

# VACUUM FORM

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# STEM Discovery Challenge

## DESIGN & BUILD



**VACUUM FORM CHALLENGE**

A key step in creating the perfect car body is translating the sculpted plaster body into a hollow plastic shell that can be mounted to your vehicle. To accomplish this step your team is challenged to construct your own vacuum form from the kit of parts provided. This guide provides the general steps necessary to complete this task. Quality craftsmanship, attention to detail and experimentation with the finished product will result in your teams ability to translate superior detail and precise shapes from your sculpted plaster car into the final product.

All teams attending the first workshop should plan to bring their sculpted plaster car body designs as well as their assembled vacuum forms for assistance and troubleshooting.

**PARTS INCLUDED**

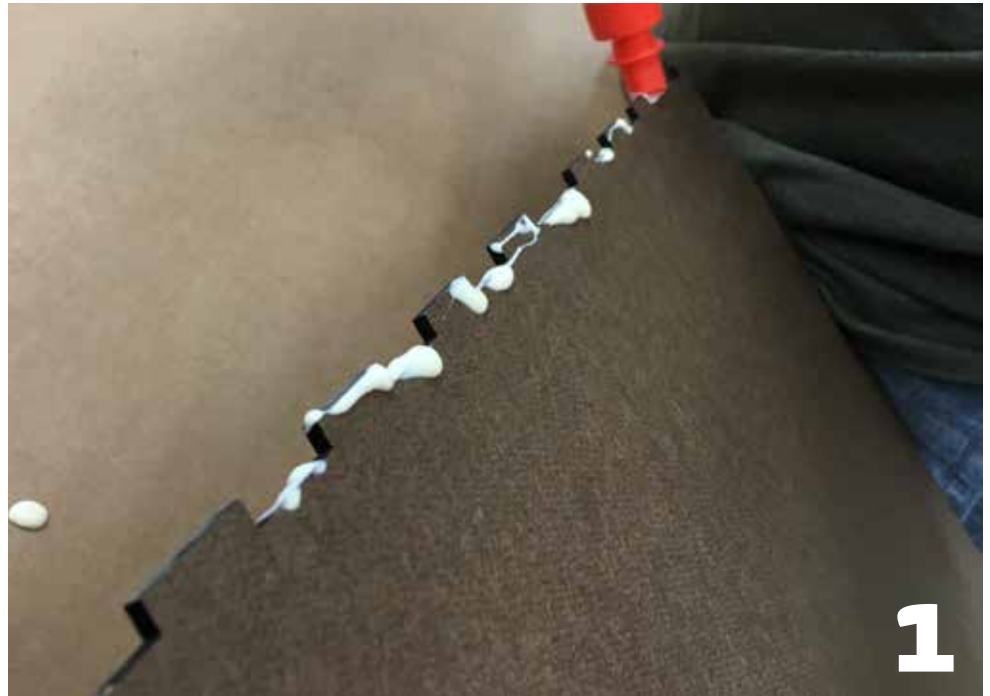
Small vacuum	Weather Stripping
Heat gun	Hinges
1x2 frame rails	Clasp
3/16" plywood panels	Aluminum foil
1/8" masonite panels	Wood glue
Screws	Caulk

**TOOLS NEEDED**

- Scissors
- Coordless drill/screwdriver

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Follow these steps carefully, and experiment with ways to improve the functionality of the tool once complete. Good luck!



Apply glue to the block edges of the masonite panels.



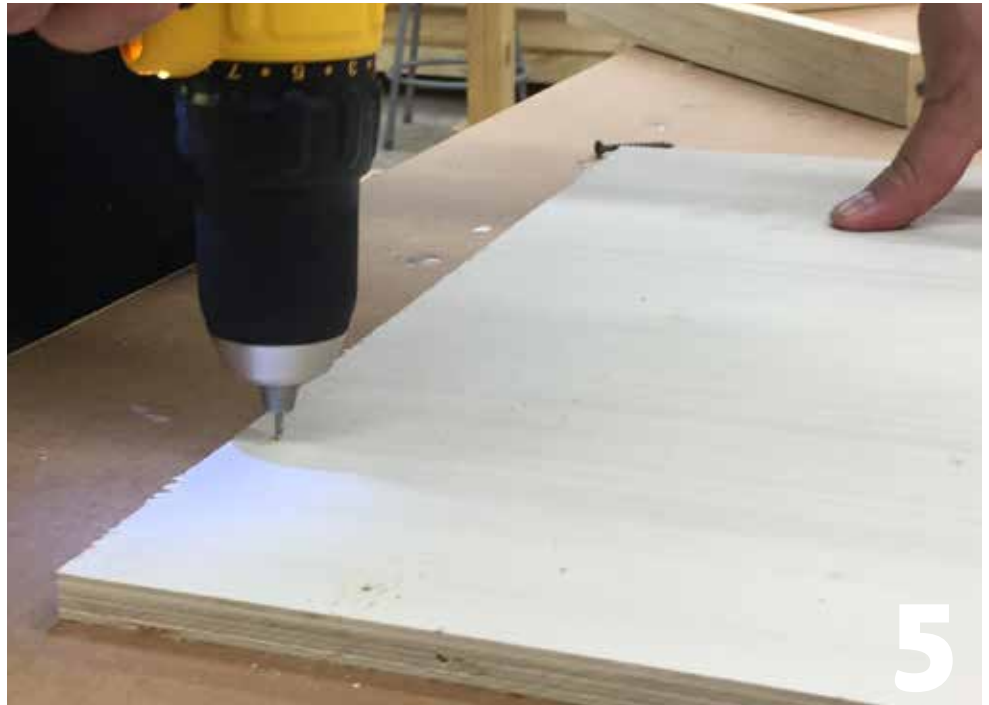
Assemble the "Warming Box". Tape can be used to hold the box together temporarily while the glue dries.



Arrange the 1x2 frame components on top of the plywood base to begin the "Vacuum Box"



Drill an 1/8" pilot hole in the side of the frame, then use a screw to attach the frame edges in a tight 90° corner. Repeat these steps for all four corners.



Drill pilot holes every 12" at the perimeter of the plywood base. Do not place the directly in the corners.



Insert screws into the pilot holes and fasten the base to your assembled 1x2 frame. Make sure the seams are tight.



Place 2 more holes near the center of the frame for attaching block supports.

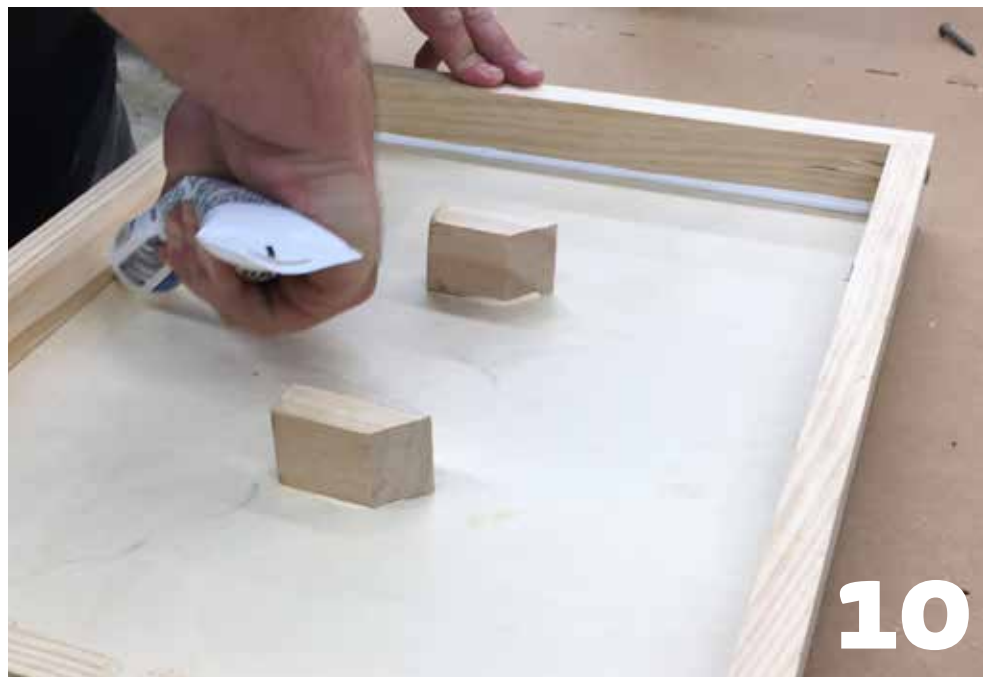


Glue blocks over holes inside the frame.



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Holding the block ready, place a screw into it through pilot hole drilled earlier. Ensure that its held down tight to the base.



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Place a bead of caulk at all seams at the interior of the box.

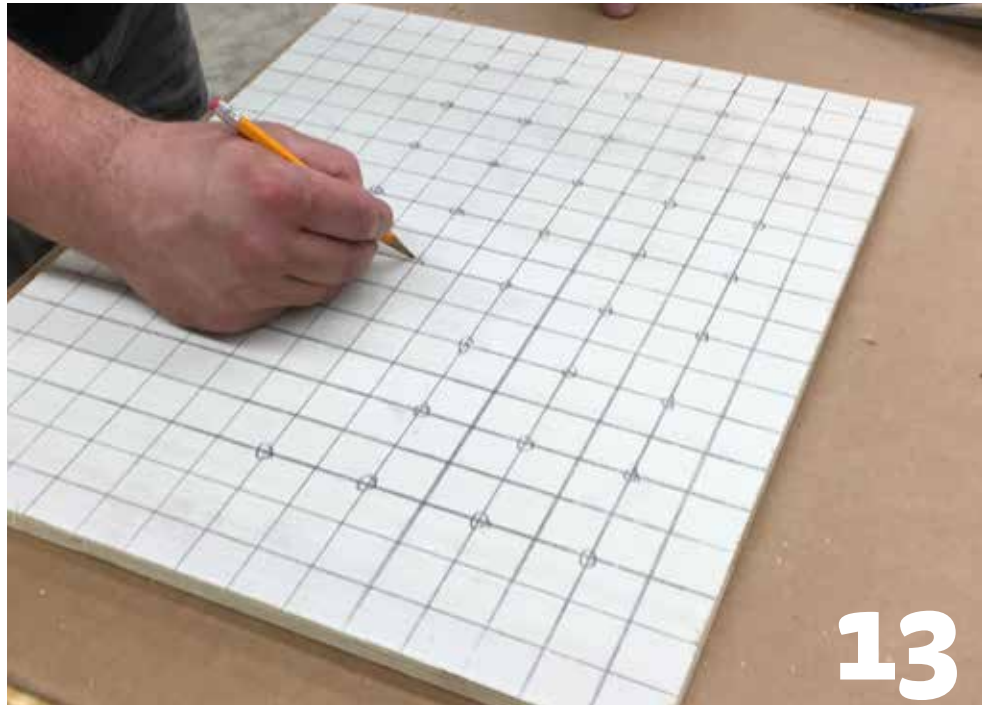


Press caulking into the seams to complete the seal by running your finger along the bead.

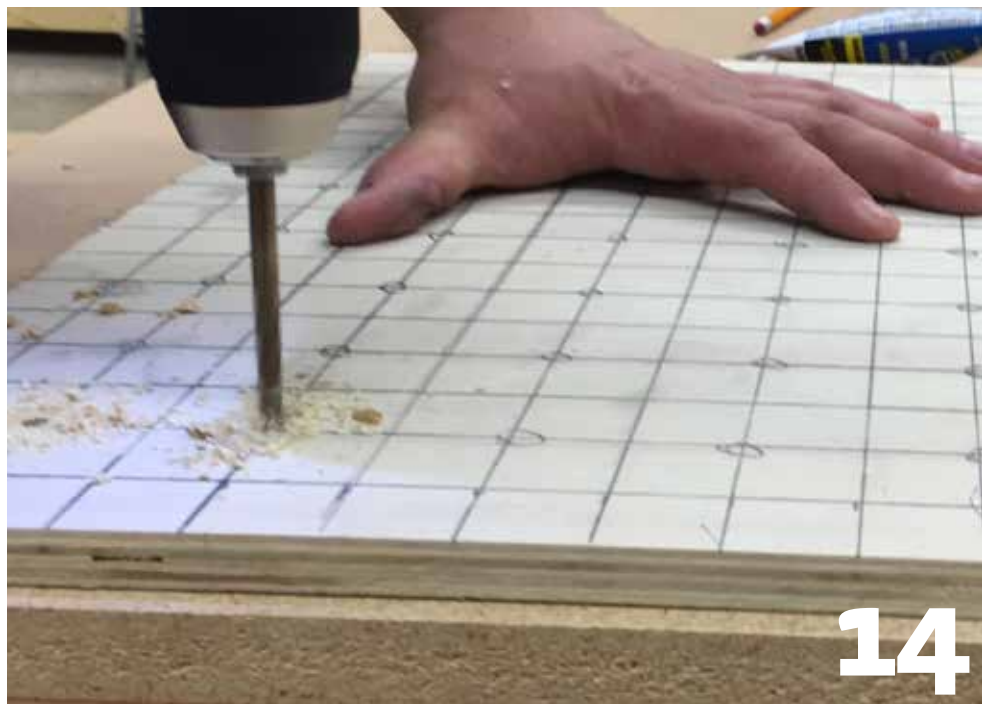


The other plywood panel will be the top of the "Vacuum Box". Use a ruler to draw a 1" grid on it.

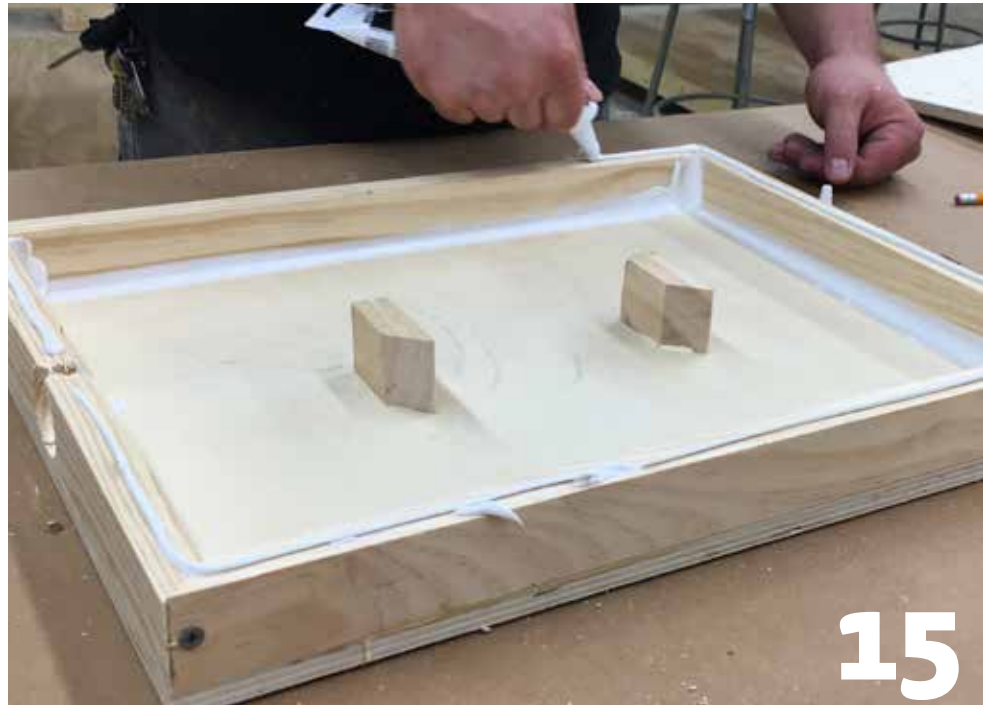




Define a pattern of holes within the grid that you want to drill. Experimentation with the density, number and size of the holes may improve the function of your vacuum form once complete.



Once a pattern is determined, drill the holes.



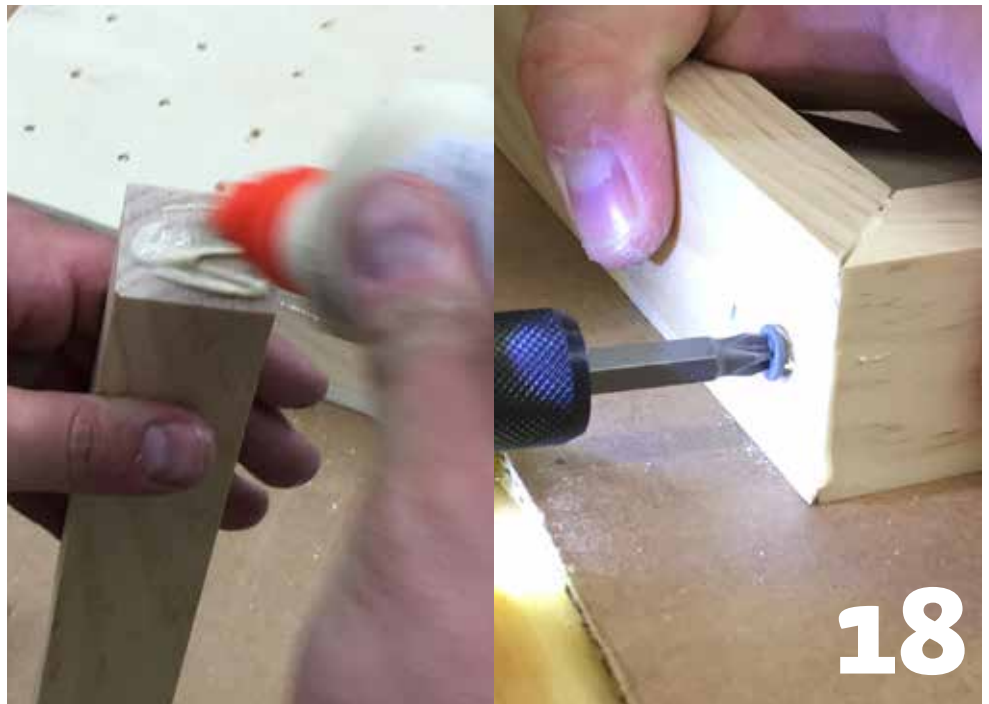
Place a bead of caulk on the top of the completed box frame.



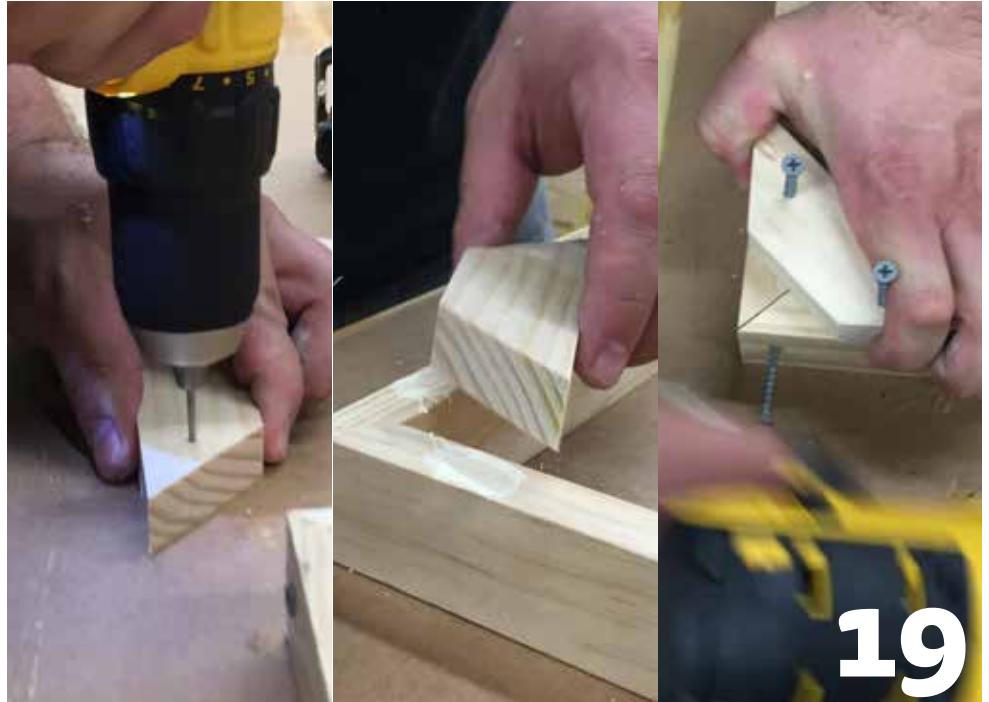
Place the drilled top onto the caulked frame to complete the Vacuum Box.



Time to build the sheet frame: Start by drilling pilot holes in the mitered ends of the other 1x2 frame parts.



Apply glue to the face of the cut edge and fasten the parts together with a screw through the pilot hole.



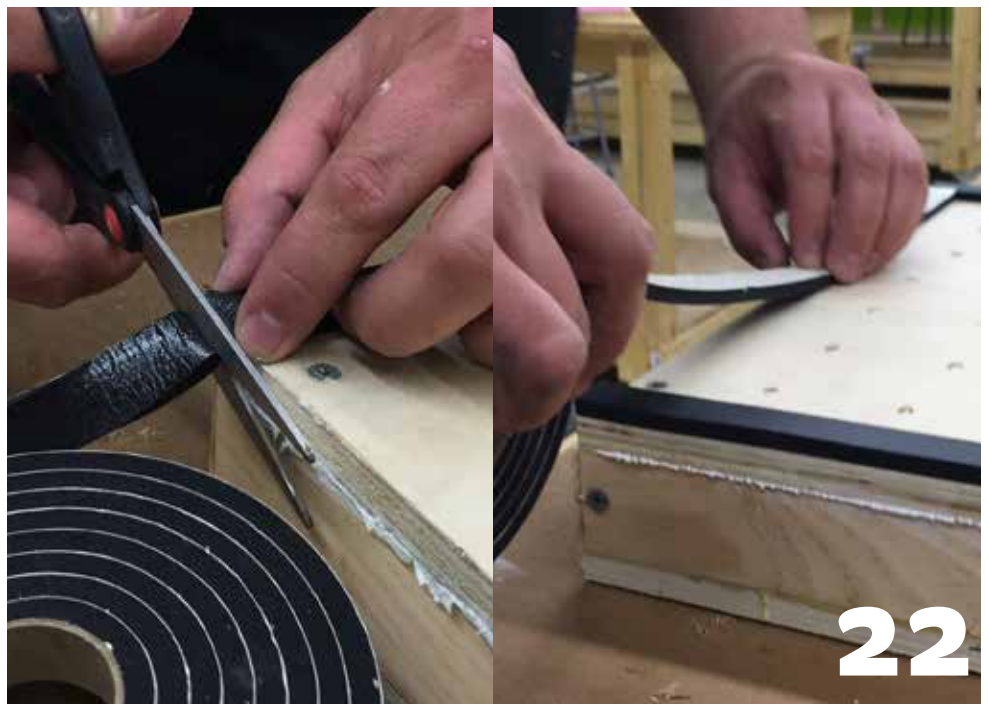
Next Predrill, Glue and screw the 45° corner braces to the frame. Use a framing square or similar tool to be sure the angles are precisely 90° before fastening.



Repeat this for all four corners. The result should be an open rigid frame with perfect 90° corners. This Sheet frame will hold the sheet of plastic while its heated and formed to its mold.



Next, apply a single layer of weather stripping to the perimeter of the drilled face of the Vacuum Box.



Cut the material to length, remove the adhesive backing and apply it so that it makes a complete seal around the outside of the drilled plywood.



Next, place the sheet frame on top of the Vacuum Box, making sure all edges align, and install the hinges on the short side without the vacuum port hole.



Be sure to install the hinges evenly spaced and perfectly horizontal. In the closed position they should slightly compress the weather stripping. The sheet frame should be able to open a full 180°.



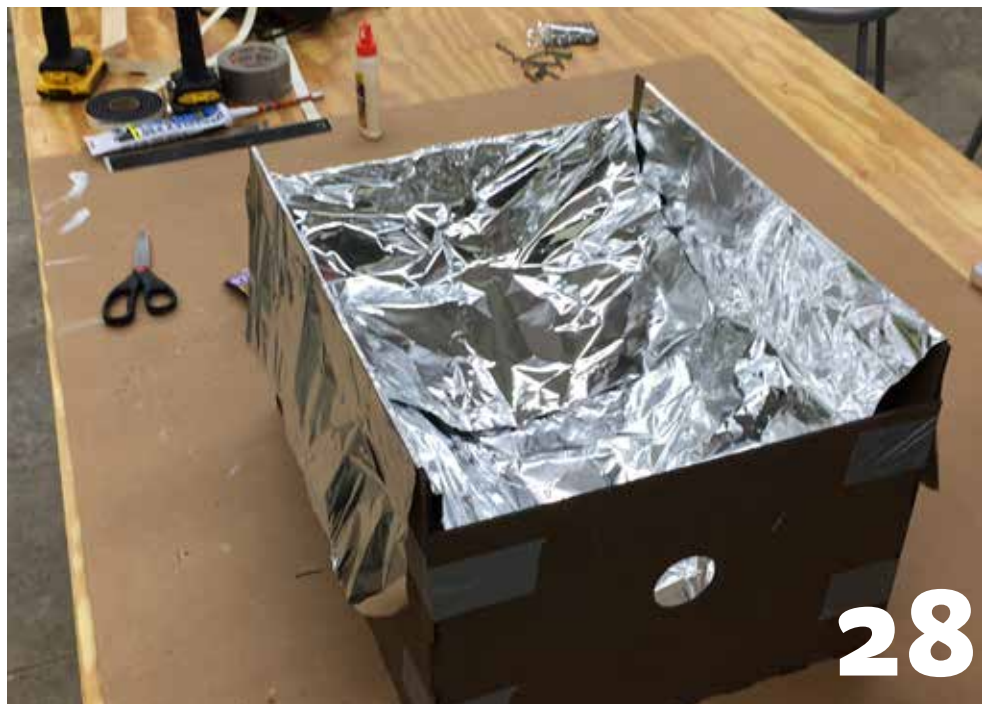
Next install the clamp on the short end close to the vacuum port hole. When closed this should also compress the weather stripping forming a tight seal.



Next, weather stripping needs to be installed inside the vacuum port hole to create a tight seal there as well. Cut the material to length, remove the adhesive backing and install it.



We're almost ready to use this thing! Unroll some aluminum foil and drape it across the Warming Box so that it sags below the heat gun port hole.



Apply another sheet of aluminum foil to side of the box opposite of the port hole. Arrange the foil so that it directs and distributes the heat from the gun upwards.





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Plug in the vacuum and connect the vacuum hose to the drilled vacuum box. Make sure you can turn the vacuum on without the hose falling out. If the box is built properly this should create even suction across all the drilled holes.



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Arrange the warming box and vacuum form so that when the sheet tray is fully open it rests directly above the warming box. Try to minimize any gaps between the warming box and the sheet tray.



Use thumb tacks to pin a sheet of styrene plastic to the flat side of the sheet frame. you can use a hammer to make sure they're fully seated and flat. Try not to allow any ripples in the plastic.



Place the object to be formed in plastic on the drilled surface of the vacuum box.



Turn on the heat gun, and apply heat to the warming box. Experiment with various methods to achieve consistent distribution of the heat to the entire sheet of plastic - this is the hardest part. You can tap lightly on the plastic to get a sense of its elasticity and temperature.



Once the sheet of plastic is sagging and flexible, quickly and simultaneously flip the sheet tray over onto the part, compressing the weather stripping seal (use the clamp if you don't have a partner) and turn on the vacuum. You have about 2-3 seconds before the plastic becomes rigid, so move fast. The warmer the plastic is (without melting completely) the more detail you'll get when vacuum forming.



Once the plastic stops moving turn the vacuum off, lift the sheet tray up, remove the part and unpin the sheet.



Lastly, use scissors to trim away the excess plastic. Tape or soldering iron can be used to repair unwanted tears in the finished product. Good Luck and happy Vacuum Forming!