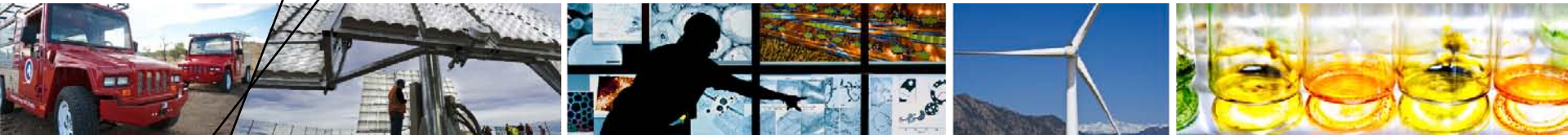
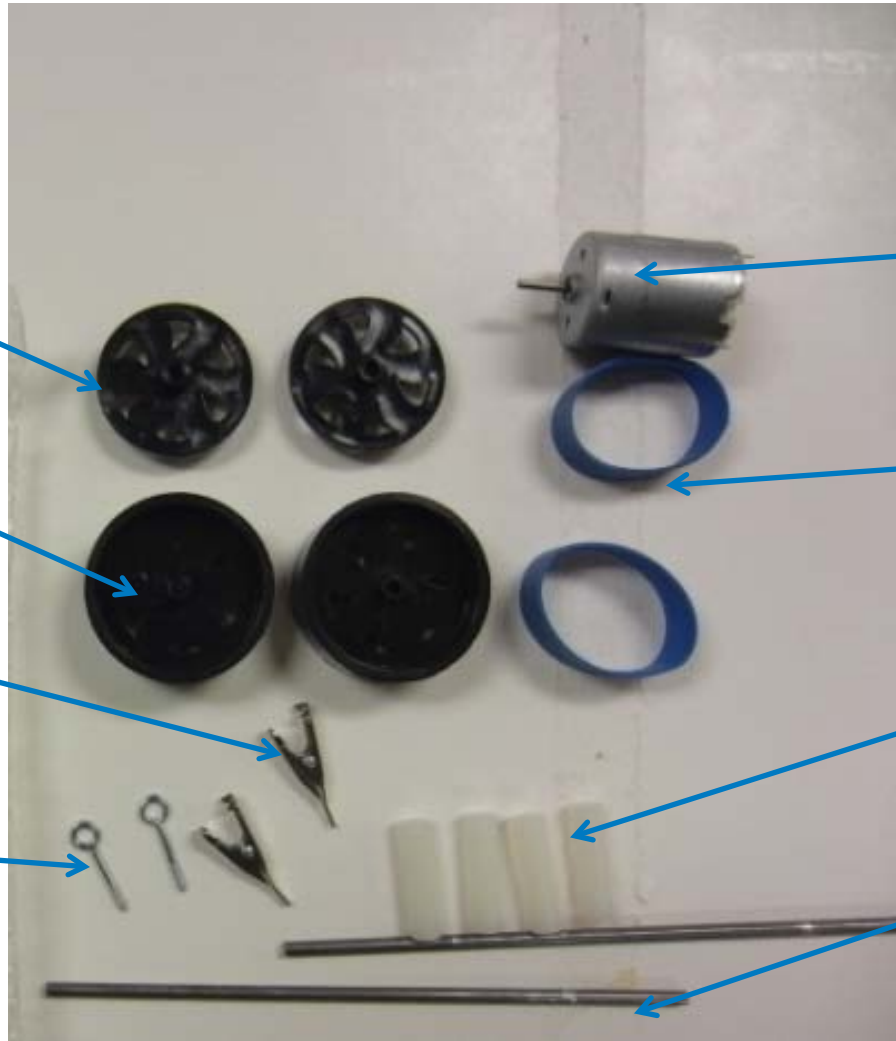


Lithium Ion Battery Teacher Workshop 2012



Parts List



2 Pitsco GT-F Wheels

2 Pitsco GT-R Wheels

2 alligator clips

2 screw eyes

1 No. 280 motor

2 No. 14 rubber bands

4 nylon spacers

2 steel axles

Also:

1 plastic gear font

2 balsa wood sheets

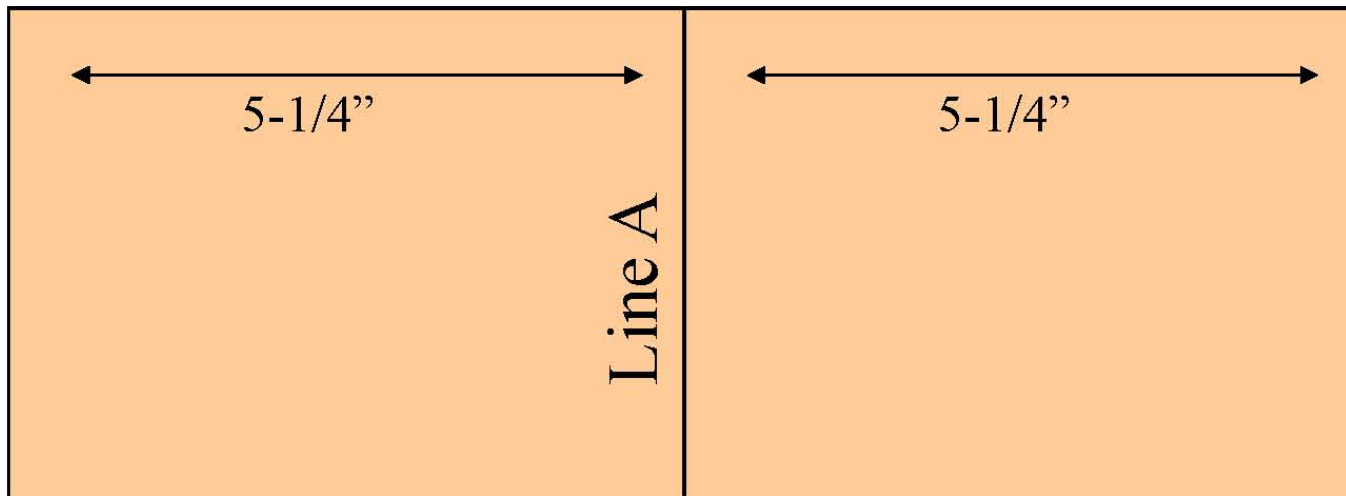
Tools Required

1. Soldering iron
2. Hobby knife or coping saw
3. Glue gun
4. Needlenose pliers
5. 2 C-clamps
6. Ruler



Making the Chassis

1. Using a No. 2 pencil, draw Line A down the center of a balsa sheet.



Making the Chassis

2. Turn over the balsa sheet and draw Line B $\frac{3}{4}$ of an inch from one end of the sheet.



Making the Chassis

3. Draw a $5/8''$ x $1/2''$ notch from $1''$ from the top of the sheet.



Making the Chassis

4. Draw Line C $2\frac{1}{2}$ " from the other end of the same sheet of balsa.



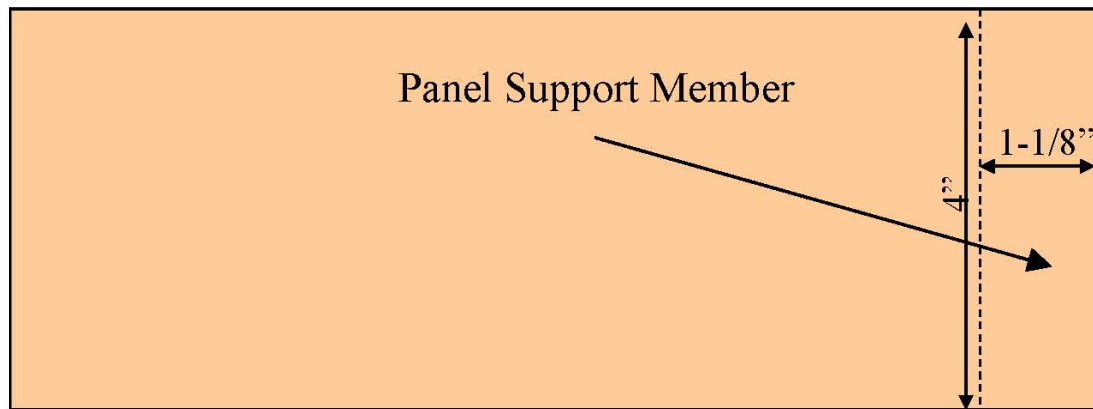
Making the Chassis

- Using a sharp utility knife or a coping saw, cut out the notch drawn in step 3. Save the cut out piece of balsa for a later step.



Making the Chassis

6. Locate the other sheet of balsa and draw a line 1 1/8" from one of the narrow ends. Cut along the line to produce a 1 1/8" x 4" panel support member.

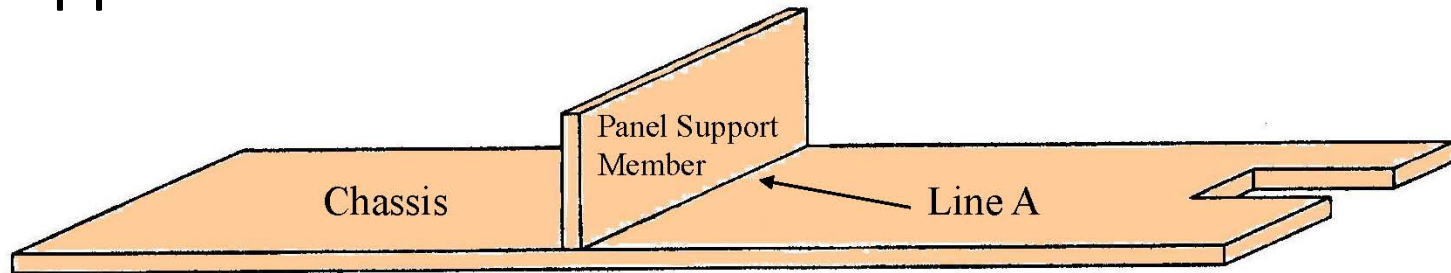


Panel Support Member

- **The purpose of the panel support member is an option to use as a brace for your water bottle if your bottle is standing in a vertical position.**
- **If you are going to place the water bottle horizontally on your chassis, do NOT glue the panel support member in place.**

Making the Chassis

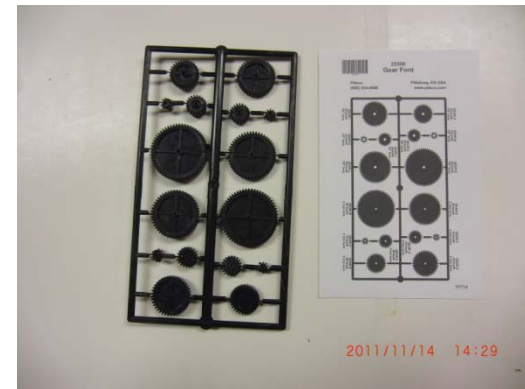
7. Using a glue gun, run a small bead of glue along one of the 4" edges of the panel support member and attach firmly where you plan to have your water bottle positioned on your chassis. After it is in place, run an additional bead of glue on each side of the joint between the chassis and the support member.



Wheels, Gears, and Axles

Rear Axle Assembly

1. Locate the plastic gear font.
Detach Gear I from the font.
2. Inspect the gear and using a sharp knife 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.



Wheels, Gears, and Axles

Rear Axle Assembly

4. 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.
5. Slide two nylon spacers onto the axle, one on each side of the gear.
6. Place one of the wide plastic 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.



Wheels, Gears, and Axles

Rear Axle Assembly

7. Lay the other wide plastic wheel flat on the table. With the 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.



Wheels, Gears, and Axles

Front Axle Assembly

1. Place one of the two think 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. Place the gear on a table. Insert one of
While keeping the spacers on the axle shaft, slide the free end of the axle into the other think 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 balsa wood sheet is hanging over the table edge and Lines B and C are face up.
2. Carefully position the rear axle assembly so:
 1. Gear I is centered in the notched area of the chassis.
 2. The axle is positioned along Line B.
 3. The nylon spacers are positioned within $1/16''$ of each wheel.
3. 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.



Attaching Axle Assemblies to Chassis

4. While the rear axle is in the correct position, gently apply a bead of cool-melt glue along the sides of the nylon spacers where they contact the chassis.
5. Hold the rear axle assembly in place until the glue cools.
6. Place the front axle assembly along Line C.
7. Position the axle so the wheels are equidistant from the chassis.



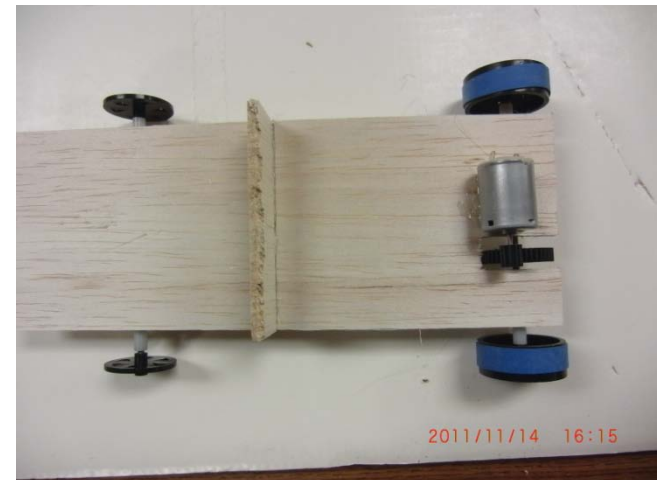
Attaching Axle Assemblies to Chassis

8. Slide the spacers to within $1/16$ " of each wheel.
9. Hold the assembly in place and gently apply a bead of cool-melt glue along the sides of the nylon spacers where they contact the chassis.
10. Hold the front axle assembly until the glue dries.



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" of the body of the motor.
4. Set the chassis on the table with the axle assemblies facing down.



Attaching Motor Assembly to Chassis

5. Using a glue gun, create a $\frac{1}{2}$ " x 1" rectangle of glue about $\frac{1}{8}$ " deep as illustrated in Figure 5.
6. While the glue is still liquid, place the motor on its side (with vent holes up). Gear F sits directly on top of and engages Gear I (Figure 5). Be sure not to obstruct or fill the vent holes with glue.
7. Hold the motor in place while the glue cools.

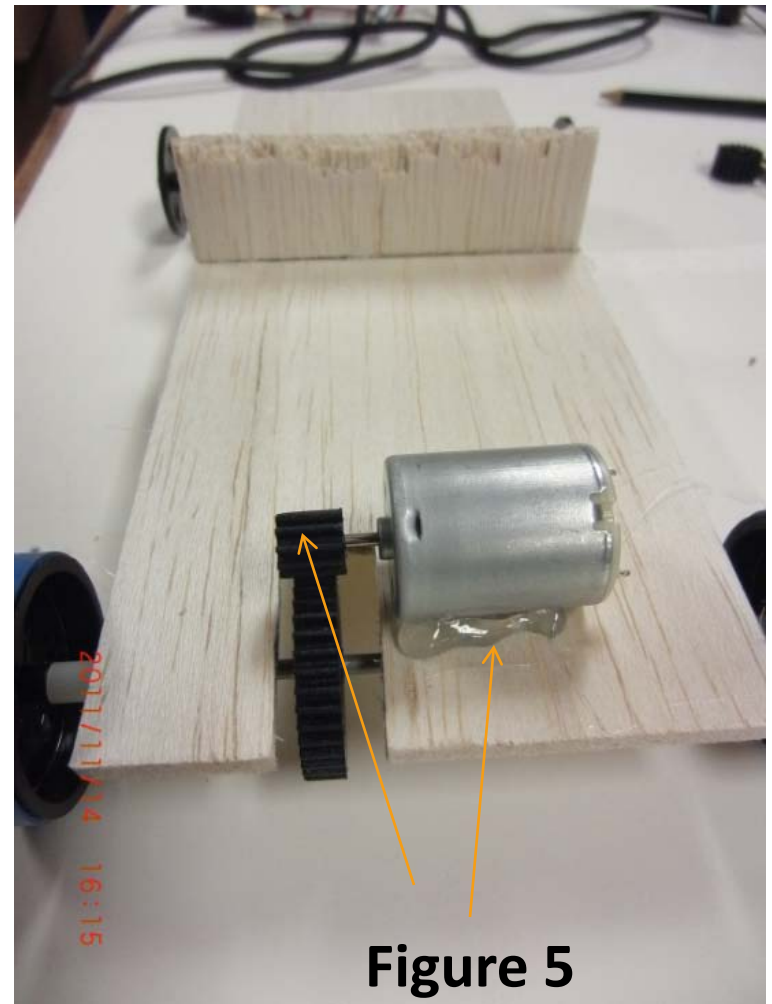


Figure 5

Attaching Motor Assembly to Chassis

8. Apply another bead of 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.

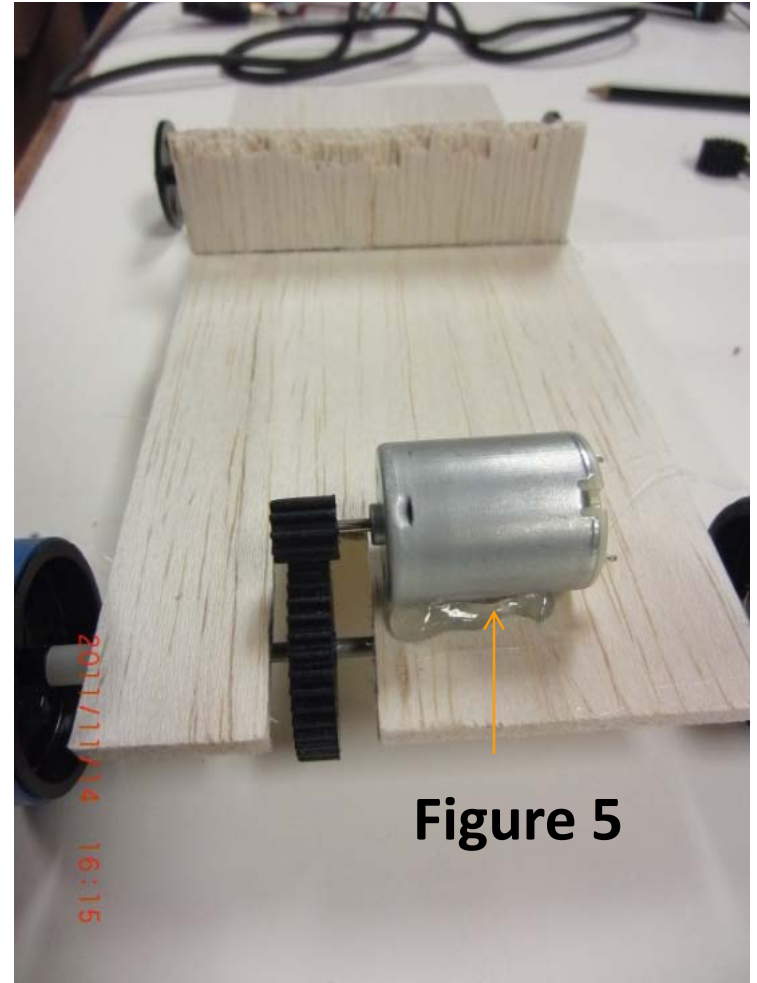
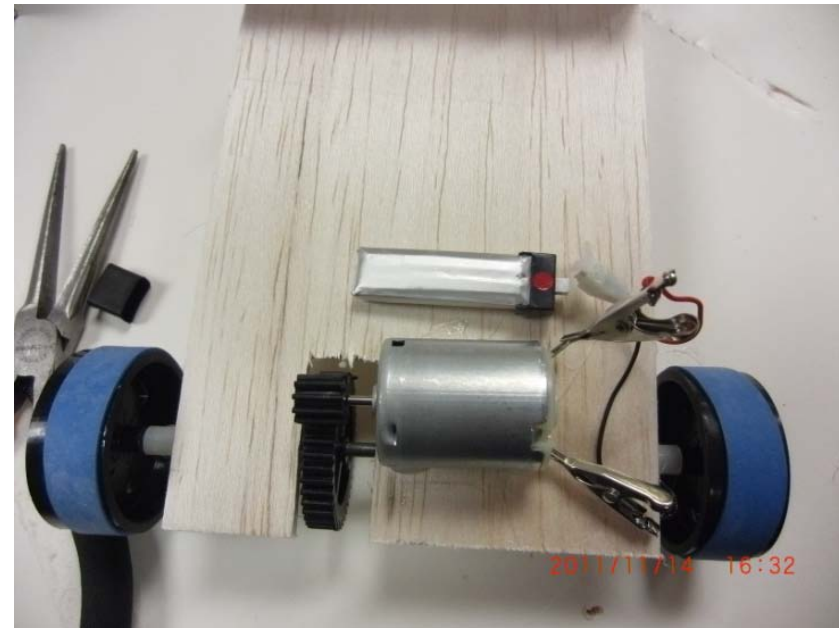


Figure 5

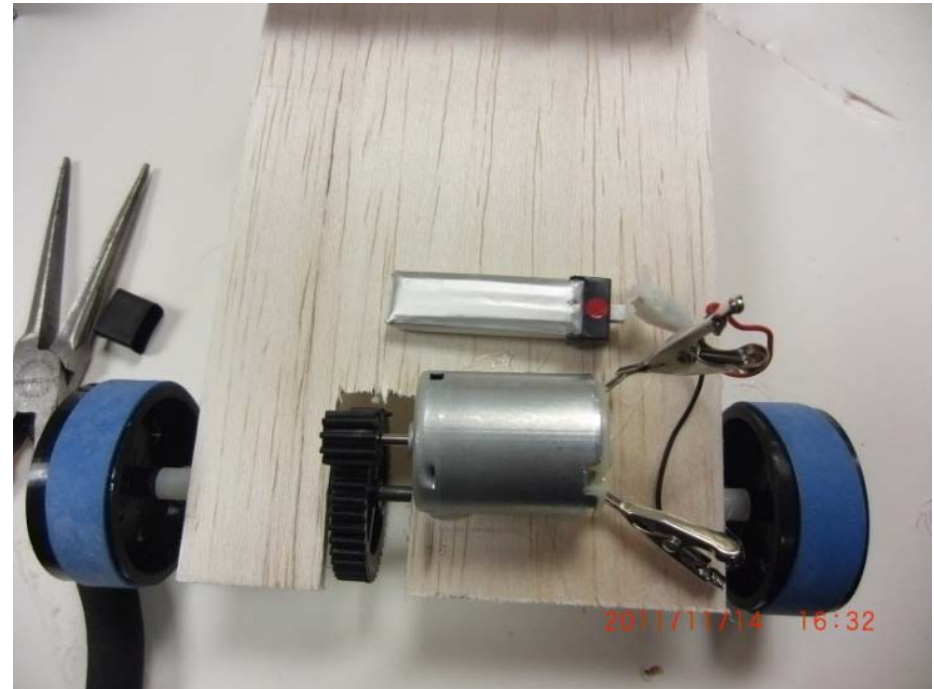
Battery Connector Assembly

1. Insert 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.



Battery Connector Assembly

5. Position the battery close enough to the motor so the alligator clips can reach the leads on the motor.
6. Plug the battery connector to the battery.
7. Quickly attach the alligator clips to the motor. Your motor should start.



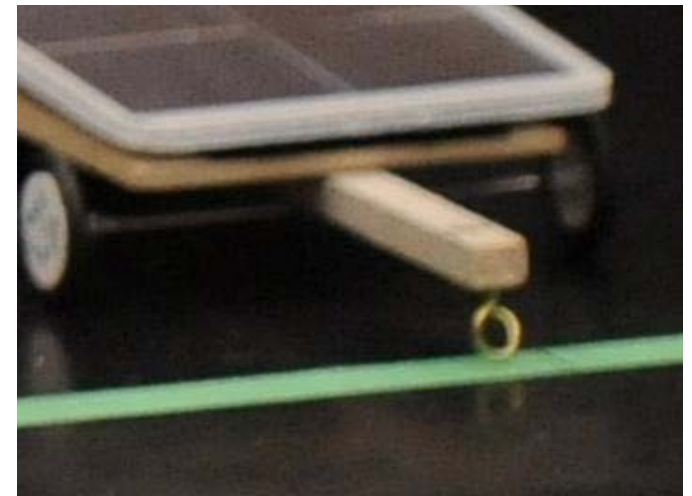
WARNING!

1. If you are not running the car, you must disconnect the battery connector from the battery. If you do not the battery can overheat and could cause serious injury.

Please review the Safety Hazards and Battery Testing documents for further information.

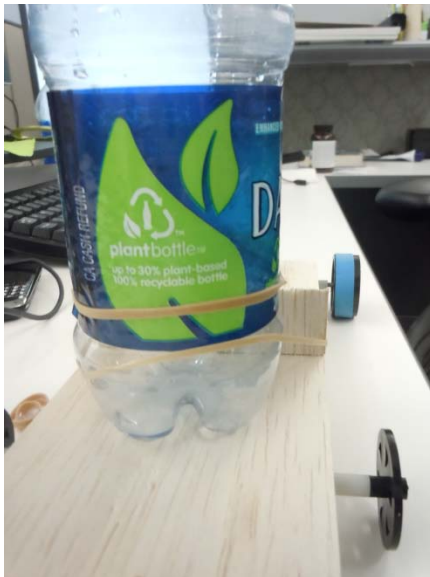
Using a Guide Wire

1. You will be running your car on a guided wire or fishing line.
2. 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.



Attaching the Water Bottle

1. It is up to the teams to secure the water bottle in place on the car. The bottle must be removable and cannot fall off during the race (this will result in a Did Not Finish (DNF)).



Questions

Please contact: Marcus Giron

Marcus.Giron@nrel.gov