

1.

During Preparation your team will have roles: Drafter and Fabricator.

The Drafter will be using ruler and pencil to lay out all the lines for cutting and drilling and also supervising to make sure that each piece is correctly sized. The Fabricator will be using the drills and razor to form the pieces after the lines have been laid out.

# PREPARATION

**Drafter:** Please be careful laying the lines on your foamboard. It is expensive. If it is cut wrong, the pieces will have to be repaired with glue, and that takes time.

**Fabricator:** Please be careful with the drill and razor. They are both expensive and dangerous. If I see you horsing around with these tools, even once, I will find an alternate assignment for you to work on.

2.

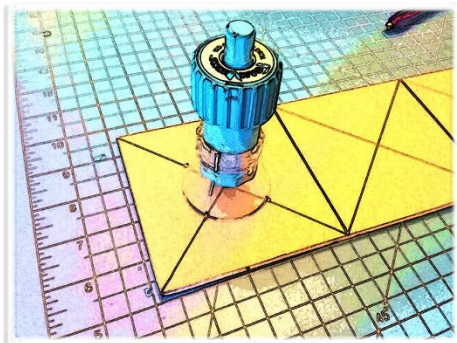
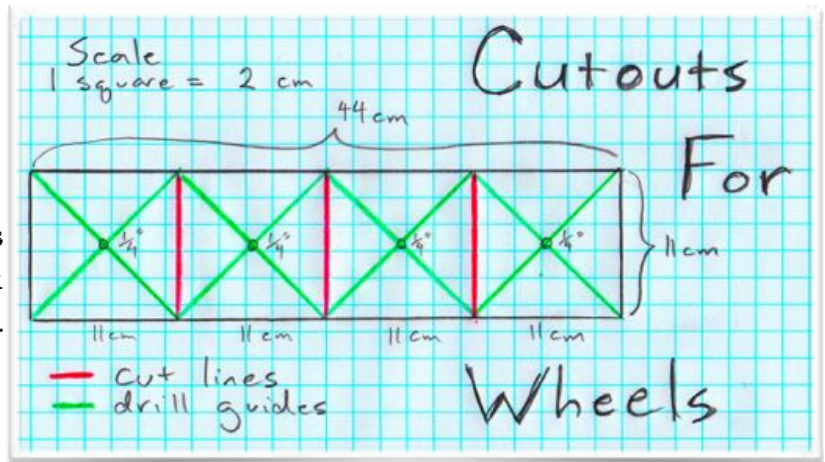
The first piece of foamboard you need is the rectangle for the wheels. There is only one tool to cut the wheels that I will be operating. So give me your wheel-squares as soon as possible so I can get them back to you on time.

**Drafter:** We just need 4 squares here. Each one should be 11cm x 11cm.

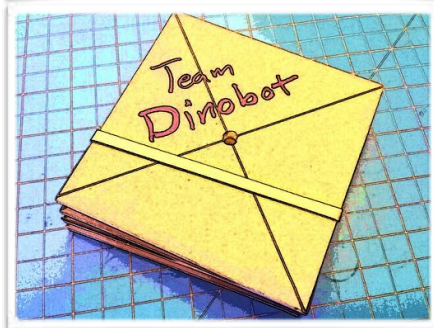
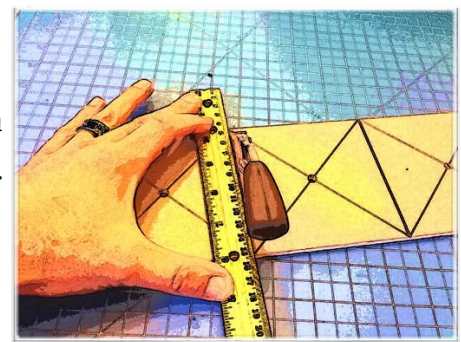
**Fabricator:**

Drill before you cut. We are using

the 1/4" drill bit. Line up your drill at the center of the x's, and notice the 4 notches around the outside of the drill. These should all be on the lines of the x.

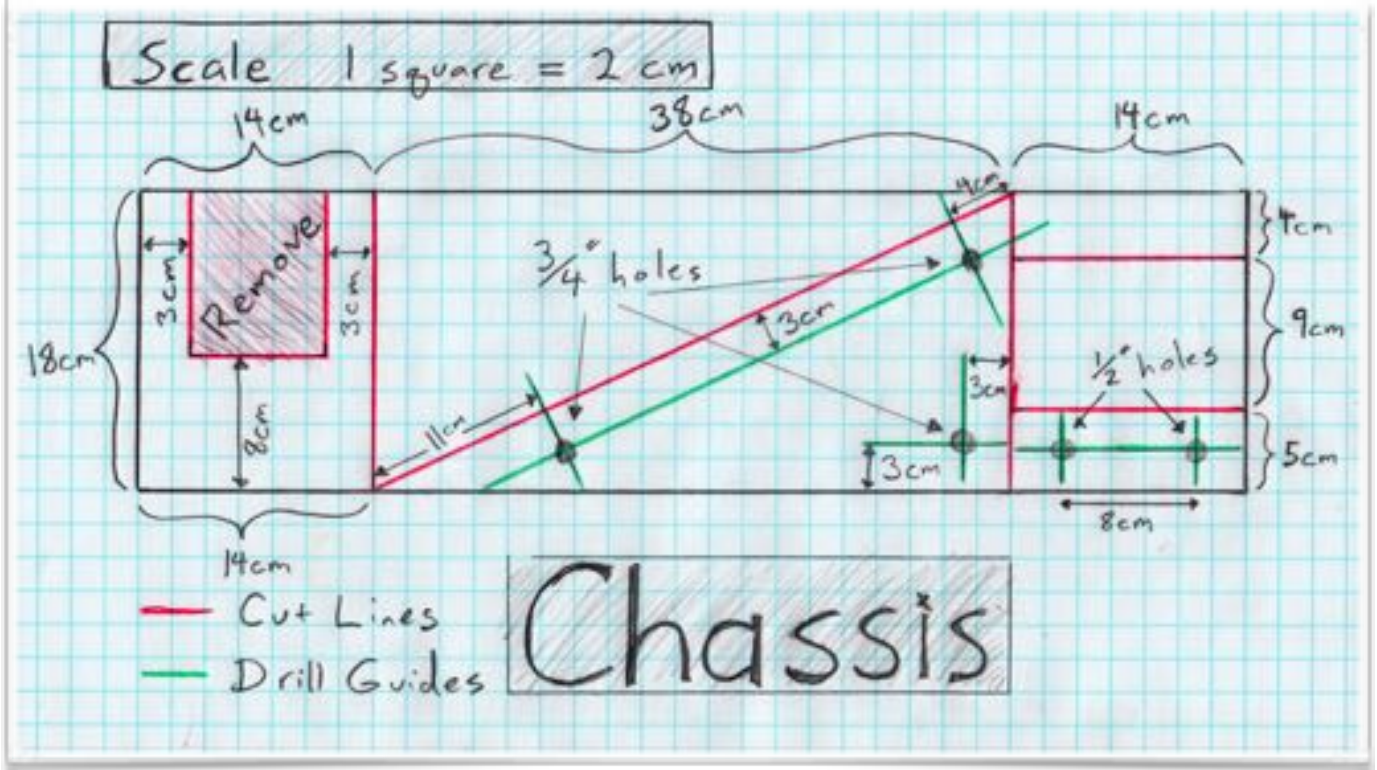


Use a ruler to help you cut out the 4 squares.



When you are done, wrap your wheel-squares in a rubber band, make sure your team name is written on them, and give them to me.

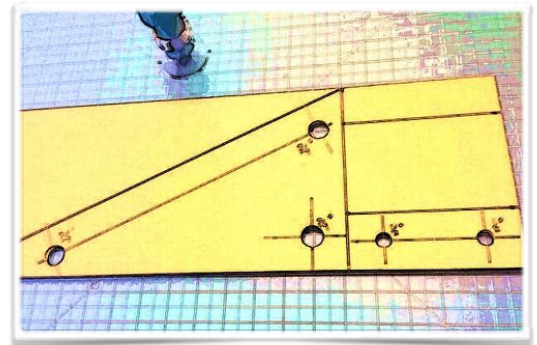
**3.** Collect the 66cm x 18cm piece of board for the chassis.



**Drafter:** We need two right triangles for the body of the car and 4 lateral rectangles that hold the triangles together. This board is the trickiest piece of drafting, so take your time with it. If you get stuck on how to draw the lines, go look at the example piece.

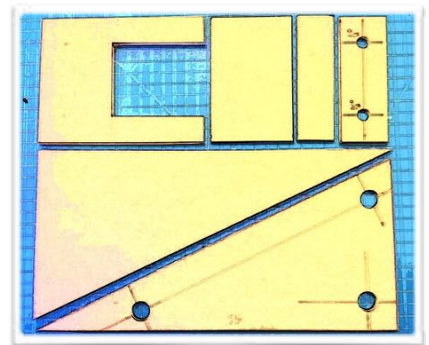
**Fabricator:**

Drill all 5 holes first. Notice they are not all the same size.



Cut out the rectangle that says "remove". You will probably need to turn the board over to work the cuts completely through.

Cut out all 6 pieces.

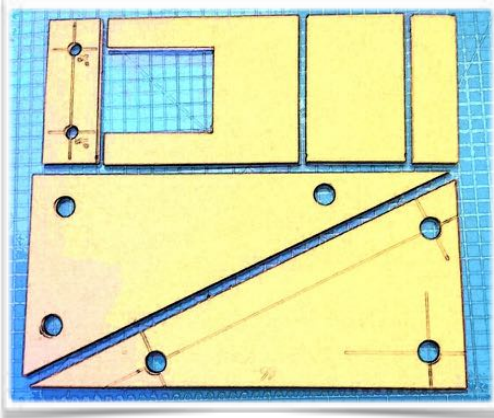
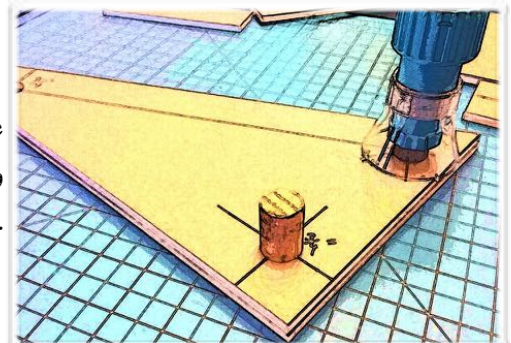




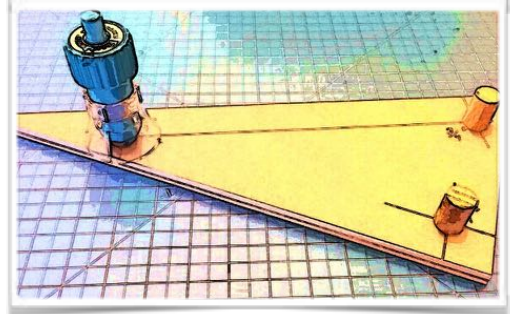


Use the triangle with holes already drilled as a template for the other triangle. Stack the drilled triangle on top of the other, line up the sides, and simply push the drill bit through to the next triangle.

Once you get a hole drilled, use a stub of 3/4" dowel to keep the triangles aligned.



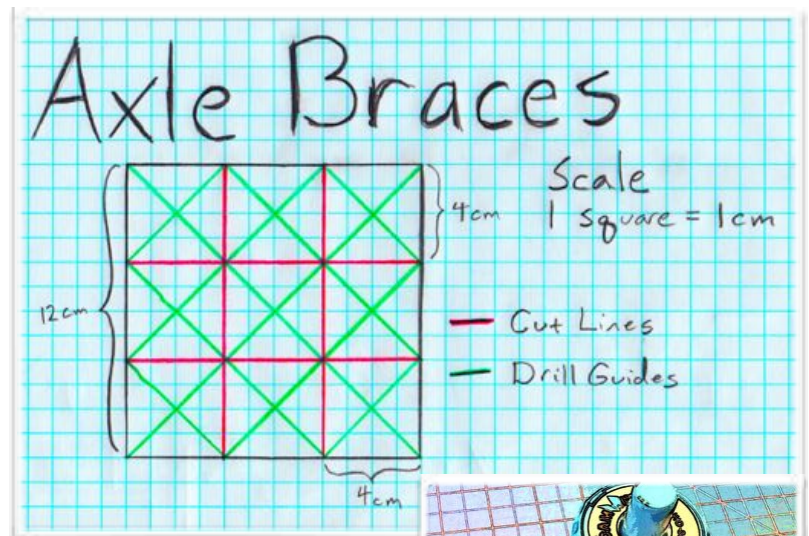
Done.



**4.** The squares glued onto the triangle pieces of the chassis are holding washers in place. These metal washers help the axles spin with less friction than foam, almost like ball bearings, but cheaper...

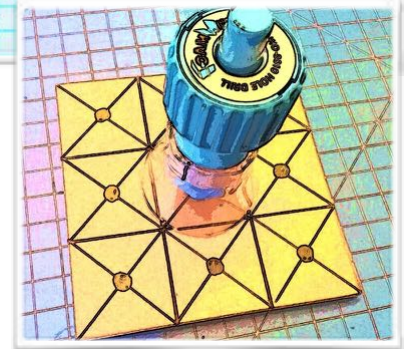
Collect a 12cm x 12cm square.

**Drafter:** we only need 8 squares, 2 per wheel, but cutting out 9 this way makes it easier, and you'll have a backup. Basically, this is just 9 squares, and each one has a 1/2" hole in the center. The hole is small enough to hold the washers in place, but big enough to let the wooden axle spin freely.



**Fabricator:**

These are 1/2" holes. Be sure to drill before you cut this piece. It can be tricky to drill these holes because the drill hangs over the edge. Just do your best to keep it level with the board.







Cut out 3 strips first. Please cut carefully here. Watch your fingers.

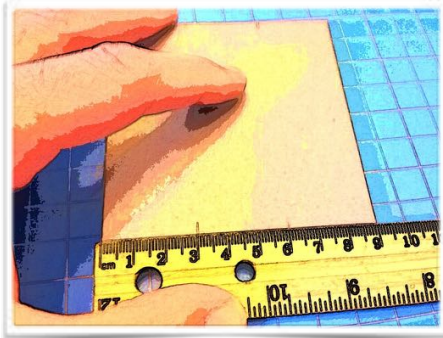
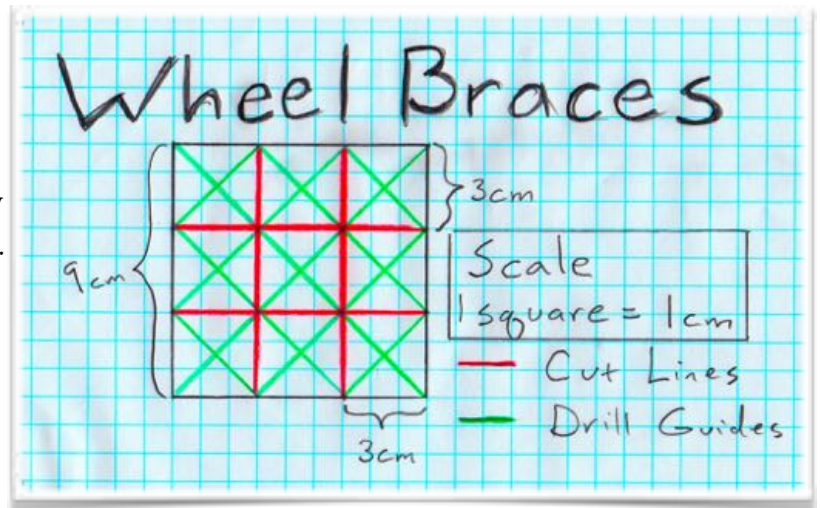


Finally cut out all 9 squares.

**5.**

The Wheel Braces are little squares used to help the wheel grab the axle and stay at a true right angle to the axle.

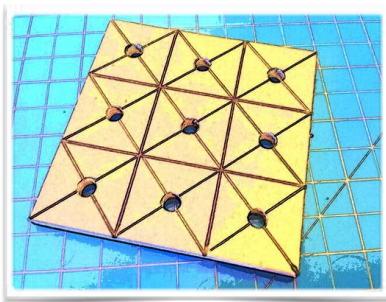
**Drafter:** This piece is very similar to the last one.



Just be sure you are making 3cm x 3cm squares this time.

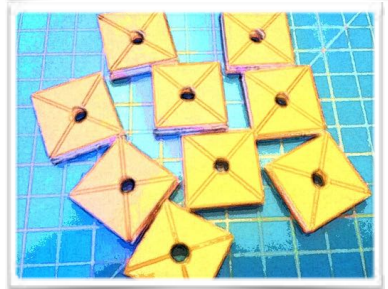
**Fabricator:** This is very similar to the last step, but you are drilling 1/4" holes this time.

Use some scrap pieces of foam to help you drill because the squares are so tiny your drill will hang well off the edge.



Once you are done drilling and cutting...

You should have 9 little squares.

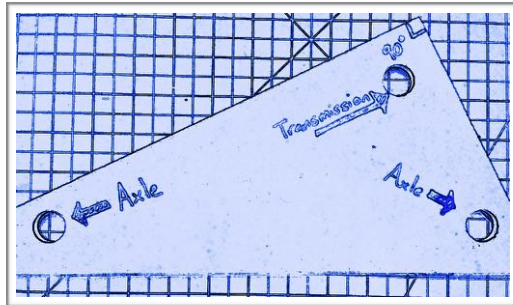




# ASSEMBLY

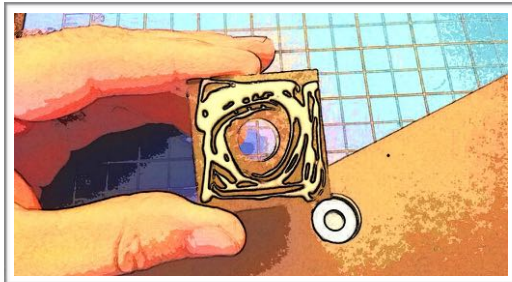
Your team no longer needs the roles of Drafter and Fabricator. From this point on simply work together to make sure that what you are gluing together is correct. Otherwise you will have to tear it back apart and fix it.

- Collect:
- \* Your 2 chassis triangles
  - \* 12 washers
  - \* 8 of your axle squares (4cm x 4cm)
  - \* glue

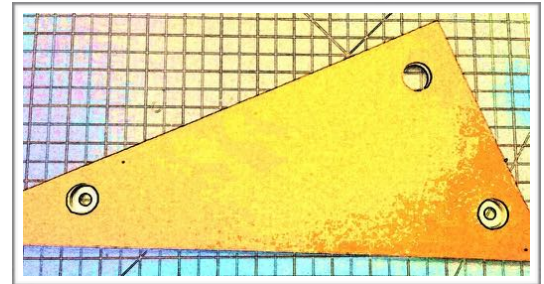


Orient one of the triangles as shown. Be sure the right angle is on top, and your acute angles are on the bottom. Label the holes: axle, axle, and transmission.

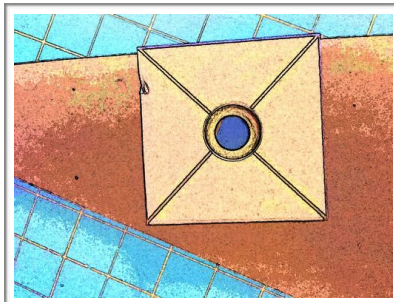
Place a washer in each of the axle holes.



Smear one of the squares with glue... not too much around the hole.



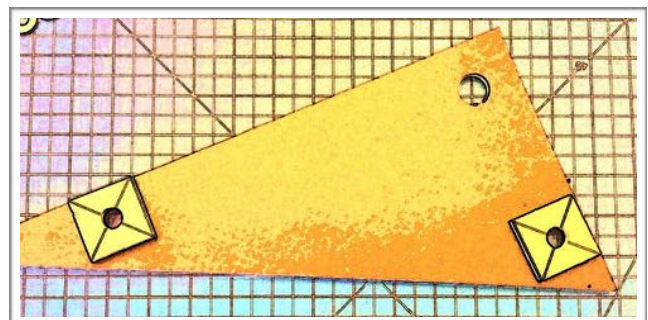
Place the square down over the axle hole and jiggle it into place to make the glue spread out evenly.

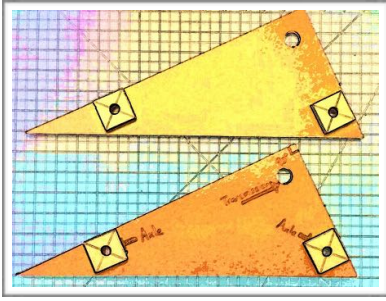


Use the washer to visually center the square. It doesn't have to be perfect. It just needs to allow the axle through the washers.



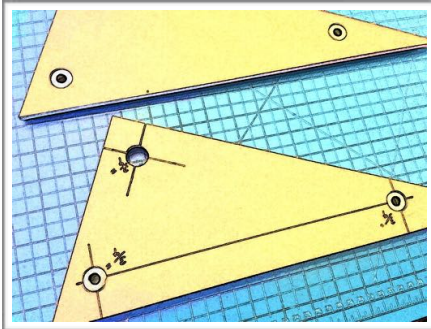
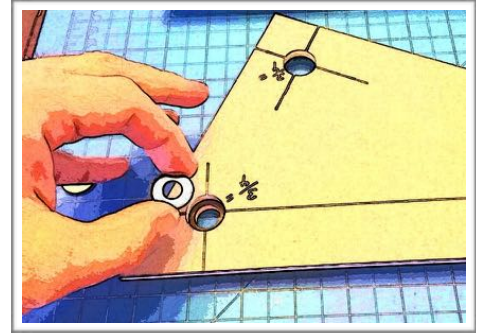
Repeat this for the other axle hole. And make sure that the square does not extend over the edge of the triangle. This could interfere with the back brace.





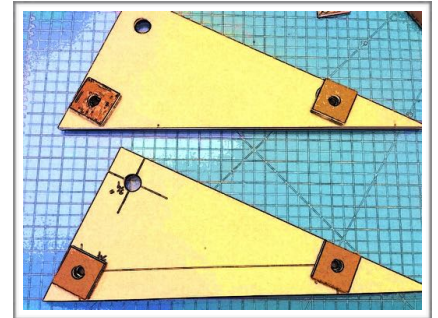
Now repeat this for the other triangle. Make sure that this one is also oriented correctly.

Once the glue has dried enough to keep the squares tacked in place, turn both triangles over. Place 3 washers in each axle hole.



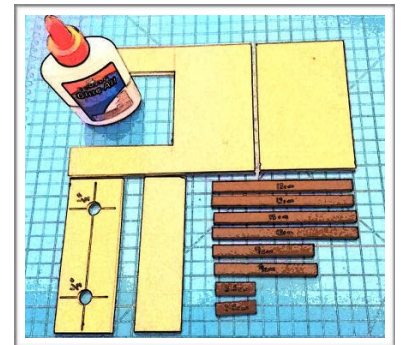
These will be our bushings to help reduce friction so the axle can turn easily.

Now glue the other 4 squares over the axle holes, sealing the washers into place.



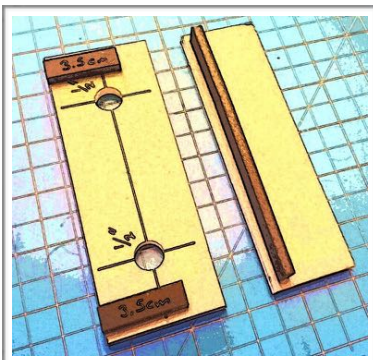
The job of the squares is simply to hold the washers in place and allow the axle to extend through. Glue dries quickly on the foamboard. After about 5 minutes these should be ready to move.

- Collect:
- \* The 4 rectangles for the Chassis
  - \* 4 13cm x 1cm glue strips
  - \* 2 9cm x 1cm glue strips
  - \* 2 3.5cm x 1cm glue strips
  - \* glue



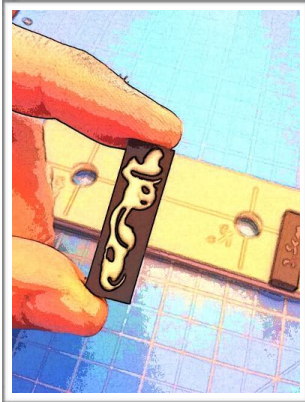
We are gluing these strips onto these rectangles to make the overall assembly easier while we glue the entire car together.

The glue strips help hold the corners together, and keep pieces lined up straight.

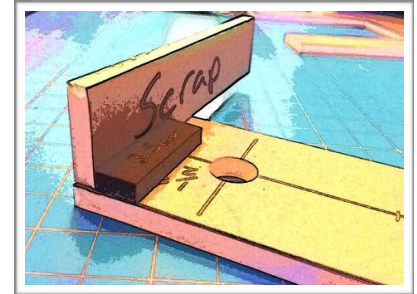


The front bumper of the car is made of the 2 smaller rectangles. We need to glue the strips on as shown.





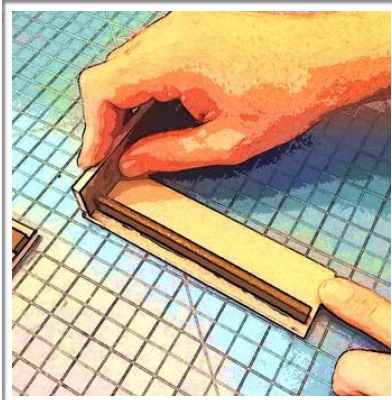
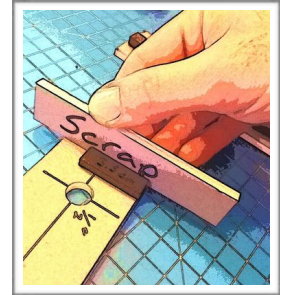
Apply the glue to the strip itself.



Jiggle the strips into place so the glue is spread and then use a piece of scrap to make sure the strip is 1 foamboard-width from the edge. Careful. The glue will dry fast.



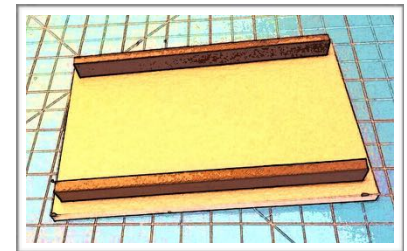
On the next piece notice that the glue strip is standing up. Just apply glue to the edge of it. And the ends should be 1 foamboard-width from the edge.



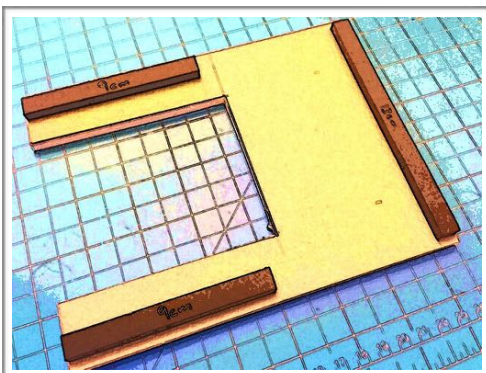
Simply make sure this piece is centered at the ends. Just make sure it's position is similar to the picture.

The 9cm x 14cm piece is the bottom plate.

We need two 13cm glue strips oriented as shown.



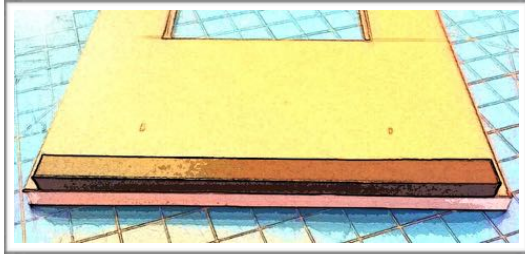
Glue along the edges again. Jiggle them into place and make sure they are centered at the ends.



The back plate needs two 9cm strips and one 13cm strip oriented as shown.

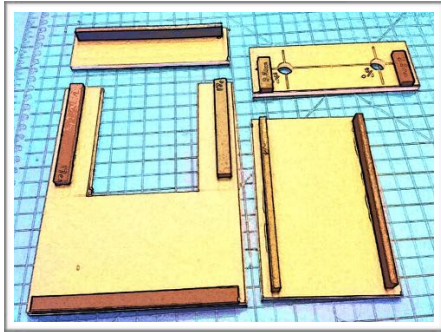


The strips are lying down flat so apply glue to the faces.

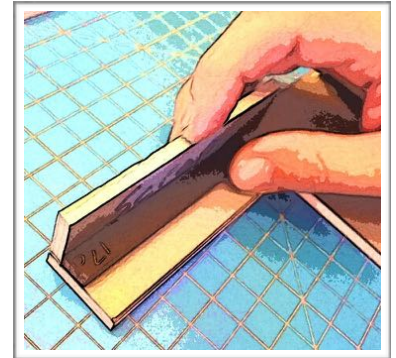


The 13cm strip is glued down all the way at the bottom but centered at the ends.

The 9cm strips go all the way to the top but need to be 1 foamboard width from the edge. So use your scrap piece.

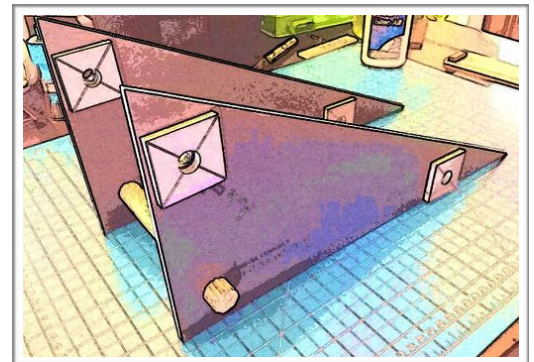
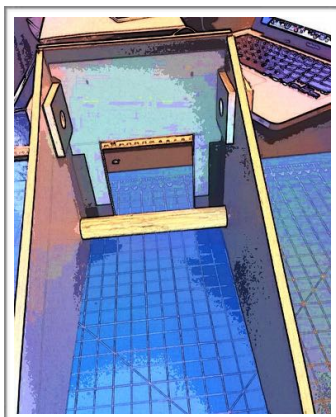


Finally, you should have all 4 pieces.



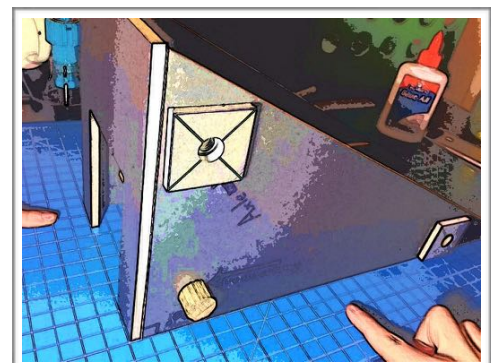
- Collect:
- \* All of the chassis pieces
  - \* glue
  - \* a long stub of 3/4" dowel

Orient the 2 triangles as shown, with the right angle on the mat, and use the dowel to help them stand up.

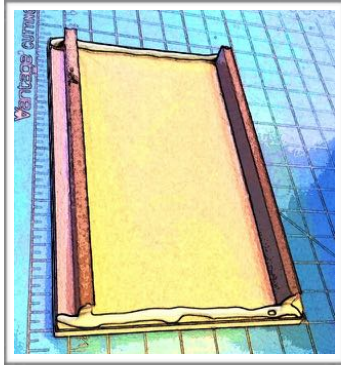


Put the back plate into position, as shown, to help space out the triangles correctly. **DO NOT GLUE IT.**

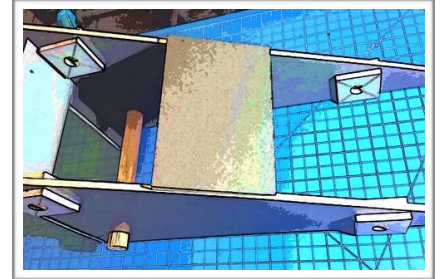
Use the mat to make sure your triangles are all squared up and at right angles to the back plate.





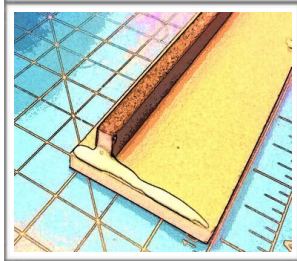
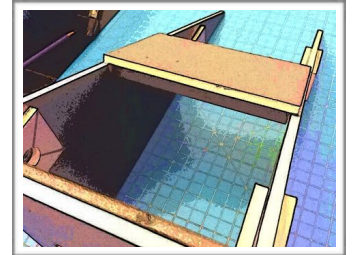
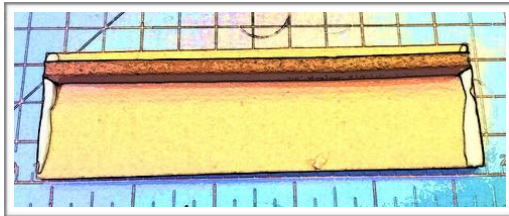


Glue the bottom plate as shown.

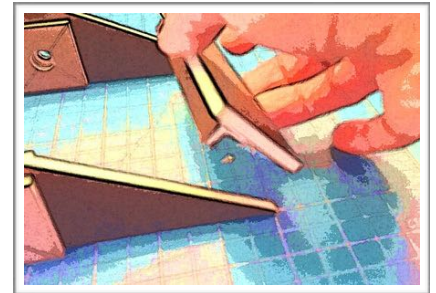


Insert it into the chassis  
approximately centered  
between the axles.

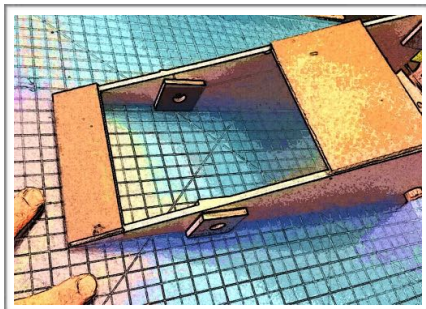
Glue the bottom part of the bumper as shown. Make sure  
it gets up onto the  
edge of your  
glue strip.



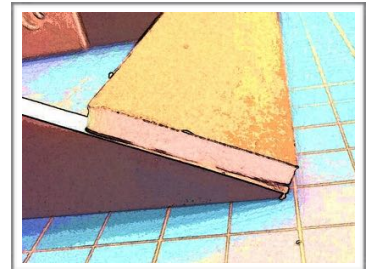
Insert the bumper piece as shown.



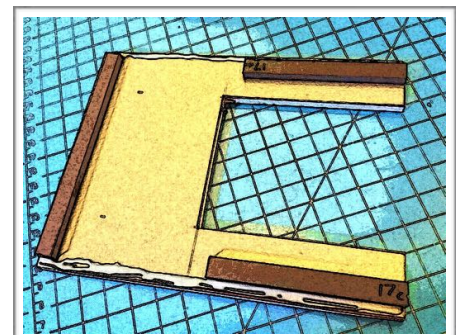
It should come all  
the way to the  
vertex of the  
triangle.



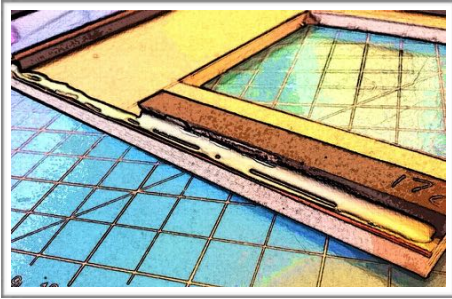
Once both of these  
pieces are glued on, take  
off the back piece and use the mat  
again to make sure it is as square as possible.



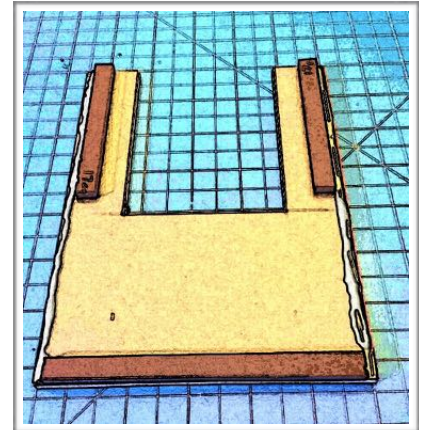
After about 5 minutes, when the glue has tacked the chassis  
together, apply glue to the back piece as shown.







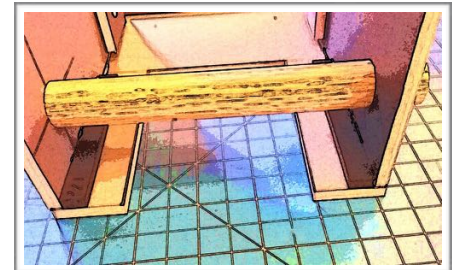
Be sure to get the glue up on the glue strips.



Orient the back piece as shown.



Place the chassis onto it as shown, and please wipe up any glue that drips onto the mat.

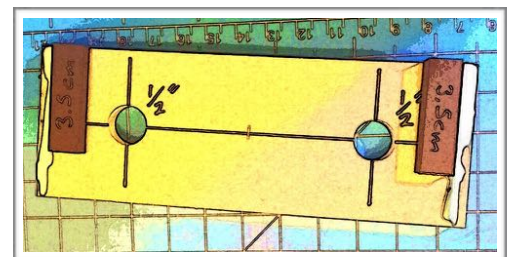


The cutout in the back piece should be by the wood dowel.



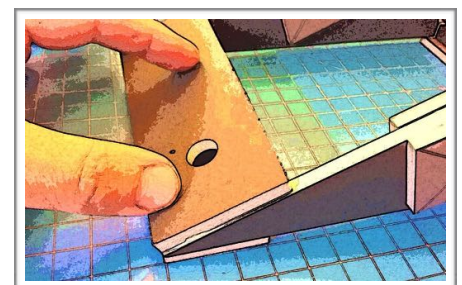
After 5 minutes, when the back piece is tacked on, turn the chassis right side up as shown. The dowel should be on top, and the axle holes should be by the mat.

Apply glue to the top piece of the bumper as shown.

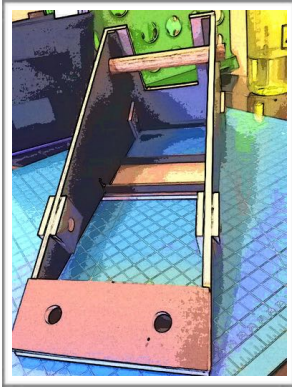


Insert the piece, making sure that the glue strips are oriented as shown.

The bumper should come all the way to the vertex of the triangle.

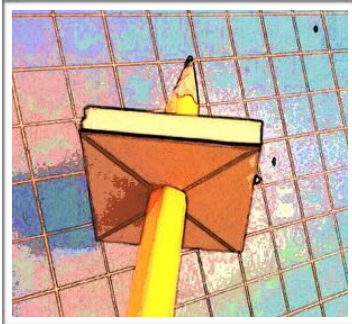
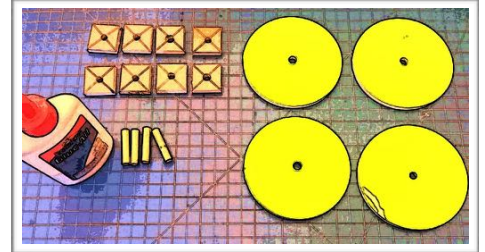






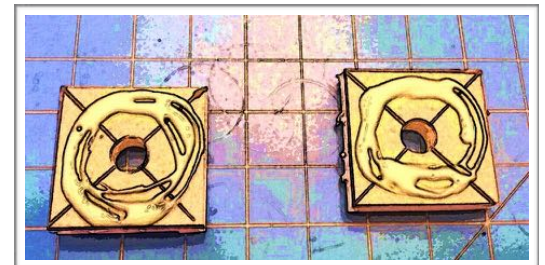
Done with the main chassis, and at this point it definitely needs a day for all the glue to dry.

- Collect:
- \* Your 4 wheels that I cut out
  - \* Your 8 wheel squares (3 x 3 cm)
  - \* glue
  - \* 4 stubs of 5/16" dowel
  - \* 4 3.5" rubber bands



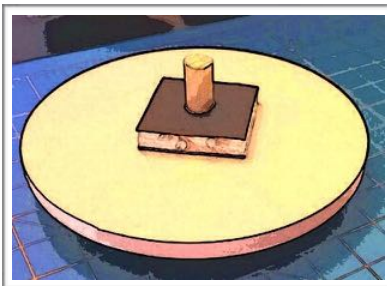
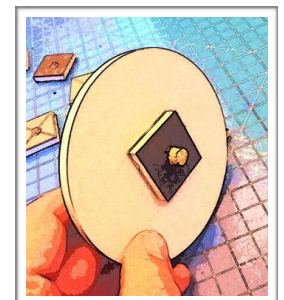
Use an ordinary pencil to stretch out the holes in all of the squares.

Glue 2 of the squares on one face. Keep the glue away from the center hole.



Place a stub of dowel into a wheel like an axle.

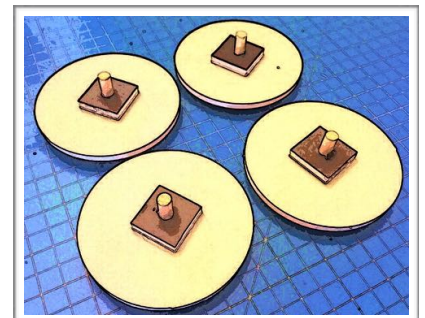
Glue one square onto each side of the wheel using the stub to keep the squares aligned.



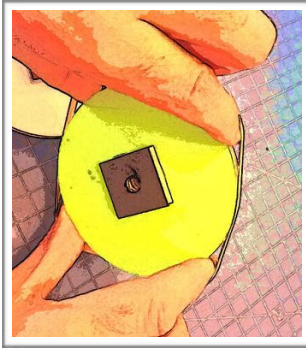
Spin the squares in place to spread the glue and lay the wheel down to dry.

Now repeat for the other 3 wheels.

Give the wheels a few minutes to tack together.



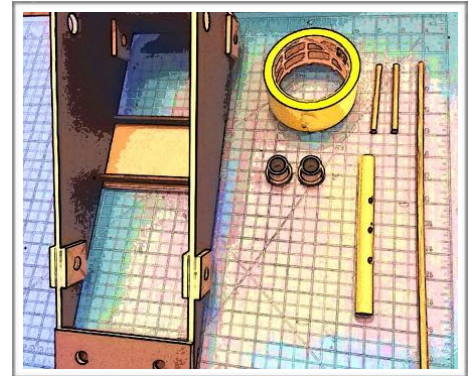
Remove the dowels by holding it down on the mat and pulling the dowel out. We don't want the dowel glued to the wheel.



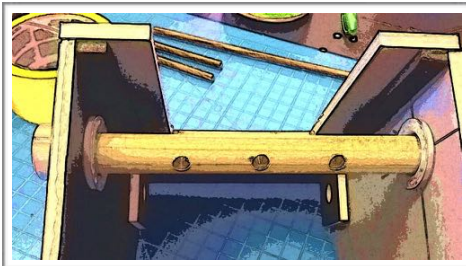
Wrap one 3.5" rubber band around each wheel. This will give the wheel traction. Work to get the rubber band as evenly wrapped as possible

Collect:

- \* 5/8" x 16cm transmission axle
- \* 2 1/4" x 8cm dowel pieces
- \* 33 cm transmission wand
- \* 2 plastic bushings
- \* chassis
- \* duct tape



Use your finger to carefully enlarge the hole for the transmission axle, and gradually work the plastic bushing through the foamboard.

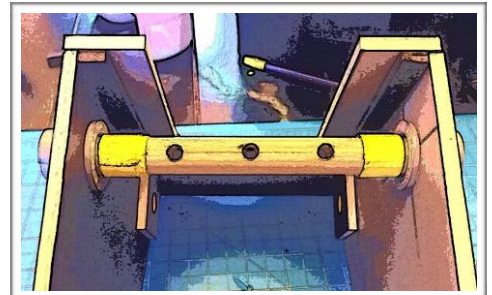


Repeat for the other bushing. They should both be sticking out as shown.



Insert the transmission axle.

Center the axle in the bushings and tear off a long piece of duct tape, about 1 - 2cm wide. Wrap it around both ends of the axle to keep it from sliding laterally.



- Collect:
- \* 2 long rubber bands (the drive bands)
  - \* 2 1/2" dowel stubs
  - \* piece of string



Tear off a piece of duct tape about 1cm x 8cm long. And place the rubber band on it as shown.

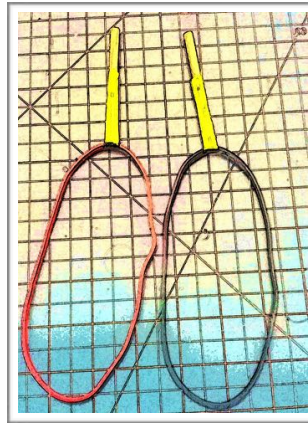
Tape the rubber band to the 8cm dowel as shown.



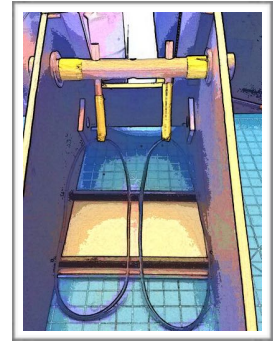




Wrap a reinforcing piece of duct tape around the first piece of tape.



Repeat for the other rubber band.

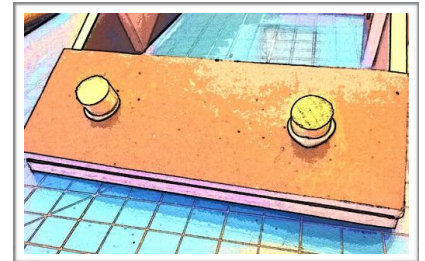


Insert both of these dowels into the transmission axle as shown.



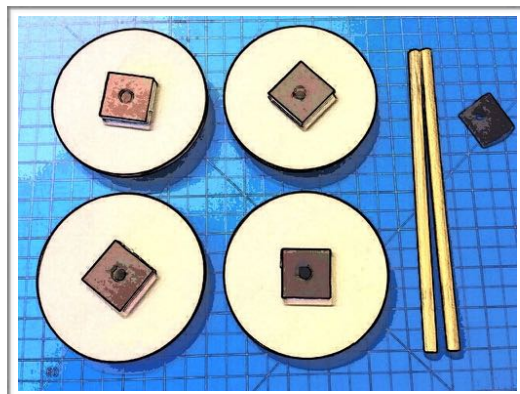
Apply some glue to the 1/2" stub as shown.

Spin the stubs into the front bumper as shown so the glue gets evenly spread.



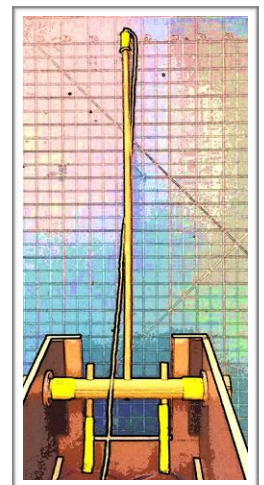
Tie your piece of string onto one end of the transmission wand.

Use a piece of tape to hold it in place, as shown.

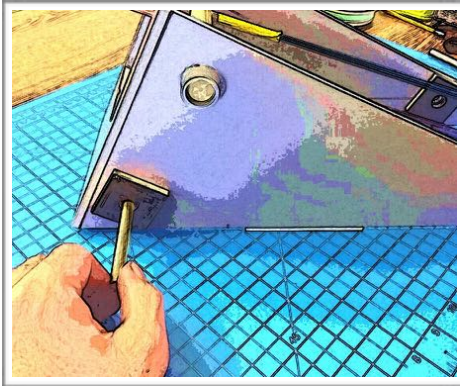


Insert the transmission wand into the transmission axle as shown.

Collect: \* 2 20cm x 5/16" axles  
\* your wheels  
\* a square of rubber



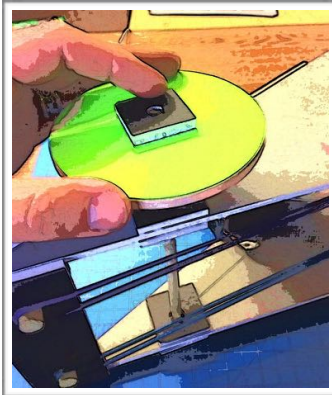
Place the Drive Bands onto their pegs in the bumper.



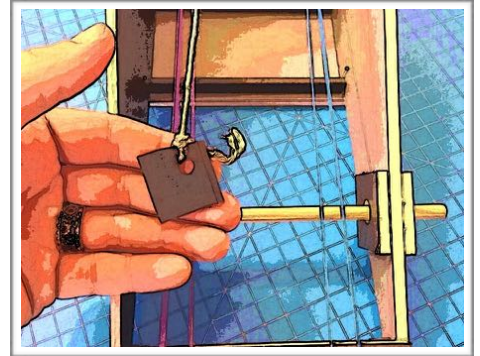
Insert both axles through their bushings.



Pull the string down to the front axle and tie the piece of rubber on so that it is close to the axle when the string is pulled tight.



**CAREFULLY** squeeze the wheels onto the axles, just so the dowel comes all the way through the wheel but not out past it.



**Done!!!! Wooohooo!!!!**

