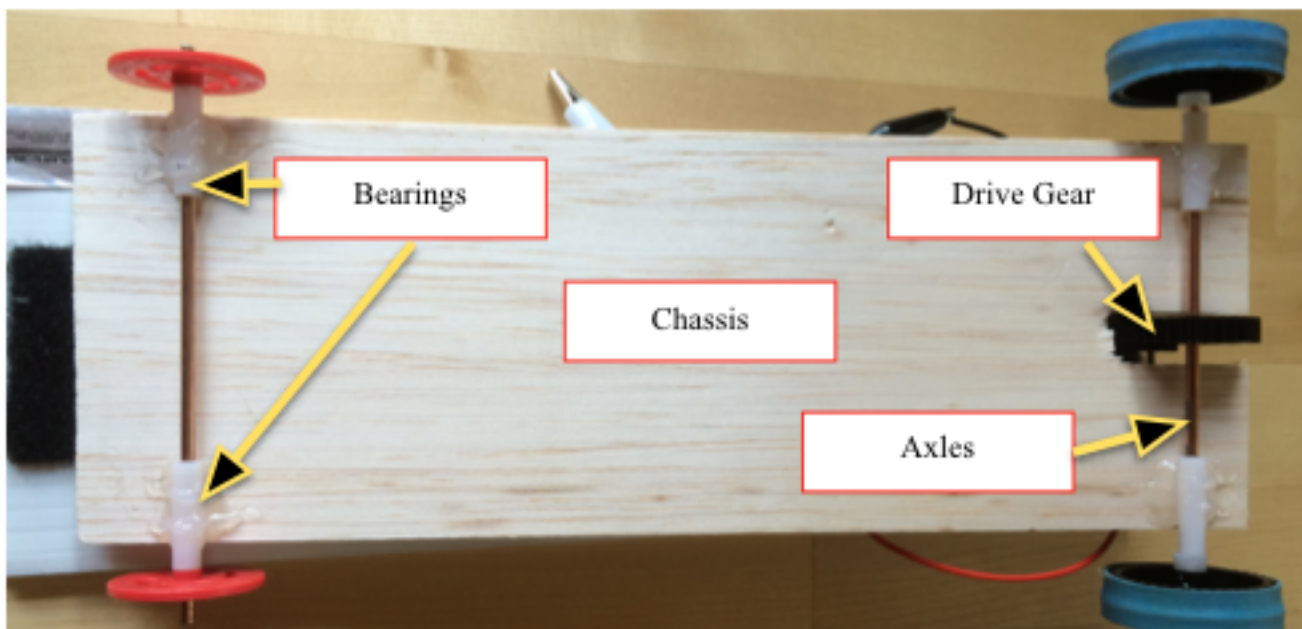


## Part 1: Parts and General Overview

You will have 5 major hurdles to get over on your way to creating a great solar challenge car. This list IS in order of importance.

1. **Friction:** You must reduce as much friction as you can, especially around the axles and wheels.
2. The car must run **straight** and true.
3. **Weight:** Your car must be as **light** as it can be and still carry the solar panel, motor and battery pack.
4. The car must have the axles positioned and the solar panel mounted so that it is **balanced**.
5. Make sure your wheels have good **traction** or your car will not go anywhere.

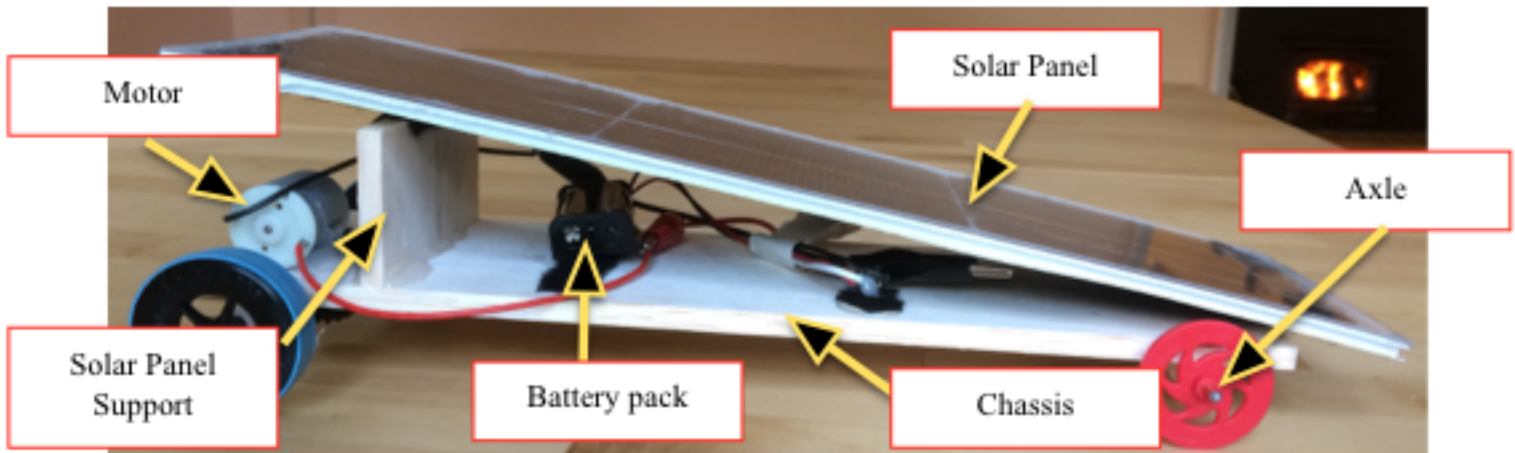
### PARTS OF THE SOLAR CAR



- A. **Chassis:** The chassis is the main structural piece of your car. Everything on your car attaches to your chassis.

## Solar Car Fact Sheet

- B. Bearings:** The bearings are responsible for attaching your axles and wheels to your car so they can spin free. Bearings are hollow



tubes that allow a metal bar (axle) to spin inside of it.

- C. Axles:** The axles are metal bars that you attach wheels to. Because the axles are installed inside the bearings, they can spin free and allow your wheels to move!
- D. Drive Gear:** The drive gear attaches to your axle as well. It connects to your motor. The motor drives the gear, that drives the axle, that drives the wheels. There are different drive gears depending on how much torque you want.
- E. Motor:** The motor takes electrical energy from the solar panel or battery and converts it into energy that can be used to spin the gear, that leads to the wheels.
- F. Solar Panel:** The solar panel converts solar energy into electrical energy that the motor can use.
- G. Solar Panel Support:** The support keeps the solar panel pointing towards the sun and gives space on the chassis to attach the battery pack and motor.
- H. Battery Pack:** The battery pack is used in case there is no sun, or when we are testing and conducting investigations. There is also an on/off switch for cars that make it to the solar challenge. You need to have a spot for that on your chassis.



## Part 2: Chassis, Bearings, Axles and Wheels

### CHASSIS

**The chassis is the frame of your car. All the other parts get attached to the chassis.**

A longer, wider chassis is easier to mount axles and get to roll straight but is heavier.

Option 1: Cut away all parts of the chassis not needed.

Option 2: Create a narrow or short chassis. This is lighter but getting them to run straight will be harder.

Option 3: Be creative and use a completely different type of chassis. This can be the most frustrating and most rewarding choice.

The first thing you will attach to your solar car are the bearings. See below for more detail, but take your time to do this part right! Test your car to see if it goes straight. On the top of your car you will attach your motor first. Getting your motor on with just the right amount of friction is tough. Take your time! You will also need space to attach your solar panel supports(front and back) and the battery pack.

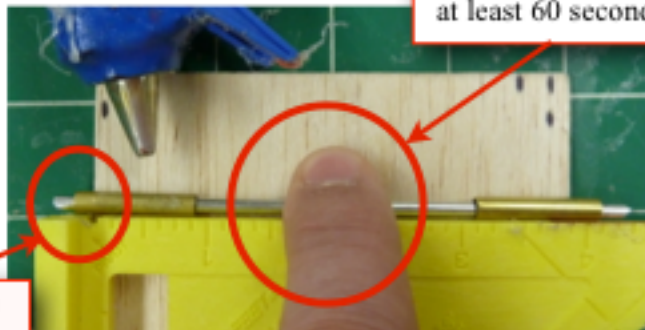
### BEARINGS

**The bearings are four small plastic tubes. Your axles spin inside these tubes and allow your car to roll!**

**Bearings must extend out beyond the chassis.**

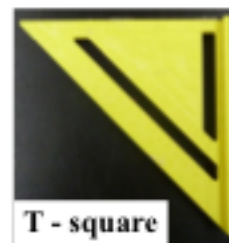
The tubing(bearing) must extend a little beyond the side of the chassis so that the wheels or gear will not make contact with the chassis. This will cause a ton of **FRICION**.

The finger holds the axle in place while the glue dries. Don't move your finger for at least 60 seconds!



Notice that the bearing extends beyond the chassis.

Use the T-square too to mount the bearings to the chassis. This tool creates a perfect 90 degree angle and mounts your bearings on perfectly (when used correctly) and will make your car run very straight. If your car does not run straight, it will run along the side of the track creating a lot of **FRICTION**.



## AXLES

**Axles are metal bars that attach your wheels and gears to the chassis.**

Axles must be straight! A bent axle creates a lot of **FRICTION**. You have two options here.

**Steel:** Steel axles are heavy, but they are hard to bend. Everyone starts with steel axles.

**Aluminum:** Light, but they bend **VERY** easily. It is more important for the car to have a straight axle than a little weight loss. You can only get aluminum axles after you have built your car and you are trying to improve it for the final race.

To test an axle and see if it is straight, you roll the axle on the desk. It should easily roll 3-4 inches.

**NEVER** get glue on the axles! It is easy to do and will slow your car down a lot because of **FRICTION**.

## WHEELS

Wheel diameter matters. A larger wheel will be harder for the motor to turn, but will have a higher top speed.

Sometimes **FRICTION** is good. It is essential to have friction between the wheel and the ground or your car wheels will only spin and not move. You also need friction between the wheels and the axles.

## GEARS, MOTOR AND BATTERY

1. Most cars will use the medium size gear or the gear that is built into the black wheel. You will need to decide which is better. You can use math to help figure out which is better, if you are willing to put the work in!
2. The gear needs to be tight on the axle! If it is easy to get the gear on, it will likely spin on the axle and you will lose power.
3. Positioning of the motor is very important. If the gears are too close there will be a lot of extra friction. If they are too far apart they will make a very loud noise and your car will go nowhere.
4. Never get glue, paint or anything else on the gear teeth. This adds more friction.
5. Concept and hill climb cars may need a larger drive gear in order to give more torque.
6. Space for double AAA battery holder must be easily accessible and close to motor
7. You can change the tension between the gears by moving the motor slightly. Start with less glue on the motor and a weak battery.



### Friction Alert!

There is always a balance to be had with friction and the gears. If the gears are too close, there is too much friction. Too far apart and there is not enough to make the wheels move. Also be careful that wires are not rubbing against any wheels or gears!

## BODY SHELL (for concept car)

1. Weight and friction are still very important for your car! Concept cars are heavy and will need all the power they can get.
2. You need to think about how the solar panel will be attached and stabilized. All concept cars need the solar panel!
3. You still must be able to access the battery pack and wires to attach the solar panel.
4. Your car **MUST** be smaller than 30 cm by 60 cm by 30 cm.

## SOLAR PANEL

1. Solar panels are your power source. The more energy they produce the faster your car will go.
  2. You can use mylar to reflect more light on to the solar panel.
  3. Mylar reflectors create more wind resistance. Is it worth it?
  4. If the sun is hitting the panel at 90 degrees you will get the most power output. However the sun moves throughout the day. One option is to make a movable solar panel. Is the extra weight worth the trouble?
  5. A solar panel 45 degrees to the sun is a fairly high angle. Is it worth the wind resistance?
  6. In my experience it is better to worry about friction and weight, but it is your car!
  7. **NO GLUE** may be used to attach your solar panel to the chassis. You must use velcro.
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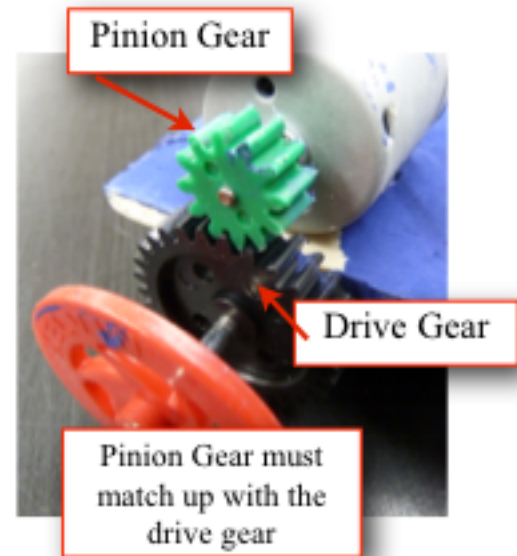


## Part 3: Gears, Motor, Battery and Solar Panel

### GEARS

Gears are wheels with teeth on them that transfer the energy in the motor to the wheels.

- The gear needs to be tight on the axle! It is tempting to drill out the hole on the gear to make it easier to put on. However, if there is too little **FRICTION** between the axle and the gear it will likely spin on the axle and you will lose power. You may need to drill out the hole in the gear, but you have to be very careful not to drill out too much.
- There are two different types of gears. The pinion gear attaches to the motor and is smaller with fewer teeth. The drive gear is attached to the axle and is larger with more teeth.
- You have to choose what gears you want to use. The gear ratio makes a big difference in your car's performance. You calculate the gear ratio by dividing the drive gear teeth by the pinion gear teeth.
- Most speed cars will use the medium size gear or the gear that is built into the black wheel. You will need to decide which is better. The smaller your gear ratio, the higher your top speed. The downside is that you lose torque.
- Concept and hill climb cars may need a larger gear ratio in order to give more torque.
- Never get glue, paint or anything else on the gear teeth. This adds more **FRICTION**.



### MOTOR

- The motor converts the electrical energy of the battery and the solar panel and converts it into mechanical energy that can turn the gear.
- Positioning of the motor is very important. If the gears are too close there will be a lot of extra **FRICTION**. If they are too far apart they will make a very loud noise and your car will go nowhere.
- You can change the distance between the gears by moving the motor slightly. **Start with less glue on the motor and a weak battery.**

## Solar Car Fact Sheet

### BATTERY

- You need to create space for a battery holder and an on/off switch. It must be easily accessible and close to motor.
- We will use the battery pack for most of our trials.
- You will start with a single battery pack to keep the speed down on your car. We will use a double battery pack when we have the tracks set up.

### SOLAR PANEL SUPPORTS

- Theoretically, you want to have your solar panel pointing directly towards the sun to get the most energy from the sun. In Oregon, that is nearly a 45 degree angle!
- A solar panel at 45 degrees is a very high angle. The trade off is air **FRICTION** or wind resistance. It also makes your car more top heavy.
- You will have to decide if you value the extra energy you get from a steep angle vs. a more aerodynamic car.
- **NO GLUE** may be used to attach your solar panel to the solar panel supports. You must use velcro.

### SOLAR PANEL

- The solar panel is your power source. The more energy it produces the faster your car will go. In addition to changing the angle of the panel, you can also use mylar reflectors to reflect more light onto the solar panel. As a trade off, reflectors create more wind resistance(air **FRICTION**). Is it worth it?
- Solar panels are fragile and very expensive. We will use batteries and share broken panels(for the mass) until we race in the sun.

