

Ray Catcher Sprint Deluxe 30-Pack Teacher Guide



PITSCO
EDUCATION

Cautionary and Warning Statements

- This kit is designed and intended for educational purposes only.
- Use only under the direct supervision of an adult who has read and understood the instructions provided in this user guide.
- Read warnings on packaging and in manual carefully.
- Always exercise caution when using sharp tools.
- Safety glasses required when soldering.

Soldering Iron Safety Tips

- Always get permission from an adult before using a soldering iron.
- Be sure to read and follow all of the manufacturer's instructions provided with your soldering iron.
- Never touch the element or tip of the soldering iron.
- Always return the soldering iron to its stand when not in use.
- Turn unit off or unplug it when not in use.

Materials Included

- 30 solar panel blanks (sheets of plastic-coated paper, 10-1/2" x 5")
- 60 balsa wood sheets (10-1/2" x 4" x 3/16")*
- 72 alligator clips
- 60 rear (wide) wheels
- 60 front (narrow) wheels
- 60 wide rubber bands
- 60 screw eyes
- 30 Motor 280s
- Junior Solar Sprint Rules and Regulations
- 60 steel axles
- 120 nylon spacers
- 30 plastic gear fonts
- 60 No. 14 rubber bands
- 30 two-cell AA battery holders
- 6 Ray Catcher Solar Panels
- 30 Ray Catcher Sprint Deluxe User Guides

*The construction process may not require all the balsa wood sheets contained in this kit. Extra wood is included for students whose designs require more balsa wood than the design specified in these instructions.

Construction

If your students are competing in the Junior Solar Sprint competition, Pitsco Education encourages you to have them create or engineer their own designs. The student user guide that is included with the pack is intended as a starting point for the design of a solar vehicle – not necessarily a Junior Solar Sprint vehicle.

With the Ray Catcher Sprint Deluxe, students construct a battery-powered vehicle that can be tested for speed, alignment, and durability. During construction, students attach a solar panel blank onto the vehicle to simulate the position and effects of the actual solar panel. The blank is attached by rubber bands, so replacing it with the solar panel is easy.

After successfully constructing and testing the vehicle on battery power, students substitute the blank with the solar panel and attach it to the motor with alligator clips. To save time, you may wish to assemble the solar panels while your students assemble their vehicles.

Assembling a Solar Panel

1. Connect the alligator clips to the leads on the solar panel.
 - A. Insert one of the two leads through the small hole in an alligator clip.
 - B. Using a pair of pliers, bend the tabs on the alligator clip over the lead.
 - C. Solder the lead to the alligator clip. Be sure to heat the metal around the lead thoroughly so solder flows freely and attaches to the clip.
2. Repeat Step 1 for the second lead of the panel.
3. Repeat Steps 1 and 2 for each of the solar panels.

Safety Precautions

- Instruct students in the proper use and care of hobby knives. If using hobby knives is not age appropriate or if there are other safety concerns, prepare the chassis blanks ahead of time.
- While cool-melt glue guns are much safer than hot-melt glue guns, students should be cautioned not to touch the metal tip of the gun and to keep the glue off their skin as much as possible.
- The voltages produced by the solar panel and batteries are entirely safe for student use. Use of electrical equipment, such as glue guns, should include the appropriate safety precautions.
- Properly dispose of batteries.
- Never force wheels and gears onto the axle. If the fit is extremely tight, use a 1/8" drill bit to ream the hole in the gear or wheel slightly.

Troubleshooting

1. If the car does not move, check the following:
 - Are all electric connections solid and soldered? If not, reconnect or solder and try again.
 - Is the Sun shining? If not, wait until the Sun shines.
 - Are the gears meshing freely? If not, pry the motor and glue from the chassis and reposition it.
2. If the car goes backward, reverse the positions of the two alligator clips on the panel.
3. If you break a piece of balsa wood while constructing the chassis, use the second piece of balsa wood for the chassis and use the broken piece for the panel support member.
4. If the wheels do not spin freely, reposition them on the axles to provide clearance between the wheel and nylon sleeves.
5. 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.
6. 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!

Resources

There are many resources available for ideas on Junior Solar Sprint competitions and for solar power in general. For more information, visit these Web sites:

- jrsolarsprint.org
- www.nrel.gov/education/jss_hfc.html
- www.basea.org/jss.php



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Battery Holder Assembly

1. Connect the alligator clips to the battery holder assembly by inserting one of the two leads through the small hole in an alligator clip.
2. Using a pair of pliers, bend the tabs on the alligator clip over the lead.
3. Solder the lead to the alligator clip. Be sure to heat the metal around the lead thoroughly so solder flows freely and attaches to the clip.
4. Repeat Steps 1 through 3 for the second lead of the battery holder.
5. Position the battery holder behind the panel support member (Figure 5). Make sure the leads are on the same side of the chassis as the motor terminals.

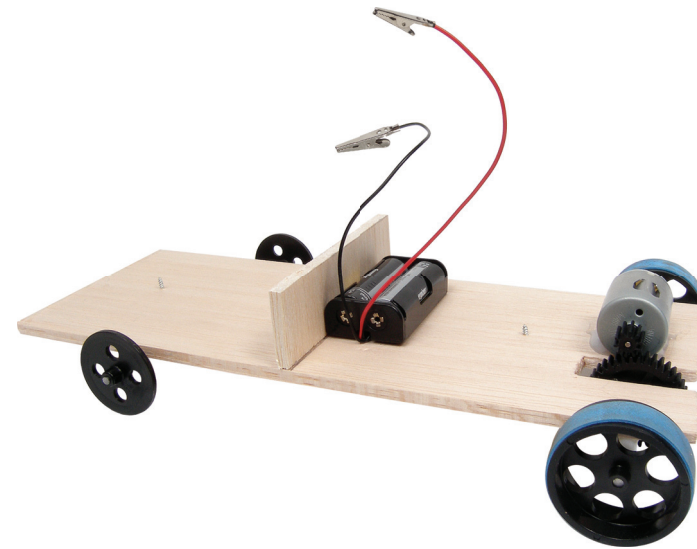


Figure 5

Motor Connections

1. Solder the two wire leads on the solar panel to the two alligator clips. **Tip:** To protect the connection, place a dab of low-temp glue on the solder joint.
2. Connect the alligator clips to the two motor tabs.
3. Take the solar vehicle outside and expose it to sunlight. If the wheels do not spin forward, switch the alligator clips on the motor.

Final Assembly

1. Using a cool-melt glue gun, run a small bead of glue on the top, extreme front of the chassis. Allow the glue to cool. This will provide a ledge on which the solar panel or solar panel blank 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 blank on the chassis so it rests at the front of the vehicle and on the panel support member. The blank is used to show the position and effect of the solar panel on the vehicle as you test your vehicle with the battery pack. When you are ready to do a solar test or race, use the solar panel that your teacher provides and replace the blank with the it.
4. Stretch one of the No. 14 rubber bands around the front of the chassis and the solar panel blank. Stretch the other No. 14 rubber band around the chassis and panel blank and position it at about the center of the panel blank.
5. Connect the battery pack's alligator clip with the red lead to the motor terminal that has a round dot. Then connect the alligator clip with the black lead to the other motor terminal.

Optional

If you are running your car on a guided wire or fishing line, use the screw eyes to keep your car in line. Insert the screw eyes into the bottom of the chassis, one toward the front of the vehicle and another toward the rear, centered between the sides and in-line with the direction of travel.



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If you are competing in the Junior Solar Sprint competition, we encourage you to create your own design. Refer to the official Junior Solar Sprint rules when designing your vehicle to meet those specifications. This user guide is intended for those **not** participating in the JSS competition and represents one of ways to build the vehicle.

Materials Included

The solar panel and motor are official parts required by the Junior Solar Sprint competition.

- Solar panel blank (10-1/2" x 5" plastic-coated paper)
- 2 balsa wood sheets (10-1/2" x 4" x 3/16")
- 2 alligator clips
- 2 rear (wide) wheels
- 2 front (narrow) wheels
- 2 wide rubber bands
- 2 screw eyes
- 4 nylon spacers
- 2 steel axles
- Plastic gear font
- 2 No. 14 rubber bands
- Two-cell AA battery holder
- Motor 280
- Ray Catcher Solar Panel (shared item)

Items Required (not included)

- Soldering iron and solder
- Hobby knife or coping saw
- Cool-melt glue gun and glue slugs
- Sandpaper
- Needle-nose pliers
- 2 C-clamps
- Ruler

Making the Chassis

1. Using a No. 2 pencil, draw Line A down the center of a balsa sheet (Figure 1).
2. **Turn over the balsa sheet.** Draw Line B 3/4" from one end of the sheet (Figure 2 on the next page).

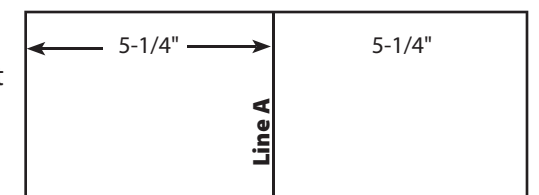


Figure 1

- At the same end, draw a $5/8" \times 1-1/2"$ notch 1" from the top of the sheet (Figure 2).
- Draw Line C $2-1/2"$ from the other end of the same sheet of balsa wood (Figure 2).
- Using a hobby knife or a coping saw, cut out the notch drawn in Step 3.
- Locate the other sheet of balsa wood. Draw a line parallel to and $1-1/8"$ from one of the narrow ends. Cut along the line to produce a $1-1/8" \times 4"$ panel support member.
- 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.



Figure 2

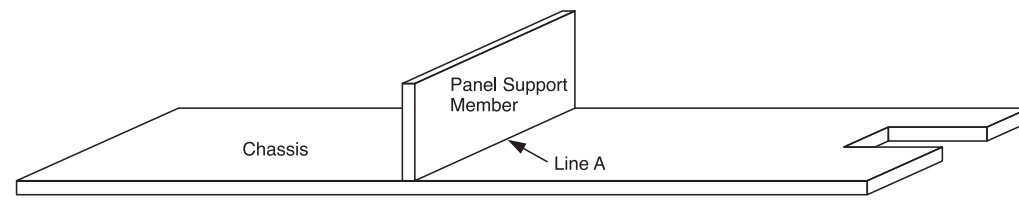


Figure 3

Wheels, Gears, and Axles

Installing wheels and gears on axles can be difficult. The gears and wheels should fit snugly to the axle and provide power to the wheels. Your teacher has a troubleshooting tips on what to do if the gears and wheels are not snug.

Rear Axle Assembly

- Deburr the axles by brushing the ends against sandpaper. This makes it easier to push the axles into the wheels.
- Detach Gear I from the gear font. Using a sharp knife, carefully remove any plastic flashing between the gear teeth.
- Place the gear on a table. Insert one of the steel axles into the gear. Slide the gear $1-7/8"$ from one end of the axle. It should be $3-3/8"$ from the other end of the axle (Figure 4).
- Slide two nylon spacers onto the axle, one on each side of the gear (Figure 4).

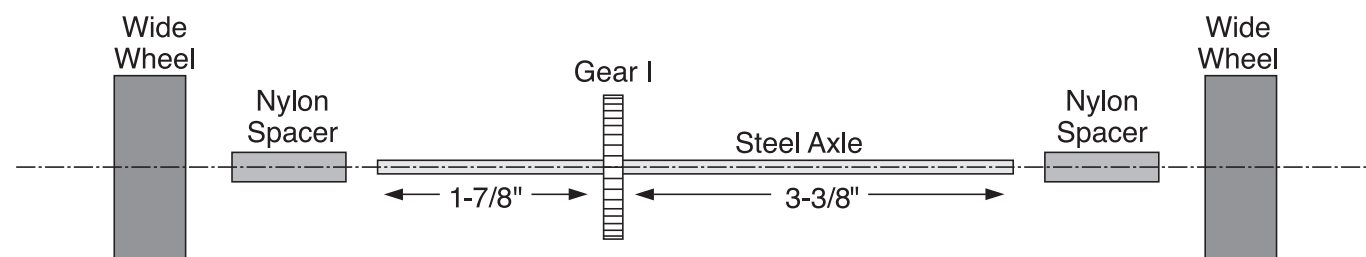


Figure 4

- Place one of the rear wheels flat on a 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.
- Lay the other rear 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.
- Stretch a wide rubber band around each of the wide wheels. These act as tires and provide traction for your vehicle.

Front Axle Assembly

- Place one of the front 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.
- Slide two nylon spacers onto the free end of the axle.
- While keeping the spacers on the axle shaft, slide the free end of the axle into the other front wheel until the end of the axle is flush with the opposite side of the wheel.

Attaching Axle Assemblies to Chassis

- Position the notched chassis on the table so the notched end of the balsa wood sheet is hanging over the table edge and Lines B and C are face up.
- Carefully position the rear axle assembly so:
 - Gear I is centered in the notched area of the chassis.
 - The axle is positioned along Line B.
 - The nylon spacers are positioned within $1/16"$ of each wheel.
- When the rear axle is positioned as described in Step 2, use small C-clamps or ask a friend to hold the rear axle assembly in the correct position. Now gently apply a bead of cool-melt glue along the sides of the nylon spacers where they touch the chassis. Hold the rear axle assembly in place until the glue cools.
- Place the front axle assembly along Line C. Position the axle so the wheels are equidistant from the chassis.
- Slide the spacers to within $1/16"$ of each wheel. Hold this assembly in place and gently apply a bead of cool-melt glue along the sides of the nylon spacers where they contact the chassis.
- Hold the front axle assembly until the glue dries.

Attaching Motor Assembly to Chassis

- Remove Gear F from the gear font and cut off any excess plastic between the teeth of the gear.
- Insert the shaft of the motor into Gear F to within $1/8"$ of the body of the motor.
- Set the chassis on the table with the axle assemblies facing down.
- Using a cool-melt glue gun, create a $1/2" \times 1"$ rectangle of glue about $1/8"$ deep (Figure 5).
- 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 Gear I (Figure 5). Be sure not to block the vent holes with glue. Hold the motor in place while the glue cools.
- 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 or crashes.
- 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.

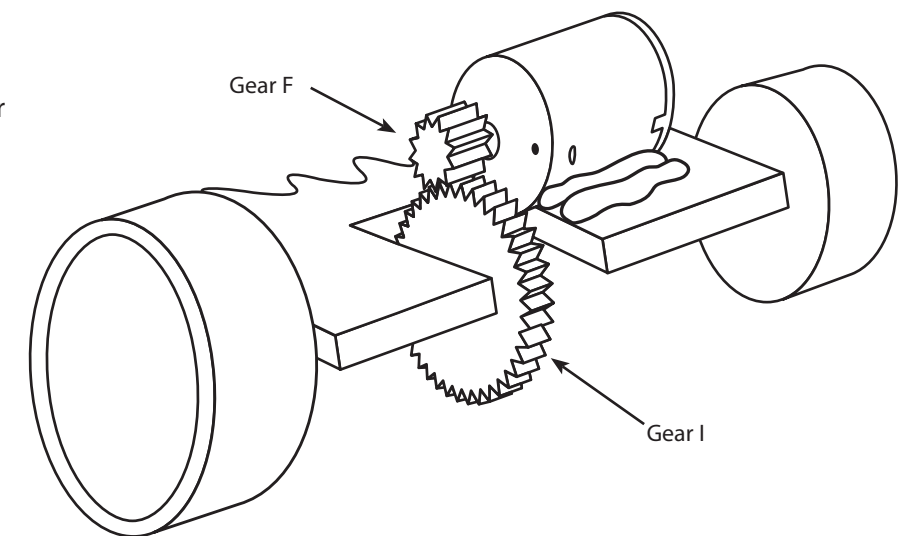


Figure 5 – In this illustration, Gear F engages Gear C.