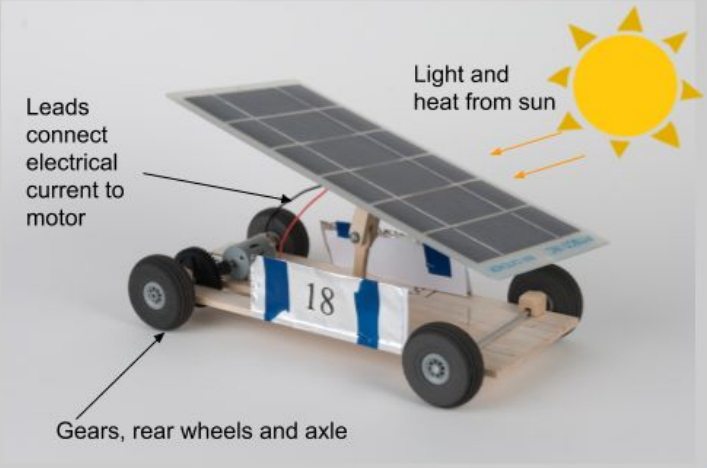
Teams are important parts of any design and engineering project. Your team should think about what makes it special, unique, fun, different etc. You should come up with a team name. Your name should be respectful and representative of a school atmosphere. Think carefully about your team name and remember that this name will represent you and the school.

Theme

In this challenge you are going to design a car. We will be going through some of the design aspects and how you will choose materials etc. You could have a theme to your car. The theme could be something that everyone likes or enjoys, it could be a mascot, or movie etc. Think of some themes with your group. Write as many ideas out as you can. Think of what kind of materials that you will need in order to make your design. This list will change as you go through the process.

Investigation: Solar Power

Solar power is light and heat radiation from the sun converted into electrical power.



1. Sunlight contains tiny particles of energy called protons.
2. When sun rays hit the solar panel, the panel absorbs light and heat from the sun, forming an electrical current.

1. Electrical current is transferred by leads to power the motor.
2. Motor powers the driving gear.
3. While gears rotate they cause the axle and car's wheels to spin, ultimately moving the car forward.

Investigation: Solar Power

Hypothesize on what things may affect how your solar panel works.
Use the formula "if_____, then_____becasuse_____."

Example:

1	*If my solar panel is inside it will not generate electricity because solar cells do not respond to incandescent lighting.*
2	Type your investigation here
3	Type your investigation here

Investigation: Solar Panels

Choose one of your hypotheses and design an experiment that will determine if your hypothesis is correct.

Example:
What we are testing: If electricity is generated by a solar panel when it's under incandescent light.
How we are testing: Hook the solar panel up to a small motor with a wheel attached. While under incandescent light, see if the solar panel will generate electricity to cause the wheel that is attached to the motor to spin.

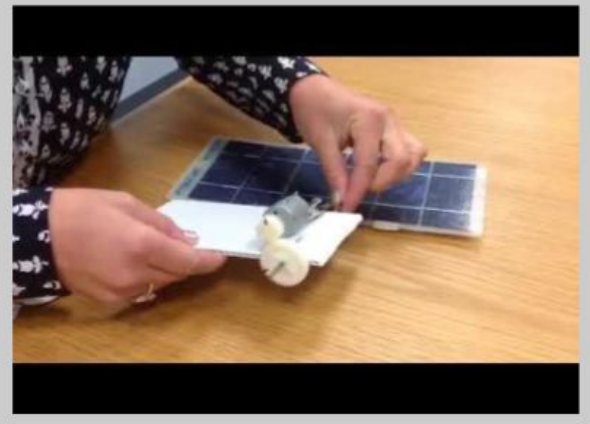
Type your investigation here:

Investigation: Solar Panels

Explain the results of your investigation here:

Investigation: Gear Ratio

Gear Ratio explains the rate at which two meshing gears spin. Gear ratio can be used to calculate the speed of two meshed gears. It is expressed in a fraction or ratio format *(ex: ½ or 1:2)*.



1. Electric energy produced by the solar panel causes your car's motor to spin.

1. Motor powers the *driving* gear.

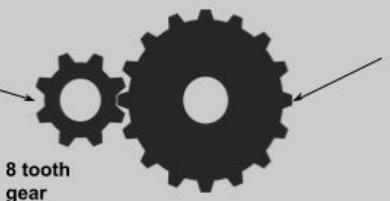
2. Driver gear meshes with the *follower* gear. The *follower* is the gear placed on your axle.

3. While gears rotate they cause the axle and car's wheels to spin, ultimately moving the car forward.

Investigation: Gear Ratio

To determine the size of each gear, count the "teeth" around the outside. When representing in a ratio the driver gear is always written first, so in the example below we write 8:16 instead of 16:8.

Driver- gear on the motor.



Follower- gear on the axle

How does gear ratio effect your car?
In the example above the gear ratio is 8:16, which we can also write as ½. This tells us that for every one complete turn the driver makes, the follower will only turn half way around. Cars with a gear ratio similar to ½ are likely to have more speed than torque (power). Experiment with the gears in your kit to find the best gear combination for your design!

Investigation: Gear Ratio

Fill in the chart. Use the gears in your kit to help you visualize each scenario below:

Driver Gear (size determined by counting the number of teeth around the gear's edge)	Follower Gear (size determined by counting the number of teeth around the gear's edge)	Gear Ratio (represent as a fraction or ratio)	If the driver turns once, how many times will the follower turn?
20	40		
10	50		
60	30		

Investigation: Gear Ratio

Hypothesize on how gears matter to your model car construction.
Use the formula "if_____, then_____becasuse_____."

Example:

1	*If my model car's gears don't fit together my car won't move because it's the connection of gears that transfers motion/energy to move my car.*
2	Type your investigation here
3	Type your investigation here

Investigation: Gear Ratio

Choose one of your hypotheses to test. Design an experiment that will help decide if your hypothesis is correct.

Example:
What we are testing: If my car's gears don't fit together it won't move because there will be no connection of energy
How we are testing: Set up one car with meshing gears and one car without. See which car moves.

Type your investigation here:

Investigation: Gear Ratio

Explain the results of your investigation here:

Engineering Design

Start to sketch your car. What do you want it to look like. How will what it looks like determine the way and speed that your car will travel. What do materials might you want to use

Investigation: Materials

Record the different materials you tried while designing your car in the chart below:

Part of Car	Material	Durable? (yes/no)	Was this piece recycled? (yes/no)	Can this piece be salvaged and reused? (yes/no)	Does this piece come from a renewable resource? (yes/no)	What is the weight of this piece? (in grams)
Chassis						
Motor mount						
Wheels						
Axles						
Race line attachment						
Soda can compartment						

Design Schematic

A ***Design schematic*** is a plan, drawing or diagram to help illustrate and convey the concept/ideas of your design.

Paste any hand drawn or digital images of your initial plans for your JSS car. You can use photos too!

Prototypes and Testing

Explain any issues or problems you had to deal with when testing your car. Also discuss solutions to those problems. Include pictures or videos when possible.

Prototype	Did it work on battery power? (yes/no)	Did it work on solar power? (yes/no)	If it did not work on solar, how did you try to fix/improve your design?
1			
2			
3			

Test your car and make modifications based on your results. Use the chart below to help record your data and draw conclusions from each trial.

Describe the modifications made to your car here:

Trial #	Distance (*cm*)	Time (*s*)	Speed (*cm/s*)
1			
2			
3			

Junior Solar Sprint Rules

Spirit of the Sprint Junior Solar Sprints (JSS) offers students the opportunity to learn by means of a friendly competition against their peers. Students design, construct and race a model solar powered vehicle. The role of the educator is to nurture the spirit of excitement and the joy of discovery and learning that awaits students. Educators should let students assume the responsibility for decisions, building and performance on race day. The races are separated into 5 division races that culminate in an Inter County Final. The dates are posted on transoptions.org/junior-solar-sprints.

Materials and Vehicle Specifications

1. The Ray Catcher solar panel sold by Pitsco is the official solar panel to be used for this race. No homemade panels or other commercial panels can be used. The use of *Solar Made* brand panels will not be accepted starting in 2017. Panels are loaned to schools and must be returned after race day. If your team moves on to the finals, panels can be kept until after finals. Solar panels are TransOptions' property. In the event you lose your panel, you must pay back TransOptions the retail value of the panel, $41. You are allowed to purchase your own panels, but they must be the Pitsco Ray Catcher, product ID W37942. Only 1 solar panel per vehicle is allowed. The solar panel can't be part of the structure of the vehicle. It must be easily disconnected from the vehicle as solar panels are shared.

2. The motor provided by TransOptions must be the only motor used in the vehicle design (Pitsco, motor 280, product ID 54428). Motors may not be rewound or disassembled. Only 1 motor per vehicle is allowed.

3. The vehicle must include in its design a compartment for an empty, 12oz. soda can representing a passenger in the vehicle. The tab must still be attached. Only soda cans are accepted and must be provided by participants. Don't expect to receive a soda can on race day. Only 1 soda can per vehicle. Soda cans may be shared. The soda can must be able to be removed from the compartment easily. It cannot be taped, glued or otherwise directly adhered to the vehicle. The soda can must stay in its compartment from the start line to the finish line. It will be counted as a loss if the soda can leaves the compartment during the race. The soda can itself can't be part of the structure of the vehicle. The soda can and compartment must retain their original shapes; the soda can compartment must retain its original shape with or without the soda can.

4. The vehicle with its solar panel must be powered solely by the sun's energy. **No energy storage devices may be used in conjunction with the solar panel.** If the weather is not conducive towards solar only races, the races will switch to battery power. The participants will be provided with faux panels that are made to be similar size and weight to the actual solar panel. The faux panel will have a positive and negative lead and various pieces of Velcro on the back. It will be powered by a single AA battery that will be provided. The panel has an on/off toggle switch and a micro switch. The students will connect the leads to their motor and switch the toggle to on. Then they will hold down the micro switch and wait for the "Ready, Set, Go" instructions, releasing the micro switch on "Go." Students will be shown the panel in

advance and informed on how to use it before their race. The construction of this faux panel is based on an example provided by the originators of JSS, the Northeast Sustainable Energy Association (NESEA).

5. The vehicle will be attached to a guide wire in the center of the lane and runs the length of the track, with no free end. The attachment device must not be potentially damaging to the line. The wire will be a small diameter line such as 60# fishing line. The wire will be no higher than 1.5cm above the track surface. Included in the kits are eye hooks that can be used to connect the vehicle to the guide wire. The eye hooks must be opened before they can be used.

6. The race track is 66 feet long. The tracks are set on blacktops and tennis courts. In the event of inclement weather, the race is moved inside and the tracks are set on the gym floor of the hosting school.

7. The vehicle must be a student team's own design and manufactured from the current school year. **No vehicle 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.

8. The name of the vehicle must be clearly visible. The name of the vehicle must correspond with the team registration paperwork submitted prior to race day.

9. Student model cars must be no larger than 12"x24"x12".

Conduct of the Race:

1. Teams will consist of 1 to 4 participants max. Participants must be middle school students (6^{th}-8^{th} grade) or children ages 11 – 13.

2. The races will be divided into heats. A scoreboard will detail who is racing now and who is up next, referred to as "on deck." The announcer will alert the crowd over the loudspeaker who is racing and who is on deck. It is the responsibility of the participants and educators to listen to all announcements. There will be some flexibility in regard to moving teams to different heats but as the race continues we will not be able to move teams. Teams that are not announced as racing or on deck should go to the Judges Table to be scored in the following categories Craftsmanship, Engineering, and Best Use of Recycled Materials. Teams that are not racing or on deck may also participate in the Student Choice competition or visit the Fix-It table if their vehicle needs repairs.

3. The races will be run in a double elimination format. Teams must lose twice before being knocked out of the Speed competition.

4. A vehicle needs to be one of the first 3 vehicles to cross the finish line to count as a win in a heat. If not all vehicles cross the finish line, the winners are the 3 vehicles that went the furthest down the track.

5. The following counts as a loss: being in the bottom 3 in a heat , the vehicle disconnecting from the guide wire, losing the soda can during the race, pushing/touching the vehicle or any attempts at cheating.

6. One team member at the start and one team member at the finish line is allowed. No extra team members are allowed in the track area.

7. The vehicle will start from behind the starting line with all wheels touching the track. The solar panel

will be completely shaded by a supplied opaque material cover held above the panel by a team member. No member of the team can touch their vehicle. The team will wait for the “Ready, Set, Go” call and remove the cover so the panel is exposed to sunlight. Once the race is started, no member of the team can touch the vehicle.

8. One team member at the finish line will catch the vehicle **after** it crosses the finish line. Participants aren’t allowed to touch their vehicle until after the race is officially called by the announcer. Participants can remove their vehicle from the guide wire when told to do so by the announcer.

9. The Speed competition will begin at 9am and will continue until a clear winner is determined. Teams placing in the top 10 will be assigned points that will count towards their overall score.

10. Vehicles that place in 1st, 2nd or 3rd in Craftsmanship, Engineering, Best Use of Recycled Materials, Progress Journal or Speed qualify to move on to the Inter County Final.