

Build Your Car Instructions

IT'S RACE TIME!

BEFORE YOU BEGIN:

1. Read your rules, instruction sheet, and team directions.
 2. Complete your car measurements/layout assignment and have it approved by instructor.
 3. If you have any trouble understanding ANYTHING ask for Help!
 4. Be careful and have a good day. Use two hands when routing or sanding!
 5. **Anytime you see an asterisks (*) next to the step #, look at your percentages worksheet and do what is indicated to do. Pay attention to the directions. Do not skip a step.**
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1. Read this entire instruction sheet before continuing with this project.
2. After reading your instruction sheet and completing your car measurement/layout assignment successfully, go to the cage and select **ONE** block of wood for your car, **ONE** strip of ½" plywood for your wheels, and **ONE** 1/8" dowel for your axles.
3. Write your **full name and period** on the end grain of your block **with a pen** and then put **your block and your dowel in your locker. Do not leave your block or dowel out for someone to steal!!!**
4. Take your 2"x16" strip of wood and find the center on the face of the board. Then draw a line down the middle of the face from **one end to the other**. Measure in 1" from the end, then put an X on the line and then an X every 2 ¼". Do as many as you can.
5. Using the 1-1/8" forstner bit, drill a hole 1/8" deep (approx.) on the "X". **The stop is set**, so go down as far as you can. Do not put any other pieces of wood under your strip of plywood. Use the drill press labeled with the number of this step!
6. Now using the center of the hole that the forstner bit left, drill your wheel out using the 2" hole saw mounted on the press. **Go down as far as the press will allow you to go. DO NOT** go all the way through and **DO NOT** turn the board over. Take your time and clean out the bit in between wheels. Use the drill press labeled with the number of this step!
7. Using the scroll saw, separate your wheels from stock and cut to shape. Be careful not to cut the wheel itself, just the outside edge. Use the groove the holesaw made to guide the blade. Stay on the outside edge of the groove. If you have your notebook up to date, the instructor will separate your wheels for you.
8. Once the wheels are separated, sand off the left over lip until it is **ALMOST GONE** on the **Disc Sander**. Keep your wheel flat on the table and do not over sand. **LEAVE SOME OF THE LIP ON THE WHEEL!!!!**
9. Once the wheels are sanded, you will shape the wheels' profile on the router using the wheel holder. If you are not familiar with the operation of the router, **ask for help** for this is **very dangerous. Use two hands!**
10. Place your wheel in the holder by setting it with the rim side against the holder centered on the pin. Then set the holder on the router table so the back of the wheel is on the table. **Working in a clockwise motion**, route the **back of the wheel first** with the **round over** or **chamfering bit**. Keep the wheel edge up against the bearing, hold on tight and use two hands.

11. Turn your wheel over so that the front (rim) of the wheel is facing down on the table. Set the wheel holder on the wheel with the pin in the center of the wheel.
12. Using the router bit marked "**Front of Wheel,**" route the front edge with the small round over bit. Use two hands, keep the wheel tight against the bearing and working in a clockwise motion. Do not use the round over bit for the back of your wheels on the front of your wheels; it will destroy your wheel. And then you'll have to start all over again and make new wheels. **Bummer.... dudes and dudettes....**
13. When you are done routing your wheels, **write your full name and period on the back of each wheel with a pen** and then put your wheels in your locker so they won't get **JACKED!!!**
14. Get your block out of your locker and take it to the scale and gently set it on the scale. ***Look at your percentage worksheet and do what it says to do now.** Write down the weight of your block on your percentages worksheet attached to the back of these instructions. Also, write it down on your block as well.
15. On the bottom edge of your block, measure the width. Then find the center of the bottom. Draw a line through the **center of the bottom from end to end**, using a ruler and checking it twice. The **bottom is the wider edge that is machined and smooth!!!**
16. **On the 3 ½" side**, lay out your car's side profile using carbon paper. Fold your drawing on the bottom edge of the car and **match it to the bottom edge of your block**. Trace out the profile and **lightly mark where the center of the wheel/axle goes**. **Look at the example if this confuses you**. The carbon paper is in a folder on the instructor's desk. **Please put the carbon paper back as soon as you are done using it!**
17. Using the **square**, draw a line up from the bottom of your block through the axle points up to the top of the block. Make sure the big part of the square is flush up against the bottom of the block. These lines are called "Line A".
18. Now use the square to draw lines across the bottom of the car from the point where the axle line meets the bottom edge of the block.
19. And then...Use the square to draw lines up from the bottom on the other side of the block. Make sure your pencil is sharp and you hold the big part of the square firmly up against the block. If you do this correctly, the lines will meet across the top when you properly use the square to connect them. If they don't line up, you have made a mistake and you must do it again.
20. Using the template on the **4 ¼" side (bottom)** lay out the cars **front and rear shape**. Use the axle line on the template to match up to the axle line you drew in **step 18**. Fold your drawing on the axle line to perform this.
21. **On Line A**, front and rear, **measure up from the bottom** of the car to mark the center of the wheel, where the axle goes through the car. **Using a ruler**, mark all 4 openings where the forstner bit will begin drilling. **They all must be evenly marked, so check this carefully**. You can use a nail, or punch to mark it exactly. You can lower your car by moving the axle hole up into the body. Use the **axle template** to check your measurements and mark the axle hole center.
22. Clamp your block into the press vise with the **bottom** of your car **facing up**. Bore a hole 1½" deep at the point where the axles and the center line of the car meet (front and rear) using a 2-1/8" forstner bit. Using a ruler, check your depth. **Do not assume that the stop is set correctly**. Use a ruler to check it yourself. **The holes must be 1½" deep**. ***Look at your percentage worksheet and do what it says to do now**.
23. Clamp your block in the press vise with the **profile side facing up and the bottom of the car facing away from you**. Center your axle hole mark with the bit and use the 2-1/8" forstner bit to bore out your wheel wells to the desired depth on that side. It must be **5/8" deep**. **Watch the top of the forstner bit**. **Make sure**

the top of the bit does not go below the surface of the block. Use the **inspection template** hanging on the press from a chain to check your depth on the wheel well. Do not assume the stop is set correctly. **Check the depth.** If the template sticks out, the hole is not deep enough. If the template is below the surface, **the hole is too deep. OOPS! Take your time and watch the stop.**

24. **Now turn the block over**, and bore the wheel wells on the other side using the **axle hole** as your center point. Make sure the bottom of the block is facing away from you.
25. Using the **drill press** and 5/16" drill bit, drill through the block for the axles. The block must be flat and straight, so take your time. **Use the drill press labeled with the number of this step! DO NOT USE THIS DRILL PRESS FOR ANY OTHER OPERATION!!!** Your car will not track straight if this is not done correctly, so ask for help if you need it. Use the dimple the forstner bit made to center the bit. Drill through slowly and carefully. When the bit gets to the other side, **go very slow.** This will prevent the bit from "walking" and messing up your block. ***Look at your percentages worksheet and do what it says to do now.**
26. Cut two pieces of dowel 4-1/4" long with **scroll saw** and slide your wheel on the one end, through the cars' body and slide the other wheel on. Your car should roll freely now. **Keep the excess dowel.** You will need it. **Run your car down the track.**
27. If your car rolls smoothly and tracks straight down the track you may continue. If not try these things:
 - a. **Make sure your wheels are round. A bouncing, noisy car is not good!**
 - b. **Try switching wheels around to correct the wheel "stagger".**
 - c. **Try another set of wheels.**
 - d. **Try a different set of axles.**
 - e. **Try another set of wheels and axles from a car that you have seen go straight!**
 - f. **All of the above.**
 - g. **Last resort: Re-drill your axle holes correctly. (A MAJOR amount of work)**
28. Take your car to the instructor with your instructions. After checking your **percentages worksheet**, the instructor will cut out your car. The instructor will not cut your car unless it goes straight nor will you be allowed to cut it. ***Look at your percentages worksheet and do what it says to do now.**
29. Use the drill press marked "**Penny Holes**" to **bore two or three** holes in the front area of your car by the front axle to add weight to the nose of your car. **You have to do this** in order to complete the **Wind Tunnel Test Sheet** and it will help your car possibly go faster and go straighter down the track! **Look** at the car on the instructor's desk to see where the holes can be bored and **don't go too deep!** One inch deep is as much as you need. Make it look like Mickey Mouse ears by boring the holes so they barely connect to the 2" hole. The back of the car is heavier and by balancing the weight distribution, your car should track better and/or be faster!
30. Check the weight of your car. It should weigh no more than **700 grams with the wheels.** If it is too heavy, remove material from the bottom using the drill press. If it is too light, you may bore 3/4" holes in the bottom to add pennies. *** Look at your percentage worksheet and do what it says to do now!**
31. Draw a line on the top of the car across the base of the windshield and across the base of the back window. Connect these two lines with a line running from the front to back on both sides.
32. Take your car to the instructor and he will cut the windows, following the lines you drew on your car. ***Look at your percentage worksheet and do what it says to do now.**
33. Using the **flush trimming bit** make the wheel well opening straight. Set the bearing height even with the axle hole. **The router to be used is marked with the number of this step.**

34. Shape the nose and tail of your car on the disc sander. **Keep the bottom of the car flat on the table** when you are shaping the front and back. Do not make it round. Look at your drawing, look at the car on the instructor's desk or ask for help. **Use two hands and be careful!!!**
35. Shape the hood and roof on the **disc sander**. Keep your car flat on its side and **do not sand too much**. Use the **oscillating spindle sander** to touch up the concave surfaces. **Use two hands and be careful!!!**
36. Check your car in the **profile template**. Set your car flat on the **inspection table**, and then place the correct template for your car over the top. The template must touch the table front and rear. There can be no more than **1/8" (.125) gap** anywhere between the car body and template.
37. The rear spoiler must be intact and it must be no less than 3" long (side to side) and 1/2" (.500) wide. When you put the **spoiler template** flat on your car spoiler, you **must** be able to see the spoiler all the way around the top and sides of the template. If the spoiler breaks, glue it back on. That is what happens when you are not careful or you "play" with your car **tooooooo much!**
38. Shape the top edges of your car with the **Round over bit**. Use the Router labeled with the number of this step. Turn your car on its side and work from **right to left**. **Use two hands and be careful!!!**
39. Shape the bottom Rocker panels using the **Thumbnail bit**. Use the Router labeled with the number of this step. **Turn your car on its side and put the bottom up against the fence and work from right to left**. **Use two hands and be careful!!!**
40. Sand your car until it is smooth and all the edges are even and round, otherwise the paint will not cover your car correctly. Sand off all of the machine marks. Look at the car on the instructor's desk if you are not sure what the corners and edges are supposed to look like. **Do not leave sharp edges on your car. All the edges should look the same and flow evenly across all the surfaces.**
41. Take your car to the instructor to have the cracks filled with wood putty. Sand the putty smooth after it is dry. ***Look at your percentage worksheet and do what it says to do now.**
42. When ready, take your car and wheels to the back room where the instructor will paint your wheels and primer your car. Use the stand to paint your wheels. Sand the front surface of your wheels to make them smooth. **Write your full name and period on the bottom inside edge of your car with a pen and then cover it with a piece of tape** and write your full name on the back side of **all** of your wheels **BEFORE** you bring it back to the clean room. **If you do not put your full name and period on your car and cover it with a piece of tape, you will not get it back!!! Es verdad, es verdad!!!**
43. Paint the inside surface area (rim) of your wheels. **You can paint it any color but it cannot stay black**. You must paint the inside "**rim**". Get a brush from the instructor and wash it out and return it when finished.
44. Finish-sand your car and the instructor will paint it. You cannot paint one color on the top of another. If you want 2 or more distinctive color stripes, two-tone, etc., you must mask off the parts you wish to paint. **You cannot speed up paint drying. Your car will not be painted until it passes through inspection by the instructor.**
45. Let the paint dry. Do not play with your car, as you will damage the paint.
46. Decorate your car!!! Your car number must be on the doors and roof. Your sponsor advertisement or logo must be on the hood; you must have front, rear, and side windows on your car.
47. Make templates for all windows (front and rear windshields, front and rear side windows).
 - A. Using a ruler and pencil, layout a line on piece of scratch paper that is 2" from a straight edge.

- B. Cut a 2" wide strip with a pair of scissors
- C. Fold your 2" wide strip end to end.
- D. Using a ruler, measure out from the fold and make a mark 1-1/2" on the top edge and 1-5/8" on the bottom edge.
- E. Connect the bottom and top marks with a ruler and pencil
- F. Leaving the paper folded, cut the line with scissors and then open it up to expose your trapezoid-shaped front windshield.
- G. Repeat for the rear windshield. The strip may be a bit smaller than 2" and the angle may change as well.
- H. Check for fitment and revise as needed until both look realistic. Look at the examples in the case or on the display for ideas.

48. For the side windows, get out your car layout drawing, a pencil and a ruler.

- A. Measure up from the bottom of the car 2" at the front edge of the rear wheel well and put a mark.
- B. Draw a line from the base of the front windshield across the side of the car through the mark you just made all the way to the rear of the car.
- C. Measure 4" back from the base of the front windshield along the line you drew in step B and put a mark. This is where the rear window (quarter glass) starts.
- D. Measure 3-3/4" back from the base of the front windshield along the line you drew in step B and put a mark. This is where the front window (side glass) ends.
- E. Draw 2 lines straight up at the 3-3/4" and 4" marks. These lines will be about 7/8" tall.
- F. Now draw your windows, following the roof line and using the examples as a reference. Do not make the ends of the windows too pointy. Ask for help or look at the examples if you don't get it.
- G. Now you can cut out your windows or transfer the shapes to scratch paper using carbon paper and cut them out.
- H. Once cut out, set the windows on the side of your car. The bottom of the window should be about 2" up (minimum) from the bottom of the car. Trim them if they don't look realistic. Take your time and don't trim too much.

49. Once all your windows are correctly shaped, transfer your patterns to your piece of vinyl. Place your templates on your vinyl in such a way as to eliminate waste and maximize the use of the materials. Make sure you lay out a left and right side set of side windows. Take your time.

- 50. Carefully cut out your pieces using a pair of scissors. Check to make sure you have all of your pieces.
- 51. Carefully peel the backing paper off and stick your windows on, using the reference points described earlier in step 47 and 48.
- 52. Cut out your numbers and attach them using a glue stick. Check the big picture in the front of the shop to see which way the roof numbers face and here the door numbers go.
- 53. Cut out and carefully attach your sponsor logo to the hood of your car.
- 54. Cut out and carefully attach your contingency sponsors to your car in front of and just behind the front wheel of your car on both sides.
- 55. Cut out and attach any other sponsor logos or artwork to your car to express your unique creativity.
- 56. Once you are done decorating your car, your wheels are painted inside and out and installed on your car, fill out your car completion grading sheet and take it to the instructor with your completed car to get it graded.
- 57. Once your car is graded by the instructor, get your track sticker put on your back windshield. Then make your car go fast. ***Look at your percentage worksheet and do what it says to do.**

58. Complete your **Wind Tunnel Test Worksheet** if you have not already done so. Complete your **Percentages Worksheet** and turn them both in. **Do not wait until the last minute.**

Keep reading, the tips are coming up.....

59. Now that you have read the directions, here are some tips for you:

60. There is a coffee can on the instructor's desk that weighs **750 grams**. Pick it up and feel how much it weighs. That is how much your car can weigh when it is done. You will be cutting, boring, drilling and sanding away about **45%** of what your block weighs before you start. It is easier to add weight with pennies than it is to lose it by removing material from the bottom of your car. Lighter is better!

61. Your wheels and axles need to be **ROUND** and **SMOOTH**! Sanding the backs of the wheels and the axles by hand with 220 grit paper from the **bucket** will reduce friction between the rotating parts and increase acceleration. Sanding the inside faces of the wheel wells will reduce friction as well.

62. There are many different types of lubricants you can use on your cars' rotating parts to reduce friction. Check with the instructor if you are not sure about a particular substance. I will not tell you what you can use, but I will tell you the pros and cons of each substance you ask me about. Better yet, ask your teammates what they think and what they are doing. But remember, **THIS IS A RACE!** Don't expect **anyone** to just give you the gift of a fast car. **You** have to do a bit of **thinking** and a bit of **experimenting** to figure this out. Watch the cars that are fast and **OPEN YOUR EYES**. **Everything you need to know is right in front of you.** **No, the answers will not be found on Google!**

63. **Anyone can beat anyone else on any given day!**

64. **Quitters never win, and winners never quit!!!!**

65. **Lane choice is everything.** Don't waste your time and tear up your car **mindlessly** racing it over and over again. Get your car to track straight, go fast, and cut a good E.T.! **Fastest time in each heat has lane choice!**

66. **TAKE YOUR TIME AND BE CAREFUL!!! GOOD LUCK!!!!!!!!!!!!**

67. **You do not have any time to waste!!!! So, stop messing around and GET TO WORK!!!**
Es verdad, Es verdad!!!