Pinewood Derby Workshop Instructions

Prior to the workshop:

- Scouts should think about a design for their car ahead of the workshop. We recommend using the Pinewood Derby Design Templates to get started. There are several templates scouts can choose from or use to design a unique car from scratch. It is helpful to complete this prior to the workshop.
- Weights are not included in the BSA Pinewood Derby Kit, scouts will need to source their own weights which could be batteries, washers, bolts, coins, etc. There are many 3rd party options for purchase online (Amazon, Pinewood Pro, Maximum Velocity, Ali Express). We recommend scouts bring their weights to the workshop so we can help you adjust the car's center of gravity.
- Scouts will also be responsible for handling the finishing touches of their car such as paint and stickers, the sky's the limit here, go nuts!

At the Workshop:

The Workshop will be split into stations where scouts can focus on specific areas of building the car.

- Body Shaping Station - Volunteers will utilize the larger power tools such as table saw, miter saw, and band saw to establish the rough shape of the car for the scouts. Scouts can use the provided hand tools such as chisels, coping saw, and files to shape the car as well. Volunteers will provide feedback on designing a body for aerodynamics, weight placement, and optimizing center of gravity.
- Axle Polishing Station - Scouts will learn how to prepare their axles through polishing their contact surfaces which minimize friction. Scouts will utilize different sandpaper grits to polish their axles.
- Rail Riding Station - Scouts will learn how to bend and score an axle for building a rail riding car. This axle will be used on the right front wheel and scouts will learn how to install the axle and tune it to optimize the rail riding ability of the car.
- Axle Drilling Station - Scouts will learn about the wheelbase of the car and how important axle placement is, once a wheelbase pattern is chosen we will walk the scout through drilling the car’s axle holes.
- Sanding Station - Scouts will get access to hand sanding tools to prepare their car for paint and finishing work.

WORKSHOP SAFETY

We need everyone’s help to make safety our top priority at the workshop. Here are some useful tips for ensuring safety at the workshop.

1. Gather your safety essentials: dust mask, goggles, and latex gloves.
2. Wear eye protection at all times.
3. Monitor Cub Scouts' use of tools.
4. Wear a dust mask when appropriate.
5. Work in a well-lighted and well-ventilated area.
6. Consider wearing gloves when using sharp tools.
7. Do not wear loose-fitting clothing.
8. Do not melt lead; handle lead with care.
9. Follow all safety rules and precautions listed on the tools and products you use.
10. Keep your work area clean and organized.

AXLE Polishing Instructions:



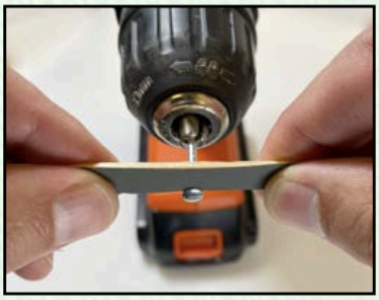
The goal is to remove the nail flashing and polish the shaft and under the nail head to remove imperfections. We want to remove as little material from the shaft as possible and we don't want to remove the crimp marks. Removing the crimp marks on the axle shaft will significantly reduce the diameter of the axle. Crimp mark removal gives the wheel more room to move on the axle, making it more likely the wheel will vibrate, causing the car to wiggle. An unstable, wiggling car is slow.



Insert the axle into the dremel. The flashing or burs under the axle head must be removed. Using the dremel to hold the axle, use the small file to scrape away the flashing. Inspect the axle head closely (magnification helps a great deal). After the flashing is removed you can move on to sanding.



Sand the shaft



Sand under the head



Sand sides and top of head

Have the scouts use the sandpaper to sand the axle. Dip the sandpaper in a cup of water at regular intervals while sanding. The water keeps the axle from becoming too hot and washes away loose sandpaper and axle material. The trick is to keep the sandpaper wet and use even light pressure. Use the following as a guide:

- 1200-grit paper, 10-20 seconds on shaft, 60 seconds under axle head, 20 seconds on side and top of axle head
- 2000-grit paper, 10-20 seconds on shaft, 60 seconds under axle head, 20 seconds on side and top of axle head
- Apply a small amount of metal polish to a foam brush. Polish the axle shaft and head area for about 10-15 seconds, then wipe off any excess with a paper towel.

AXLE Bending Instructions:

To complete our rail riding setup, we will be using an axle bending jig to get a perfect bend for the right front axle. Have the scouts bend one polished axle to use for the Right Front Wheel. This bent axle will be used to steer the car slightly into the rail. On Test Day the scouts can adjust this wheel to achieve a smooth rail riding car.



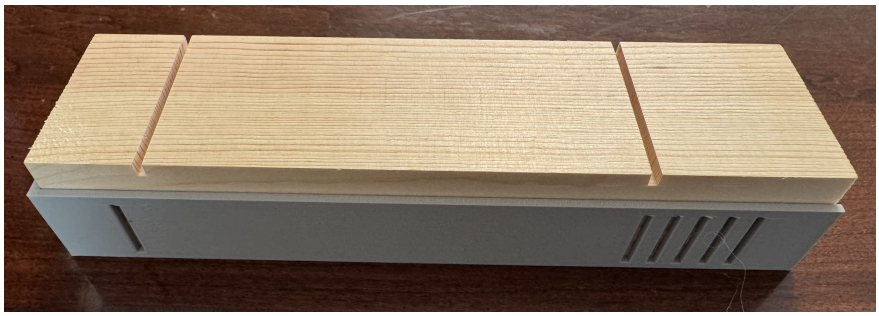
Loosen the top nut bolts and insert the axle, align the tuning groove with the reference line. Firmly tighten the bolts in the top nut to secure the axle in place.



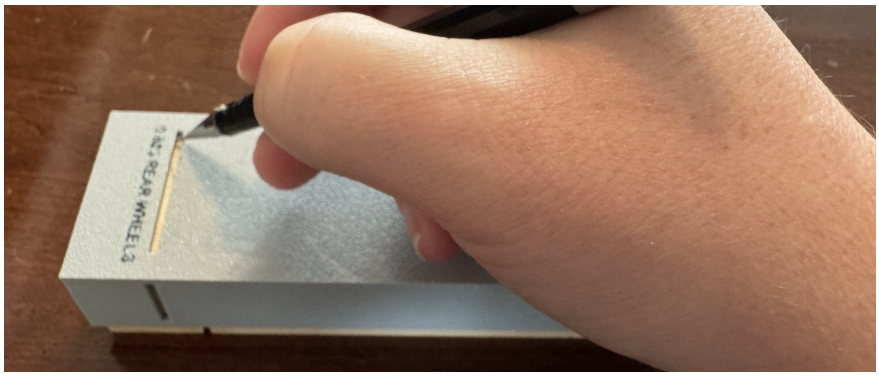
Insert the axle with the head positioned as shown in the photo. Tighten the screw (snug the screw, but don't over tighten. With your thumb on top of the black knob, use your index finger to lift up on the Bending Lever until the Lock Ring stops the lever. Remove the axle and verify/adjust the Lock Ring as needed. Before using the tool on the production axles, fully polish the axles.

WHEELBASE Instructions:

Have the scouts mark their wheelbase using the wheelbase jig. The jig helps optimize the wheel placement by moving the rear wheels as far back as possible and allows the scouts to choose the placement of their front axle locations. Choosing the location of the front axle is a design choice the scouts need to decide on. Place the block in the jig with the pre-drilled axle locations exposed, the clean face should be in the jig and will be marked, the pre-drilled axle slots represent the top of the car and will be removed later.



Use Wheelbase Tool to mark the Rear Axle locations. It may help to use a clamp for the scouts to keep the jig from moving. They should mark both the top and sides.

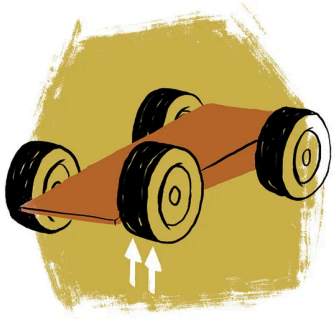


Next mark the front axle position. The Jig allows for scouts to choose a front wheelbase location or wheelbase that is 4.75 inches to 5.75 inches. We recommend the 4.75 inch wheelbase for speed. The longer wheelbase positions improve stability but at the cost of speed.

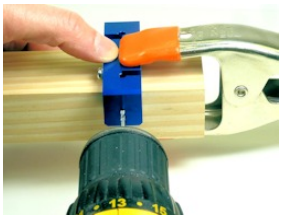


AXLE Drilling Instructions:

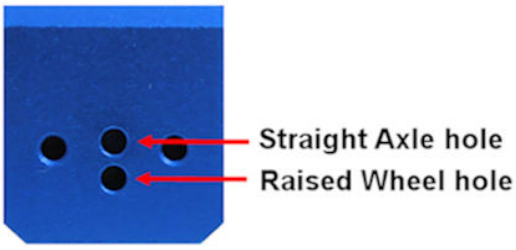
We will be using a jig to drill angled axle holes to cant the rear two wheels of the car. Canted wheels migrate toward the axle head where there is less friction. Less friction means more speed. The jig provides for multiple types of holes, it is very important we choose the right one when drilling the axle locations. Here is a video of how to use the tool: https://www.youtube.com/watch?v=f6pMdieQOOI



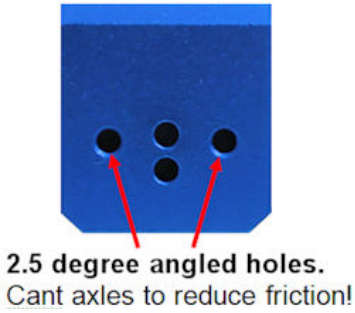
We raise the left front wheel to reduce friction. You will move faster if you have to get only three wheels rotating, giving you an advantage over an identical Pinewood Derby car riding on four wheels. We recommend scouts start out by drilling the left front raised wheel, since this wheel is less critical, if the scout makes a mistake we can easily recover. Prior to drilling ***make sure the bit extends 1.5" inches from the chuck*** so that it has enough depth to properly drill the hole.



NOTE: The left front wheel needs to be raised but to use the axle jig you will need to flip the car over and use the bottom side which inverts the location of the wheel. We recommend marking the wheel locations ahead of time so you don't confuse which side of the car needs the raised wheel (Hint: Left Side).



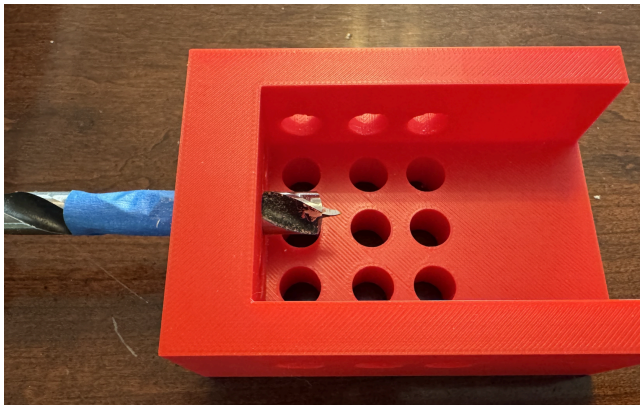
Have the scout attach the jig with a clamp and then drill the left front axle, then the right. Align the jig with the center line for proper alignment. The picture to the left highlights which hole is for the "Right Straight Axle Hole" and the "Left Raised Wheel Hole".



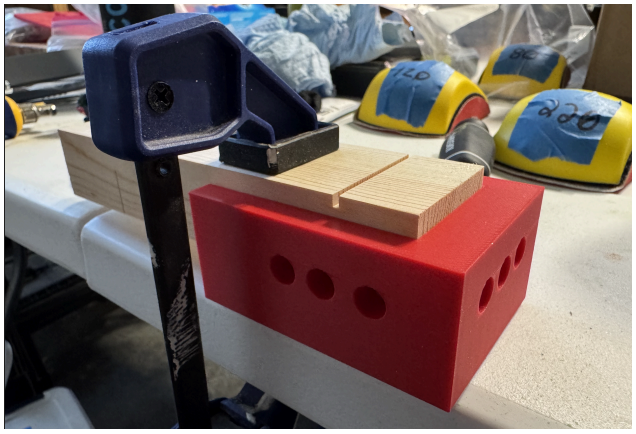
Next we will use the jig to help us drill the rear wheel axle holes. We want to use the "2.5 degree angled holes" for this. This will allow us to utilize straight axles to achieve canted wheels in the rear. It is critical that the jig be well clamped as these holes need to be exactly parallel to one another. You can use either set of outside holes to drill the canted axle holes. Have the scout attach the jig with a clamp aligning the jig with the outer hole.

WEIGHT POCKET Drilling Instructions:

We have provided a jig that allows for drilling equally spaced holes in the rear of the car for the scouts to place weights. The jig allows for holes to be drilled in multiple locations, Scouts will need to choose which location they wish to use prior to drilling.



Mark your drill bit prior to drilling. Be sure that the bit does not protrude further that ½ inch into the block of wood. For this jig that is 1 ¼ inch. We are using a 25/64" inch diameter bit which will leave a hole perfect for circular tungsten weights.



Secure the block of wood by using a clamp in the position that you wish to drill. In this example we will be drilling side pockets.