

Pack 176 Grand Prix Pinewood Derby

Information & Rules

Race Practice Day: Friday March 25, at Tess Corners gym from 7:00 – 8:00 pm. Cars can be inspected for conformity, weights can be added or removed, graphite lubricant can be applied, and cars can be run down the track. Cars may be registered for race day after making practice runs. Once registered, cars must be left in the pit area in the gym. No changes or modifications after registration! Advance registration is urged in order to streamline proceedings on Saturday morning.

Race Day: Saturday March 26, at Tess Corners gym. Race event starts at 8:30 am sharp. If you haven't registered your car at the Friday practice, plan on arriving early to register, gym opens at 7:30. Registration closes at 8:15! Practice runs are limited to Friday night, no practice on Saturday.

Race Divisions: 1st, 2nd, & 3rd place trophies will be awarded for the overall 3 fastest cars.

Additional Categories: All cars will be voted on by the Scouts. The categories will be as follows: **Most Cub Scout Spirit, Coolest Car, Most Colorful, and Most Patriotic**, Scouts can not vote for their own car. In the event of a tie vote for one of the categories, the car with the fastest average time will be the winner. Only one special category trophy will be awarded per scout.

Additional Awards: All Scouts will receive a participation trophy with an engraved nameplate.

General Rules

- 1.) Only official Grand Prix Pinewood Derby kits may be used. Axles and wheels must be from the official Grand Prix Pine Wood Derby kit. The wooden blocks in the official kit will be stamped with the year on the bottom. This stamp must be visible at inspection time. Cars constructed from previous years and competitions may not be used. If a car does not have a date stamp, it can be raced but will not be eligible for a trophy. Scouts should be encouraged to do as much as possible on the construction of the cars, and the older the scout, the less the parent should be helping.
- 2.) All participants are required to have fun!!! In the event of a dispute over racing or conformity, the Derby committee will have the final say. Winning cars may be subject to a post race inspection if any construction is suspect, i.e. wheel bearings, unofficial axles, etc. These would be items that could not be visible at the time of registration.

3.) Car specifications: The car is to be constructed from the official Cub Scout Pinewood Derby block of wood included in the kit. The Block may be shaped and formed to any design desired. Additional wood, plastic, or metal pieces may be used for structure or decoration as long as these pieces are firmly attached to the car and do not provide any motive power to the car. Additionally, the car must conform to the following specifications:

- Wheel Distance:** Approximately 1.75 inches between the wheels.
- Overall Width:** Not exceeding 2.75 inches.
- Overall Length:** Not exceeding 7.0 inches.
- Overall Height:** Not exceeding 3.0 inches.
- Chassis Clearance:** 3/8 inch minimum.
- Overall Weight:** Not exceeding 5.0 ounces - official race scale is final.

3.1) Wheel Distance: The block of wood must remain at its original width at the location where the wheels are mounted. This will give the car a wheel to wheel distance of 1.75", which is needed to straddle the center guide strip.

3.2) Overall Width: At no point on the car shall the width exceed 2.75". This ensures that the cars will not interfere with each other on the track, and that the cars will fit through the finish gate.

3.3) Overall Length: The length of the car may not exceed 7.0", which includes wheels. The leading edge of the front wheel and the trailing edge of the rear wheel must be behind the front and back of the edge of the car.

3.4) Overall Height: While resting on its wheels, nothing on the cars may exceed 3.0" in height.

3.5) Chassis Clearance: While resting on its wheels, there must be a clearance of at least 3/8" from the lowest point on the car to the ground. This is needed to clear the center guide strip on the track.

3.6) Overall Weight: Not to exceed 5.0 ounces.

RULES ON CAR MODIFICATIONS

1.) Wheels: Wheels may be sanded to remove molding seams on the tread, but not grooved, ridged, rounded, concave, or angled. The width and shape of the original wheel tread cannot be changed. The wheels must specifically ride flat on the track, and may not be beveled to ride on a narrow ridge or tilted to ride on an edge. The original width of the wheel may not be substantially changed. The hubs can be sanded to smooth out any imperfections in the wheels. The inside wheel rim that will rub on the guide strip may be sanded to remove imperfections. No substantial removal of material from the inside of the wheels will be allowed.

Bearings, washers, bushings, or any wheel lubrications of any kind other than graphite or Cub Scout Teflon powder is prohibited. The car shall not ride on any springs or suspension system, and it must be freewheeling with no starting devices. Cars riding on 3 wheels are acceptable.

2.) Axels. The axels from the official Cub Scout kit must be used, no other axels are acceptable. The axels can be filed, sanded, and polished to remove any imperfections from them. Beveling the heads as well as grooving of the axels to reduce friction is acceptable.

3.) Wheelbase. Because the grooves for the axels may not be square, you may drill new holes for the axels. You may extend the wheelbase if you wish. (Move the wheels farther apart). The wheels cannot extend at all past the front or back of the car. If you do drill your own axel holes, make sure that the car has at least 3/8" of ground clearance so that it clears the center of the track.

4.) Staging: No part of the car may protrude beyond the leading (uphill) edge of the starting pin. The uphill edge of the starting pin is the starting line, and no part of the car may be over the plane of the starting line prior to the start of the race.

5.) Gravity Powered: The racecar may not be constructed or treated in such a way that the track's starting mechanism imparts momentum to the car. (For instance, this provision disqualifies cars with sticky substances on the front of the car and protrusions, which may catch on the starting pin.)

RACING RULES

The winning racers will be determined by time. Each car will run down each of the three lanes one time. The cars will be matched against various opponents in these heats, but they will only make 1 run in each of the three lanes. The cars times will be electronically recorded and averaged. The cars with the lowest average times will be the winners.

If a car jumps off the guide strip or fails to make it down the track the Race Officials will declare the heat void and rerun it. If the Officials determine that a flaw exists in the car that prohibit it from being able to complete the race without coming off the track, the Officials reserve the right to remove it from the race.

Within reason, and to be decided by Race Officials, if a car experiences breakage during a race, the Scout and parent may be allowed a quick (up to 5 minutes) repair of the car to enable the Scout's continued participation. Officials will then run that heat again. If the car cannot be repaired within 5 minutes, it loses the heat.

Building a Pinewood Derby Car

Every year, children with their parent's help, build cars of every description to enter at the local competition. The construction of the car is intended to be a parent and child project with the child doing the majority of the work. The parent should supply the advice and limited assistance with the more difficult tasks. Please remember above all that the Pinewood Derby is supposed to be fun for all. So get started early and take your time building and testing your car. Plan to spend at least 4 to 6 hours building the car over several days. The experienced racers may spend many times this amount of time and it shows in the appearance and racing performance.

The planning and construction of your car may be approached in many ways. This information will serve only as a guide to some while providing good first-time information and pointers for others. The experienced wood craftsman will find the teaching experience a great project for a young man while the "Klutz" may find it just a little challenging. No matter, the time spent working and learning with your child should be a lot of fun.

If you're designing a car for speed here are the important points about car design to keep in mind.

- o Sleek Shape
- o Maximum Weight
- o Smooth, Round Wheels
- o Polished Axles
- o Good Lubrication
- o Straight Running

On the other hand if your objective is to create a unique design then think about these points.

- o Use color and finish as a way to get your car noticed. A bright red or yellow paint job with a high gloss finish is always an attention-getter.
- o Attention to the details of car construction shows in the final product
- o Design on paper before you start cutting wood

Construction Step 1 - The Plan (or What are we Doing?)

You may already have an idea as to what your car should look like when you're done but in order to take this idea to a completed form you should have a plan. Take a little time to sketch out your idea on paper. If you haven't decided what you want to do you may want to check out some possibilities. Look at the profiles provided in this guide to get some ideas. Draw your design at full scale so you can transfer the profile and shape to the wood block later. Ready-made templates or car outlines can be purchased at Scout supply outlets, the Scout Shop or Scout mail-order catalog. These will help you transfer a predefined profile to your car but are certainly not required. You may want to take a look at the templates in this web site for some ideas.

Starting with a block of wood is like a hand full of clay. What are you going to do with it? What kind of car do you want to build? Well, there are several basic types of car classifications cars that are fast, cars that are fast to build and then there are character cars. Character cars are cars that model other types of cars or objects. Remember that a highly decorative car with characters, decals and other trim will not be as aerodynamic as a "plain" car. The sleek low profile designs will tend to have less wind drag and therefore faster. The fast car is usually not a handsome car. Don't limit your design ideas but we'll talk about the plain, more aerodynamic designs and remember, you can paint car just about any way you you'd like.

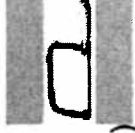
Construction Step 2 - Gather Materials and Tools.

You will, of course, need the basic car kit that includes the wood block, axles, wheels and numeric decals. **Do not substitute the wheels and axles from non-BSA kits into your car design.** This will make it illegal and you can be disqualified.

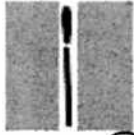
You will need the following tools and additional materials:



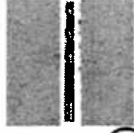
Safety Glasses (for drilling, sanding etc.)



Coping Saw (A Powered Dremel Saw or Scroll Saw may also be used)



Small File (Mill or Fine Cut)



3/8" / 10 mm Drill Bit (a Brad point bit gives you better hole positions)



Electric Drill Motor



Tracing Paper



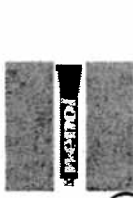
Small Strip of Soft Cloth (like an old Tee Shirt)



80 Grit and 220 Grit Garnet Sand Paper



400 or 600 Grit Wet or Dry Paper



- Metal Polish (for polishing the axle)

- 3/8"/10 mm Tubular Weight (Available from Scout Shop or plumber supply)

- Wood Putty (or better yet - plastic auto body filler)

- Sanding Sealer or wood Primer



- Finish Paint (Either Spray or Brush on)



- Decals and Decorations as Desired

This set of tools and materials will vary depending what you have available and the extent of work you have in mind.

Construction Step 3 - Cutting the Basic Car Shape.

Decide how you want your car to look. Again, you may want to refer to the templates in this web site. When you have a design idea it's time to transfer the profile (side of the car) and plan view (top of the car) to your block of wood. The block included in your kit is usually close to 7 inches (17.8 cm) in length but may vary a little shorter or longer. Be careful to measure the final overall dimensions of the finished car to insure that your design does not violate the racing specifications.

Using your side profile drawing and a sheet of carbon tracing paper align the drawing to the block and carefully trace the outside lines of your car so that the image is transferred to the wood. If you prefer, you may find it just as easy to copy or duplicate your lines on the wood directly. Use a hard lead pencil or ball point-pen so that the lines are easy to see when you're cutting.

Construction Step 4 - Wheel Mount Preparation.

Some people think that cars with a longer wheelbase can be faster than shorter wheelbase cars, because the longer wheelbase may make them track straighter. With this in mind you may want to consider relocating the two axle slots in the car block toward the ends of the block. Remember to set the wheel slots back at least half the diameter of the wheel so that it doesn't extend over the end of the car body. The overall length of the car (including wheels) cannot exceed seven inches. It is *very important* to cut the new axle slots exactly square to the sides of the block so that the axles provide a good alignment for tracking. An alternate method is to use a drill press to make the holes but in either method make sure that the final position of the axle isn't too high so that it creates a problem for the block dragging on the track's guide strip. Use a #43 (2.3 mm) drill bit. Insert the axles in each

of the slots or holes so that you know they'll fit later. Install the axles at the top of the slots so that they have plenty of wood under them. Now that we have opened the wood fiber remove the axles. We'll permanently install the wheels and axles after the paint has dried.

Construction Step 5 - Drilling Holes for Weight.

Your finished wood block along with the, wheels, axles and trim will not usually weigh much over 2.5 ounces (71 grams) while the finished car is allowed to weigh in up to 5.0 ounces (141.75 grams). **Don't even think about skipping weight addition if you want to be race competitive.** The weight of your car overcoming friction is what will allow you to win over other cars. You must make gravity work for you. Your car must overcome both breakaway friction and minimize air resistance and it will do this by being as heavy as allowed while presenting the smallest profile to the air-stream. That's why we wanted the low and skinny body design.

There are two basic approaches to adding weight to a derby car. The easiest is to attach pre-drilled and shaped lead or zinc weights to the outside of the car. Some of the commercial varieties are cast such that they provide a tapered shape and break-off ribs that permit convenient adjustment to overall weight after the car is assembled. It is best to attach this type of weight to the bottom of the car so the center of gravity may be kept low. If you use this type of weight on the bottom of your car *insure that the weight doesn't hang down too far.* It may not be obvious until race-day but the weight could drag on the track guide. This could prevent the car from moving off the starting line. Mortise or "hog out" a void in the wood on the underside of the car and then attach the weight inside the void.

The other method for adding weight involves the installation of weight internal to the body so that there is no additional wind resistance. This may be only a small advantage but it just might make the difference of a winning inch or two at the end of the track. Most car profiles will be narrower at the nose and provide little space for adding lead internally. There is an advantage in placing the weight in the back. The front wheels perform the function of guiding or steering and the less weight on these wheels the easier the car corrects itself when it strikes the guide strip. **Fewer and shorter contacts with the guide strip mean a faster car.**

Drilling the Car Body. Each internally weighted car will have a little different cavity placement based on the wheel/axle position and amount of wood available to accommodate the weight. The hole or cavity for the lead weight must be large enough to accommodate the weight you using. You will need fewer holes for lead than you will for other materials. Plan on drilling at least 2 or 3 holes of 3/8" (10 mm) (or 7/16") diameter at a depth of 1 1/2" (38 mm) each. Experience has shown that holes drilled from the side or back tend to work the best. Locate and drill the holes being careful not to drill all the way through the wood. Also make sure that you are leaving enough wood around the hole to provide a margin of safety in your drilling operation.

Construction Step 6 - Adding the Weight.

There are many things that you might use to add weight to the car but you will find that lead and zinc will probably be used most often. These are the heaviest materials easily available for their volume. Lead works easily and is commonly available in a number of forms. As options you can use steel in plate, tubular forms or even common bolts. Other metals may be used but just as steel you will find them difficult to work and sometimes awkward to attach or insert.

Warnings

Lead is toxic and should be handled as little as possible.

Use gloves and never put your hands in or near your mouth

after handling it. Always wash your hands thoroughly after handling lead.

Do not use mercury at all! It is toxic, difficult to handle

and should not be touched by Cubs or adults.

Weigh your car on accurate scales. Most household scales are not very accurate. If you have access to calibrated scales compare a known item weight on the calibrated scales to your home scale indication for that same item. Mark this reference for use later. Allow for scale inaccuracies by not adding to exactly the 5.0 oz. (141.75 grams) indication. ***It is better to be slightly light than to have to remove weight on race day.*** Consider also, while you may have an accurate scale your *pack* may not. It could be weighing items heavier than they actually are!

Weigh your car body, wheels, axles and any other parts that will be on your car all at once. This weight is usually less than 3 ounces (85 grams). Now, with your car lying with the weight holes facing up carefully add your weight until the weight is just over 4.5 ounces (128 grams). Allow enough space in the holes so that you can add filler material in the next step. If you find there isn't enough room to add weight to get to 4.5 ounces (128 grams) you will have drill an additional hole or holes. Remember, you will be adding wood filler and paint to your car later and this will a little more weight. When you are satisfied go to the next step.

Construction Step 7 - Sealing the Holes.

Once that you have got the correct amount of weight installed you are ready to seal the hole(s) in your car body. There are a number of materials that you can use to cover the weight holes in car body. If you are in a hurry and want to insure a good seal try using automobile body putty (like Bondo®). This type of filler material is a two-part mix that sets in 15 minutes. You will need only a small amount but it works very easily and may be sanded,

drilled and painted. Standard wood fillers that don't use a catalyst will take longer to harden (usually overnight) and may need to be applied with several thin coats. Apply the filler so that it may be sanded down smooth to the original wood surface. You'll want to recheck you total car weight at this time.

Construction Step 8 - Sanding and Smoothing.

Sanding the wood body will eliminate any of the saw blade marks as well as any small blemishes in the wood surface. If you have access to a motorized belt-disc sander your work will be quickly done but for most of us a sheet of sandpaper and a sanding block will do just fine. Start by using a 100 or 120 grit paper and wood or rubber block on the filler and rough portions of the wood car body. Gently smooth the edges and corners of the car while using a little more pressure on the flat areas. Then switch to a 220 grit paper to smooth the sanding marks left from the initial sanding. When you have the wood smoothed switch to the 400 grit paper. It will provide an excellent surface for your final finish. **DO NOT WET-SAND UNPAINTED WOOD.**

Construction Step 9 - Painting and Finishing.

The bare wood surface will act much like a sponge when your paint is first applied and it will take several coats of paint to seal and finish the wood. A better approach is to apply a wood sanding sealer to the wood. This acts like a primer coat for the wood and provides a good base to apply the color finish paint.

Prepare a place to paint your car that will be out of the house while you are painting and out of the reach of younger children while your car is drying. You may either paint one side at a time waiting between coats or suspend the car on a string with a nail in the axle slot and paint all of it. Brush or spray the sanding sealer on the car with a complete coat and wait for it to thoroughly dry. You will see that the grain of the wood will raise slightly. After the paint is thoroughly dry, sand it with 400 grit wet or dry sandpaper. You will find that the finish is smoother if you use a wet-sanding process. Wet the paper and the painted car body. Lightly sand until the sanding-sealer is smooth but not through the sealer to the wood.

You are now ready for the finish color coats of paint. The best and smoothest finishes will be had with a spray paint but brush-on paint will not effect the overall speed of the car. Use fast drying enamels and avoid using different brands on top of each other. Above all don't use lacquer paint on top of enamel paint. Your paint will wrinkle and bubble. If you get a run in the paint, let it dry and sand it smooth. Re-coat it later. You can achieve a very, very smooth finish if you wet-sand between coats with 600 grit wet-or-dry sandpaper. Your car can look like it has a glasslike finish with several coats of paint and fine sanding.

If you are going to apply decals and detail work now is time to do this type of work. If you are careful, you can apply a clear coat of finish over the decals to seal them. Don't use too much clear-coat at one time or you'll wrinkle the decals.

Construction Step 10 - Wheel Work.

Next to the weight of the car the wheels are the most important element in the car. The biggest problem is that there is not a great deal that you can legally do with them. You must insure that the wheels roll smoothly, in a straight line and roll very easily. The wheels included with kits are very inconsistent. There are things to check and fix on each of the wheels. First, the wheels must be perfectly round. The wheels are produced in Multi-cavity molds and some molds may produce slightly out-of-round wheels that will be slower than others. To check for this put the wheel on an axle and spin it. It should turn with the outside surface at a single reference point never varying. Check the wheel for burrs on the running surface of the tire and hub areas, as well as the inside rim that will rub against the guide strip on the track. These need to be freed of any extra plastic residue or molding marks. This means that the outside wheel surface can be sanded or filed to make it flat across the bottom of the "tire". To perform this work you may use a very small machine screw. Put the machine screw through the wheel and using a nut tighten it till the wheel is held snugly. (Alternately, purchase a commercially-available wheel turning kit from a hobby store.) Chuck the screw with the wheel on it in to a drill motor. Using a fine flat mill file, turn the drill on and at an angle to the rotating wheels, apply very light pressure to the wheel surface. File the wheel until it is perfectly round. Then using 600 grit sandpaper smooth out the surface. Insure you don't create a rounded wheel surface, which is illegal. Using a file, and sandpaper smooth out the inner rim of the wheel as well. To smooth the inner hub you may have to remove the wheel from the screw and use sandpaper (The hobby store mandrels allow you to partially smooth the inner hub while spinning.

Construction Step 11 - Axle Polishing.

The 'nail' type axles that come in the Pinewood derby kit must be used in the construction of your of your car. These axles provide no bearing surface so there is friction between the plastic wheel surface and the metal axle. Since this friction reduces speed we need to minimize the contact surface area, make the surfaces smooth and lubricate the mating surfaces. The following suggestions are things you can do with simple hand tools to improve the performance of the axles.

Axle Burr Removal. First, the heads of the nails used as axles in the kit will often have a mold or casting mark in two places just where the head attaches to the shaft the nail. Remove this web of metal with a file being careful not to gouge or scratch the running surface of the shaft. This will prevent the axle from grinding the plastic hub area and slowing down your car. You might be surprised to how "out of round" the shaft of the axle really is. Chuck/secure the axle in a drill press or electric hand drill secured into a stable position.

Optional step. This step can be performed before actual polishing but is designed for those creating "the ultimate" racing machines. It's not necessary for the average racer. Use a fine flat file to reduce the overall diameter of the axle. To do this, chuck the pointed end of the axle into a drill press or drill motor that has been secured with a vise or clamp. Place the file against the rotating axle and apply even pressure while moving the file slowly. Do this until the area within 1/2" (10 mm) of the head is smaller than the rest of the axle body. The more

metal that is removed the less contact surface available to create friction. The drawback to removing too much metal is that the axle becomes weaker and will not tolerate being dropped or withstand rough handling without bending. This is often a trial and error procedure with much testing required to result in a fast turning wheel. You will want to buy extra axles to try this and use the best of the lot for your car.

First-Surface Polishing. The axle can be finished to a high luster by following the steps detailed here. First, mount the axle in drill motor chuck exposing the head and the first 3/4" of the axle. Secure the drill so that it doesn't move. Now cut a piece of 400-600 grit wet or dry sandpaper to a strip approximately 1/2" (10 mm) wide and 4 to 6 inches (about 100mm) in length. Wet the surface of the sand paper with water or light machine oil, start the drill and loop the sandpaper over the axle and pull the paper back and forth like a shoe polish cloth. Work the paper until the metal is smooth in the wheel running area (next to the head of the axle). This usually takes about a minute for each axle. Now, using either pumice paste or metal polish in a soft cloth (like a tee-shirt), start the drill again and press the cloth and polish compound into the axle with a slight movement back and forth. This will also take about a minute. The finished axle will be very smooth and bright in appearance

Construction Step 12 - Lubrication.

The wheel should turn on the dry axle without any undo force but the friction between the two parts will quickly act to slow it down. It's this friction that you would like to eliminate. While we can't eliminate friction completely it can certainly be reduced. An automobile uses steel roller or ball bearings to reduce friction on its wheels but our car isn't permitted to use them. We can only lubricate what we already have. A lubricant is any agent that provides a reduction of friction. While there are many types of lubricants many will either not work on lightweight parts or are not formulated to work with plastics. Petroleum products such as motor and household oil may soften the plastic wheels. The wheels could, after a time, fail to turn at all. This is not the surprise you'd like on race day. Other liquid or aerosol lubricants include spray-on Teflon, WD-40, CRC and 3 in 1 oil. Except for Teflon, these are all petroleum-based products, which you'll want to avoid.

The most common and successfully used lubricants are the graphite formulations and Graphite-Molly blends. They provide a very thin plating of microscopic spheres that greatly reduce rolling friction. Plain graphite is available in hardware stores and some variety stores. When installing your wheels fill the axle hole of the wheel while capping the other side. Gently push the axle through the wheel. Do this several times and spin the wheel to help distribute the graphite through the running surface. A good test of the wheel, axle and the lubrication is a spin test. While holding the wheel in the axle in a horizontal position spin the wheel with a flick of your finger. It should spin freely, then slowly coming to a stop after 20 to 30 seconds. If it didn't spin that long take a close at your wheel clearance, axle finish and lubrication. Correct the problems than test them again.

Construction Step 13 - Wheel Installation and Alignment.

The guide strip on a pinewood derby track will keep the cars on the track and prevent them from hitting each other. This strip is necessary but each time your car's wheels hit it the car slows down a little. This is where wheel installation becomes important. If the car runs straight it will less often hit the guide strip.

There are a number of little *tricks* to consider in this stage of the car building. First, while you must run all 4 wheels they all don't necessarily have to touch the track surface. If each wheel has rolling resistance don't roll *all* of them. Simple. Usually, the best one to elevate off the track is one of the front wheels. Second, to prevent additional rolling resistance install the axles at an angle to the body so that wheels ride the end of the axle not against the car body. Install your wheels so that there is clearance between the body and wheel and insure that the car body surface has a hard finish (No washers though) next where the wheel hub might touch the body.

Test roll the car so that you are satisfied that the car rolls in a perfect line. Put the car on a flat board or other smooth surface that has a straight line scribed for reference. Lift the board so that the car begins to roll. It should roll very close to the line. If it doesn't, then a front-end alignment is required. Slightly bend the wheel axle(s) to correct the drift.

Checking Alignment. Another test using a long smooth surface is to check for tracking or wheel alignment. Draw a straight reference line on your surface and place the car on the surface with the wheels on top of that line. Now elevate the surface to the rear of the car to start the car rolling. Your car should roll along that line is its tracking straight.

Construction Step 14 - Other Testing.

Now that you have finished construction and initial wheel alignment of your car you will want to test and re-test your car until you're sure that you have reached the best that the car can do. This will involve reviewing the last few steps in the construction phase of the car and verifying those details. Go back to any of the previous steps if you feel the car isn't right. Then you might just decide to build another car for comparison. Race the fastest.

Breakaway Friction. Using a smooth board or table, evaluate how soon the car(s) start to roll. To judge the rolling resistance and the initial breakaway friction resistance place your car(s) on the surface than slowly elevate one side until they just start rolling. The lower the angle the lower the friction and better your car.

Step 15 - Racing your Car.

It's too bad that you don't have a chance to race your car every day but that makes it all the more special when you do race. We'll talk about technique and technical racing tips in just a minute. First we have to remember what this is all about. **Fun!** Of course we have spent a considerable amount of time building this car and we expect to do well **b-u-t** so did a lot of other racers. At the end of the racing there will one car declared the fastest. It may or may not

be yours. It may not be your fault or something you have control. Sometimes luck may in the end help determine the winner. This is where your sportsmanship will come into play. Sometimes it's hard to be a good loser but remember you are in good company and you will have done your best!

The following hints will help give you the best chance to win:

1. ***Insure that your car is tracking (steering) in a straight line before you check-in your car.***
2. ***Insure that you have thoroughly lubricated your car before the check-in.***
3. ***Check your wheels for freedom. Can you spin all the wheels and have them spin 15 seconds before they come to a stop?***
4. ***Always handle your car by the body not the wheels.***
5. ***Don't roll your car in the dirt or on concrete surfaces. It's a sure way to ruin the wheels and axles.***
6. ***Don't run while carrying you car.. You may to drop it, which may break something you cannot repair.***
7. ***Place your car on the track with the wheels spaced so that the wheels do not touch the lane guide.***
8. ***Take your time in placing the car on the track. Point it straight down the track.***