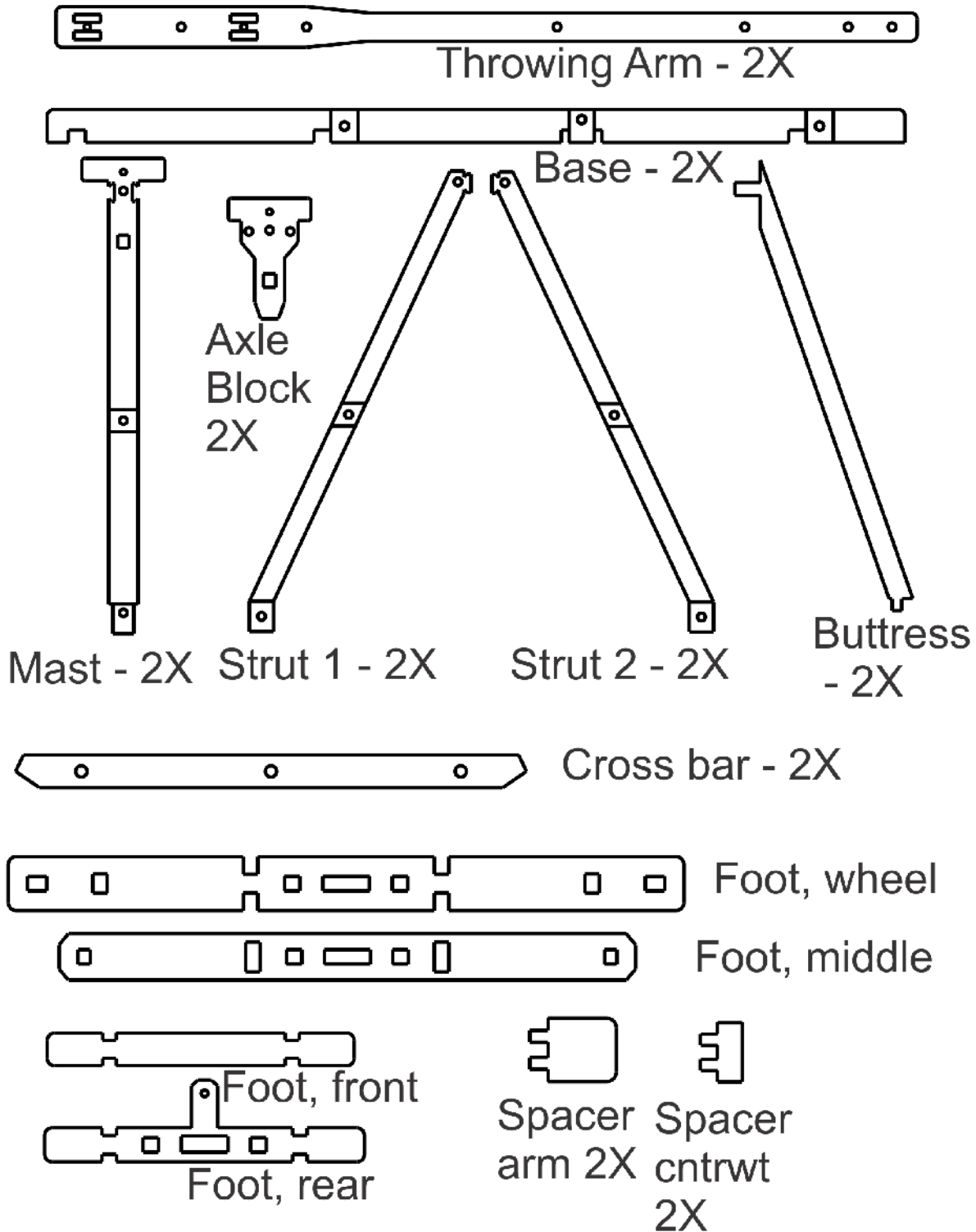
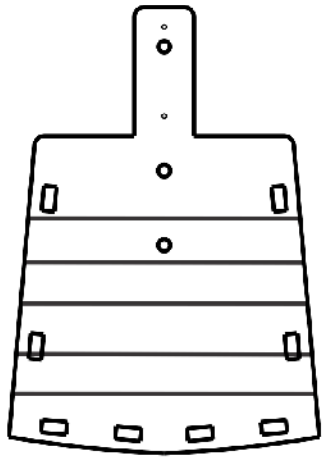


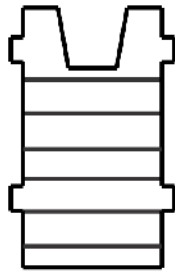
Desktop Trebuchet Kit Assembly Instructions

Contents of package (drawings are not to scale for clarity, parts that have duplicates are indicated with total number of that part to be found, example: 2X means that there are two of those parts)

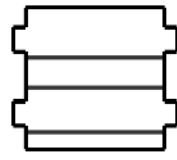




Counterweight side - 2X



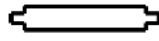
Counterweight front - 2X



Counterweight bottom - 2X



Cntrweight brace - 2X



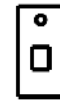
Wheel rung - 16X



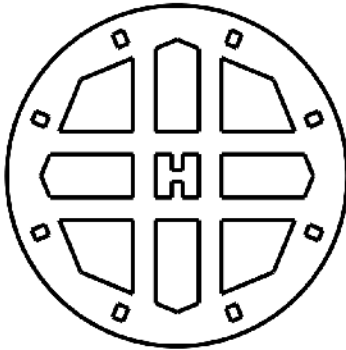
Wheel mount - 2x



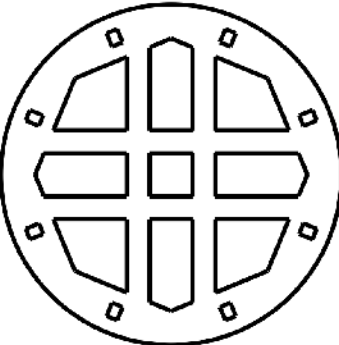
Wheel strut - 2x



Wheel brace - 2x



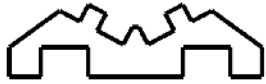
Wheel outside - 2X



Wheel inside - 2X



Wheel axle half - 2X



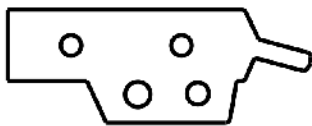
Trough mount - 2X



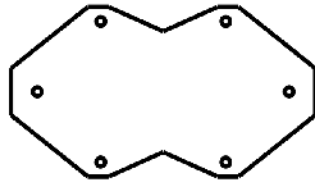
Trough mount with holes



Release pin



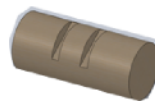
Arm end pieces
Various angles
Total 7 pieces



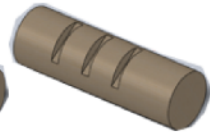
Sling pouch



Dowel 1 line - 6X



Dowel 2 line - 10X



Dowel 3 line - 12X

Other parts:

String pack

Axles, steel – one each of 3 different lengths

Eye screw (for basic version) or brass pulley (modeler version)

History of the Trebuchet

The trebuchet was used in the middle ages, roughly from about 600 to 1400 AD. Large siege weapons had existed long before, such as the ballista or catapult used by the Romans and other civilizations. These preceding weapons used energy stored in twisted ropes to throw rocks and other ammunition. The trebuchet was an improvement in that it used either human power, or later, gravity by using a counterweight. The twisted rope system required great skill to set up and had to be kept dry in order to operate properly. The gravity powered systems were thus simpler to construct and easier to maintain.

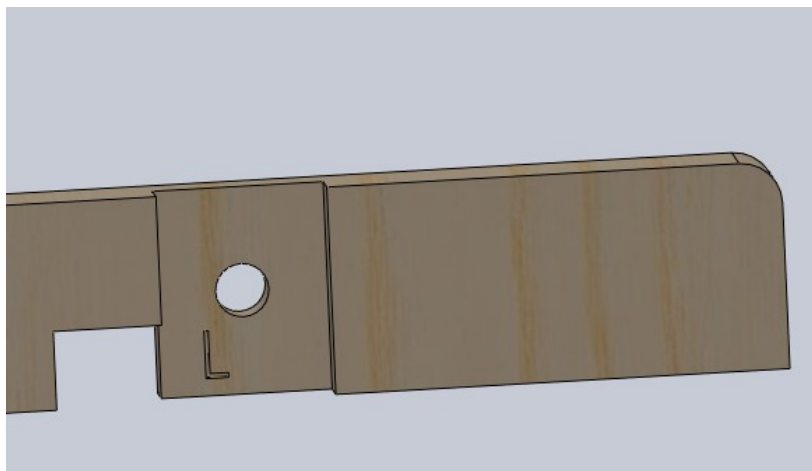
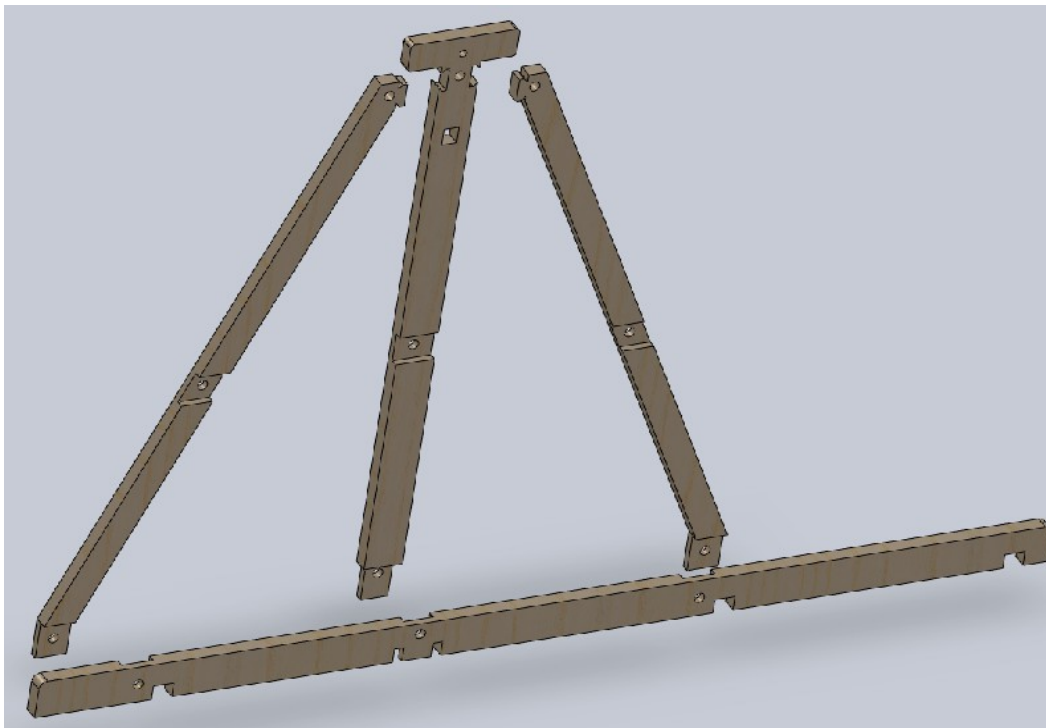
The word trebuchet is French in origin, but that does not mean that it was a French invention or that it was restricted to use only by French. It is just a word that is commonly known today. But this machine and many variations of it were used by many nations during that time.

Assembly notes:

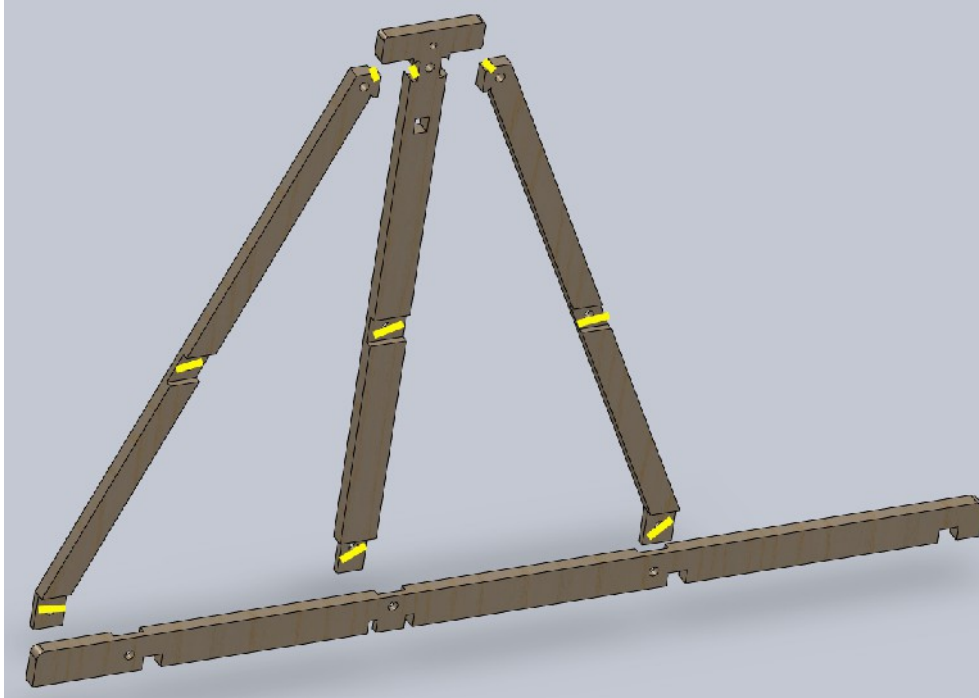
You should assemble on a flat surface like a table. Put down some paper or similar material to protect the surface from any spilled glue or scratches.

Note about “best” side appearance of laser cut wood: The wooden parts that have been laser cut have a light brown appearance on the side where they were cut. This side often is very attractive in appearance. You should decide which side you like best, the laser cut side or the other side and each time you assemble parts that will face outward, use that side.

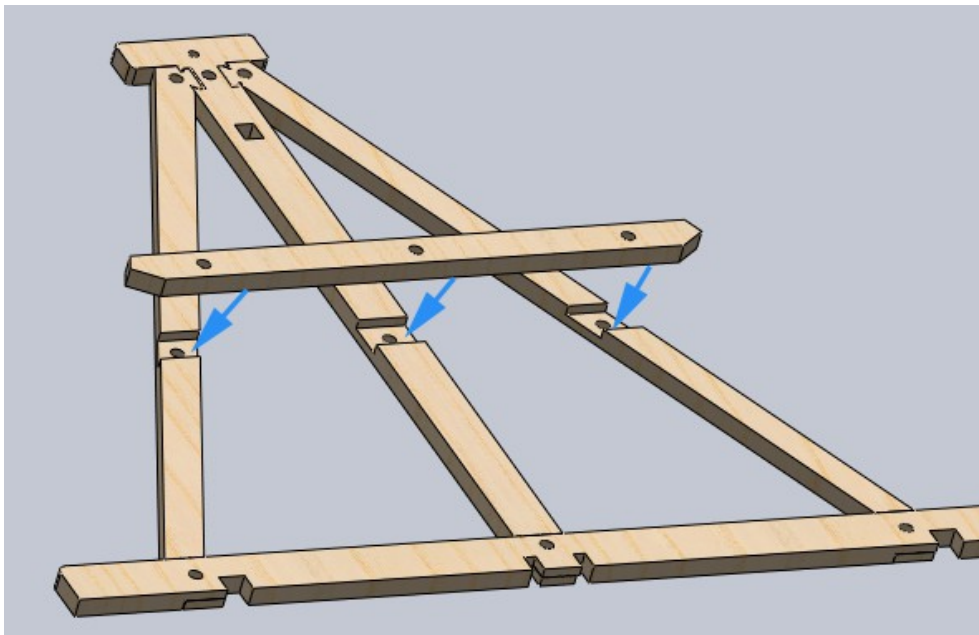
1. Locate the parts shown (mast, strut1, strut2, base). These parts will make up the A-frame assembly of the trebuchet's left side. The base parts are different for the left and right sides of the trebuchet. For the left side base part, look for the letter “L” engraved in the cut out portion near front.



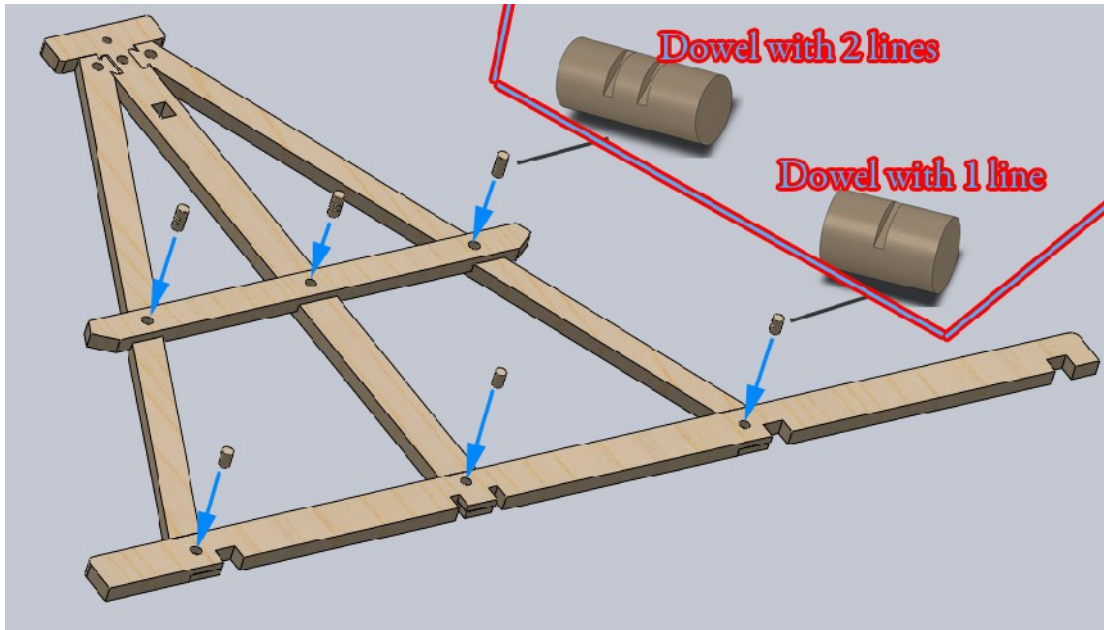
2. You will glue these parts together but first, dry fit the parts together and check that you have the right parts and that they all fit well together. Check that the angled struts and the vertical mast part have a cut out facing out. Then take apart and apply glue lightly in the areas shown, then re-assemble them. It is easiest to lay down the vertical parts on a flat surface and assemble them, then add the horizontal base part.



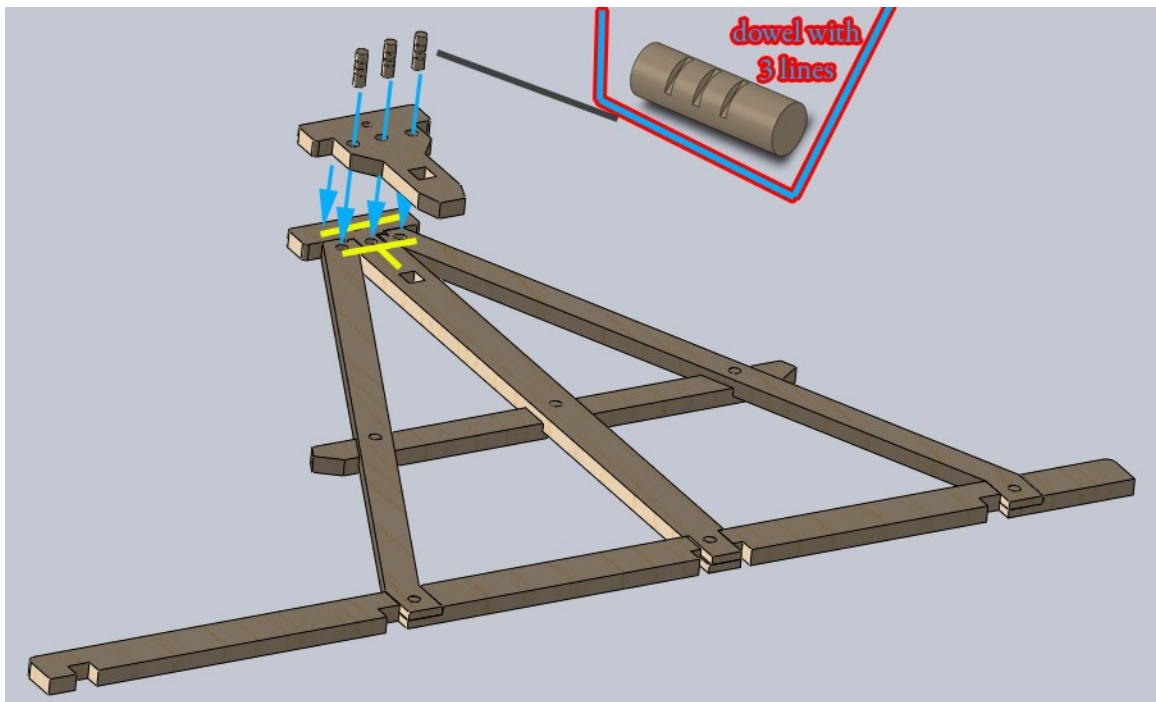
3. Add the cross bar part. Be careful to align the round dowel holes.



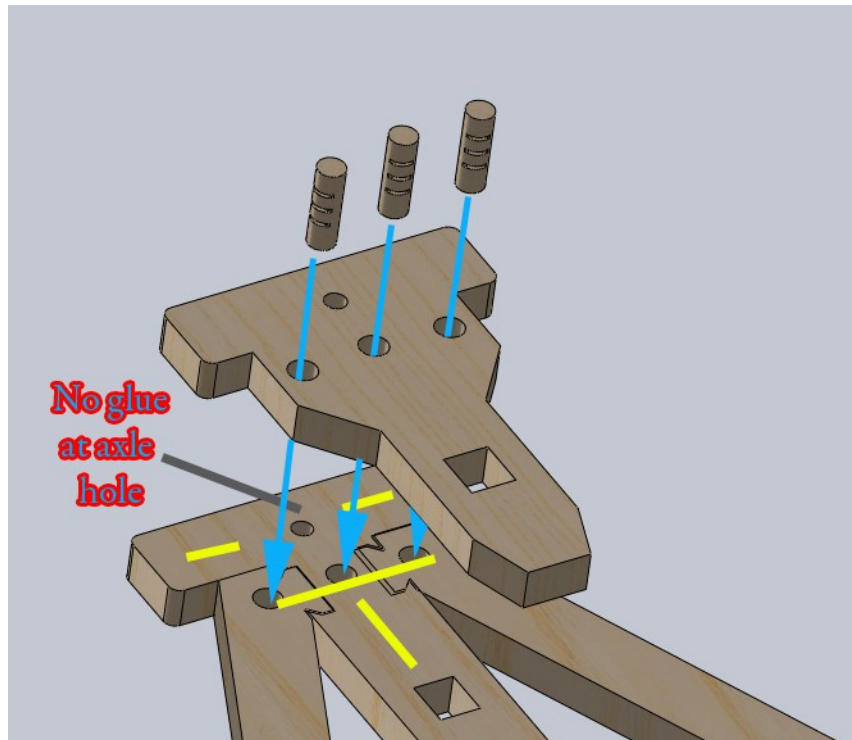
4. Locate 3 of the dowels with one line marked on them, and 3 of the dowels with 2 lines marked on them. Insert the 2 line dowels into the crossbar piece, and the 1 line dowels into the bottom horizontal base piece. You can tap these into place gently with a hammer or just shove them in as far as you can by hand, and then turn the assembly over and press down on the back side, using the table surface to shove them in fully from the other side.



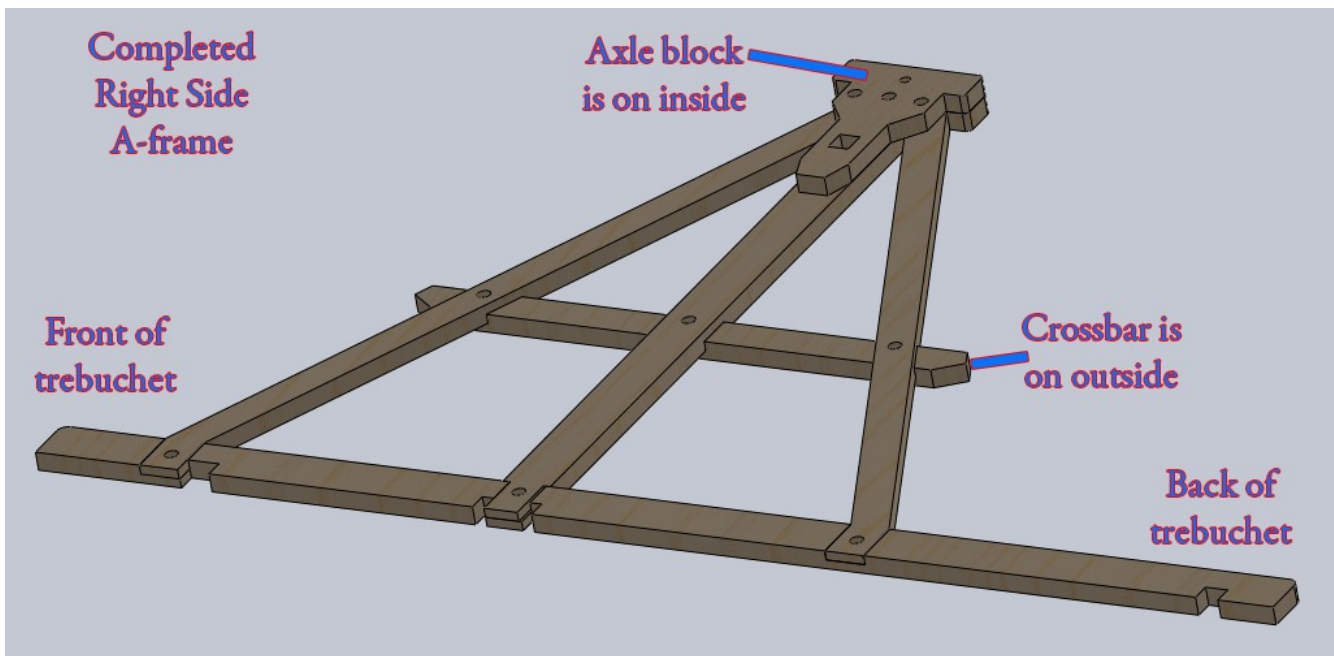
5. Carefully turn the assembly over and add the axle block part. Apply glue as shown by yellow areas, then place the axle block part onto the glued area and secure it into place with 3 of the dowels with 3 lines. The top hole is for an axle and does not get a dowel. **WARNING: DO NOT ALLOW GLUE NEAR THE AXLE HOLE!**



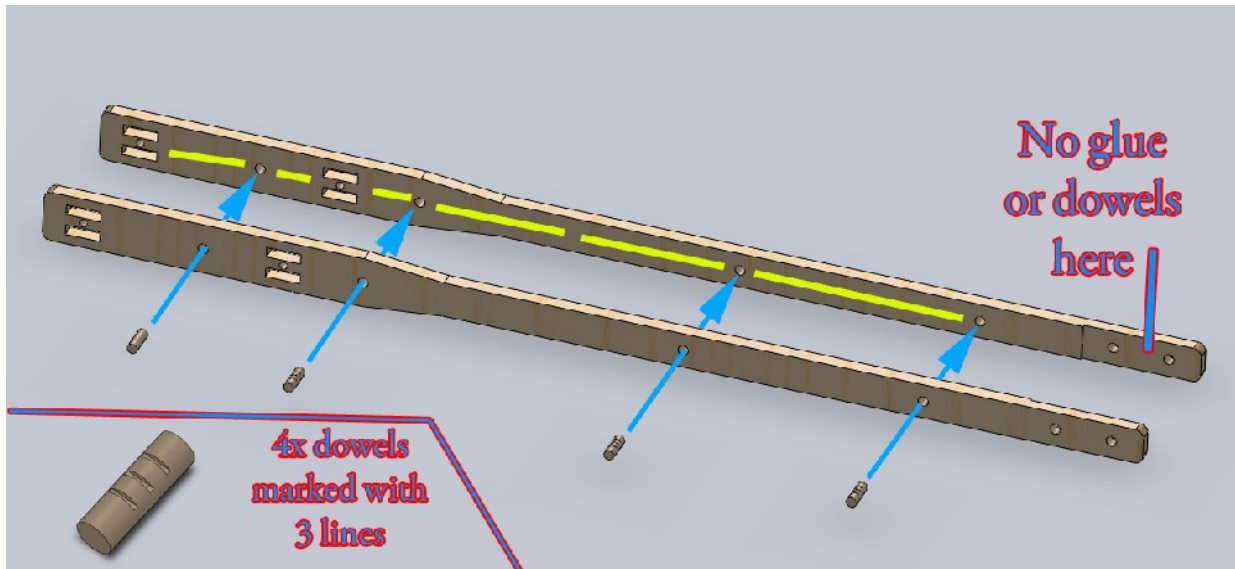
Detail view of step 5



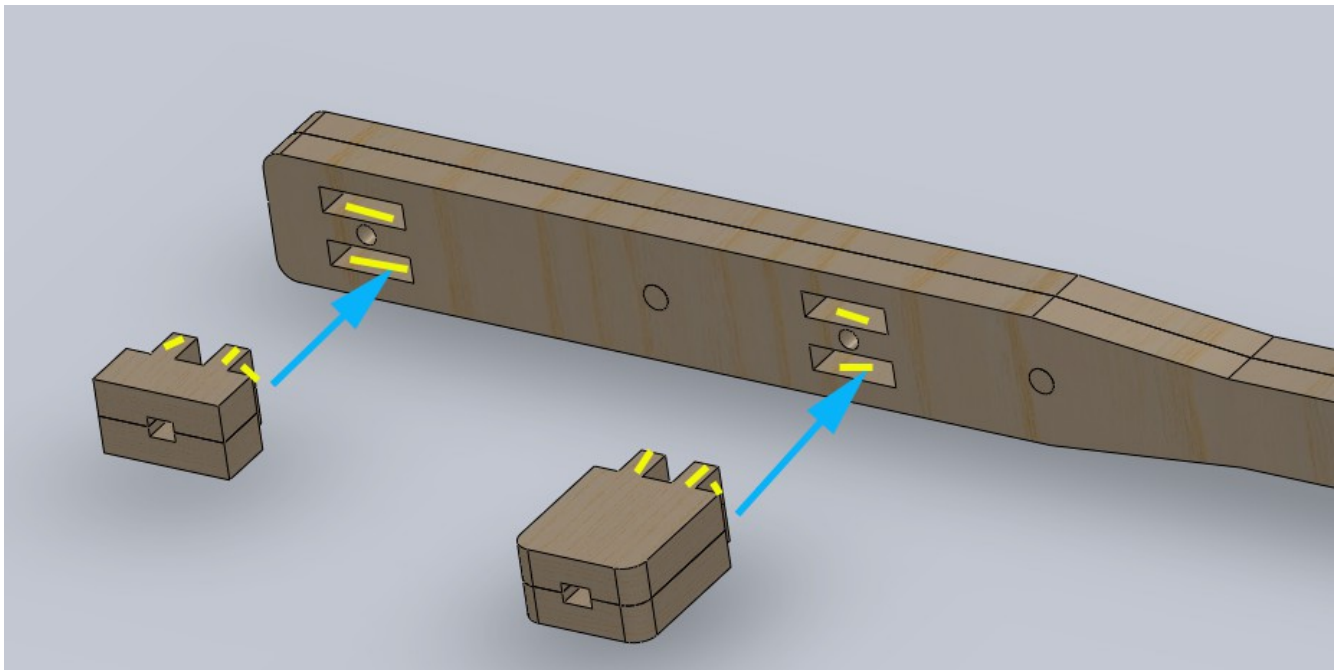
6. Repeat steps 1-5 for the right side of the A-frame. The base part will have the letter “R” engraved on it similar to the left side's engraved “L”. Illustration below shows the completed A-frame for the right side of the trebuchet.



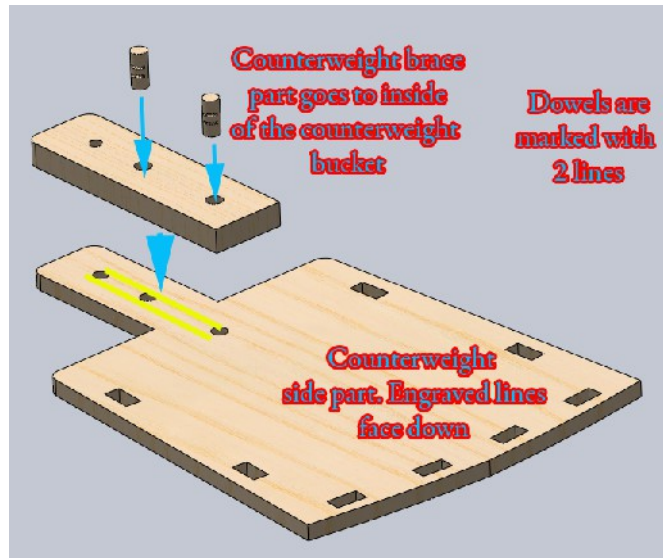
7. Locate the two pieces of the throwing arm and 4 of the dowels marked with 3 lines. Note that the cut out area at the ends of the arms both face INWARD. Apply glue in the yellow areas shown, then press the parts together, carefully aligning the holes for dowels. Insert the dowels and tap home lightly with a hammer or flip the part over and press down on the part against the table to force the dowels into place. **WARNING: DO NOT GLUE OR PLACE DOWELS IN THE CUT OUT AREA!**



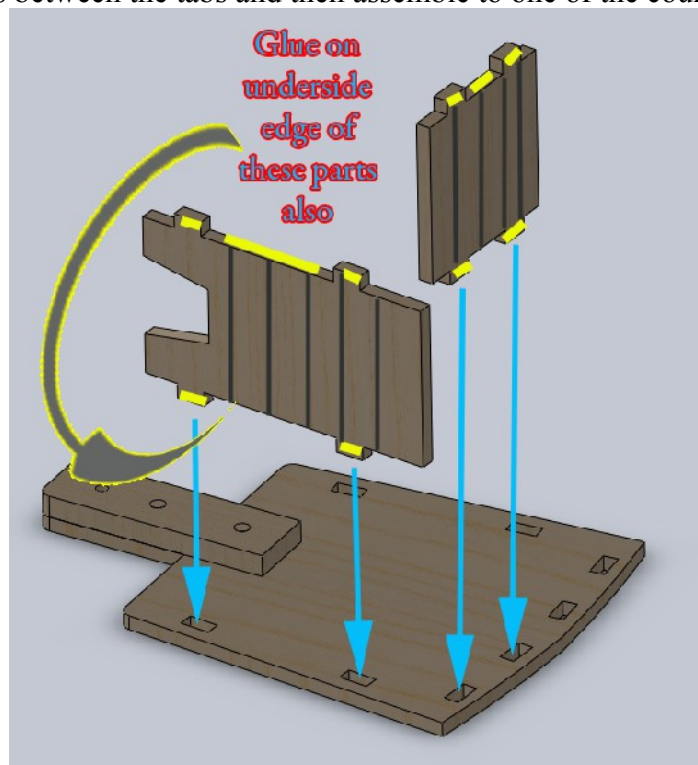
Complete the arm by adding the pairs of spacers for the main axle and the counterweight axles as shown. The cut out area on each should face each other. The axle will fit into these cut out areas. Repeat for other side of the arm.



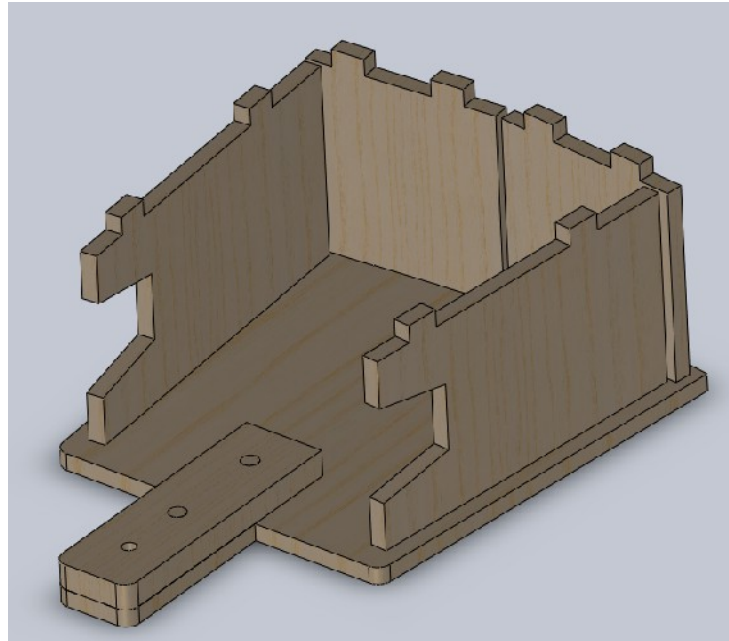
8. Locate the counterweight side and brace pieces as shown and 4 of the dowels marked with 2 lines. Note that the engraved horizontal lines go to the outside, so have them face down. The counterweight brace parts Then apply glue as shown by yellow areas and fit the pieces together, carefully to align the dowel holes. Then place the dowels and drive or press them home. Repeat for the other counterweight side piece.



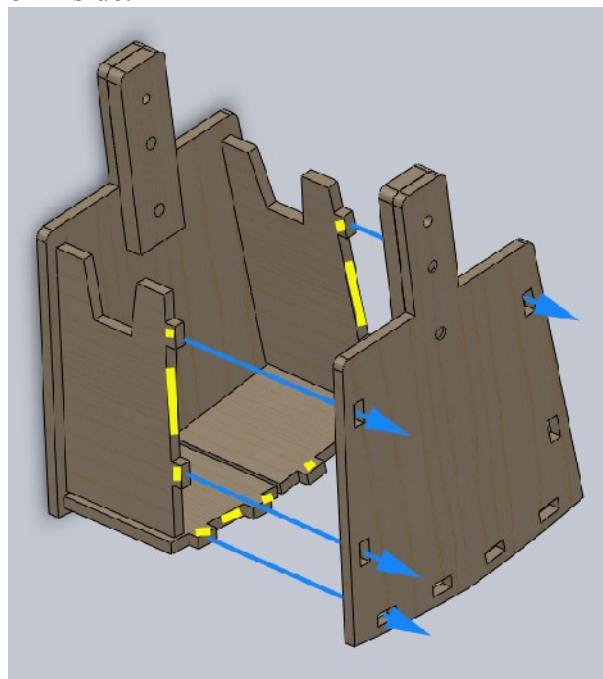
9. Locate a counterweight front part and counterweight bottom part as shown. Apply glue to the “tabs” and edges between the tabs and then assemble to one of the counterweight sides.



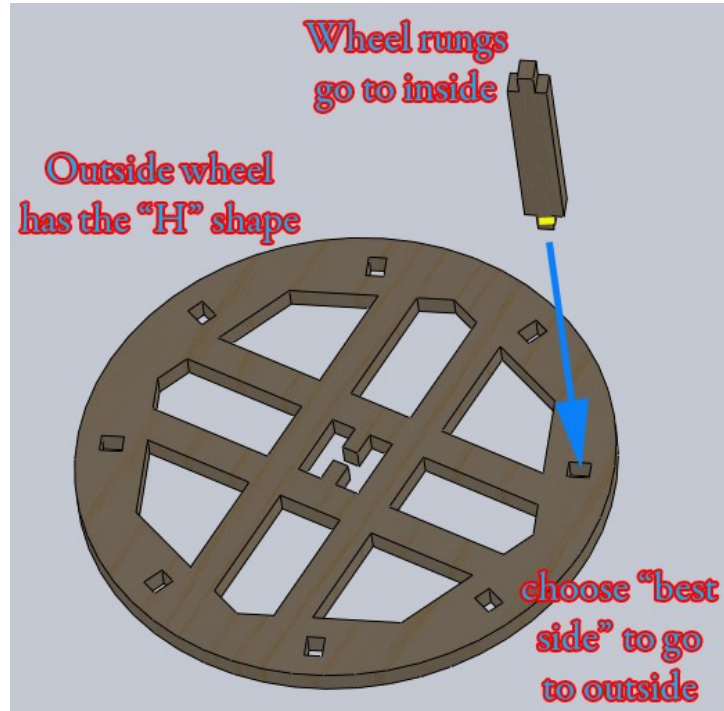
10. Add the other counterweight front and bottom parts, gluing them as in step 9.



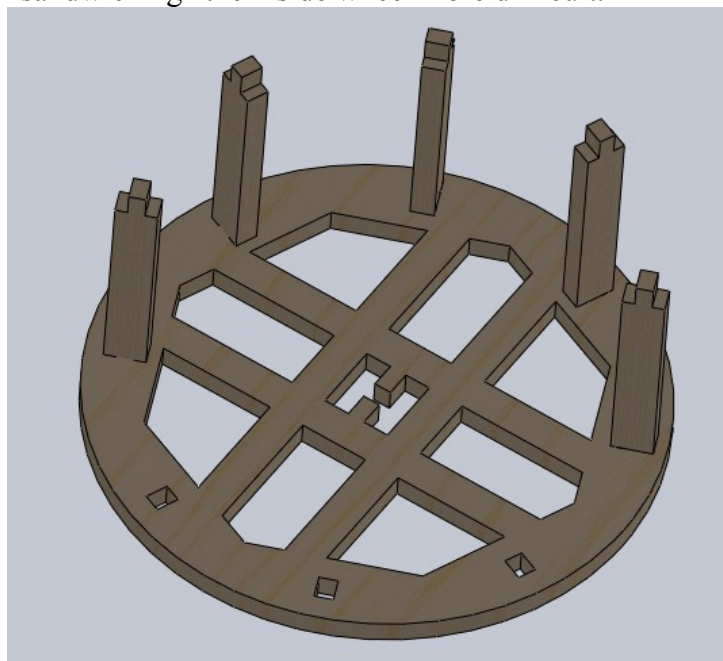
11. If you have not already applied glue as shown in yellow areas, you can do so now. Then add the other assembled counterweight side piece. Note that the engraved lines go to the outside and the brace part is on inside.



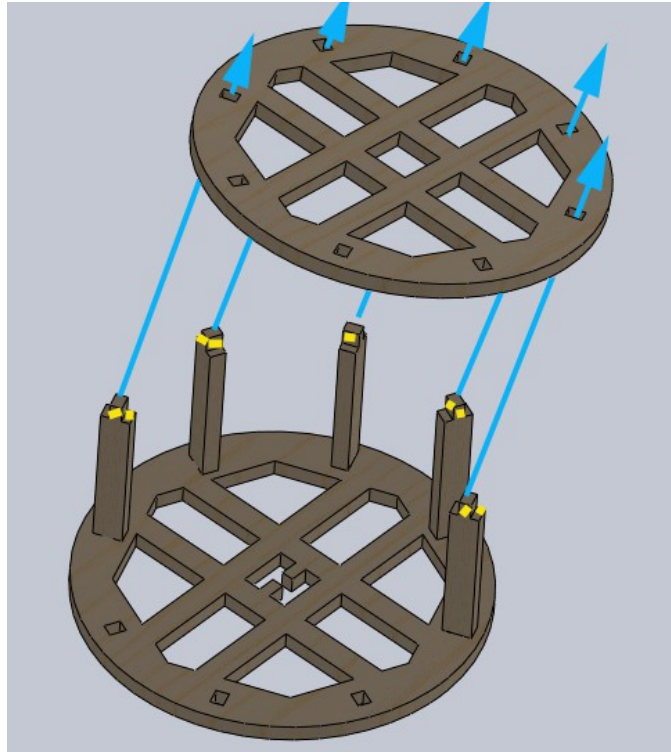
12. Begin assembly of the wheel by locating an outside wheel part. This has a distinctive “H” shape in its middle. Choose its “best” appearance side to face to the outside. Lay that side face down and add the rungs one at a time. Each rung should have a small amount of glue applied to the tab. Careful to not use excessive glue as it is difficult to clean inside the assembled wheel.



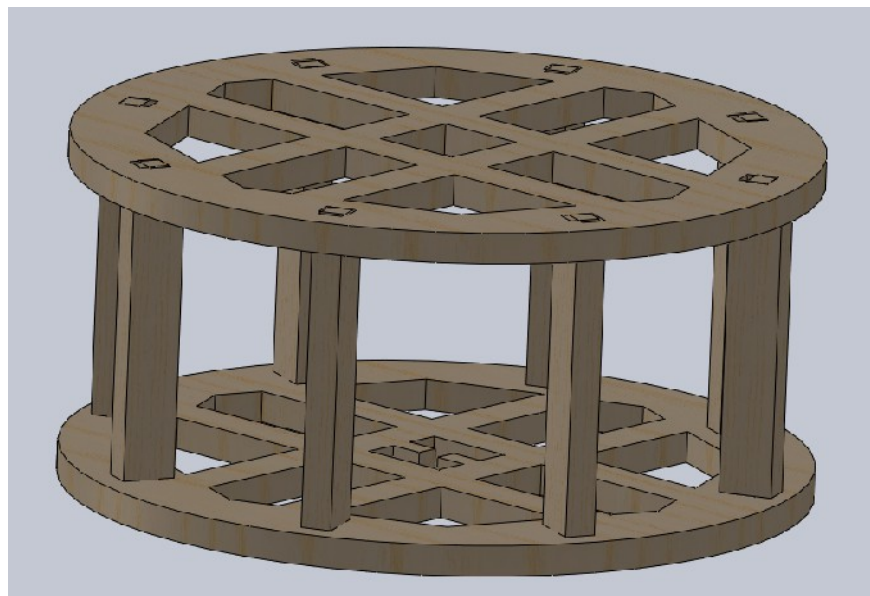
13. Add another 4 rungs, glueing each carefully. It is best to not add all 8 rungs at once as it makes the next step of “sandwiching” the inside wheel more difficult.



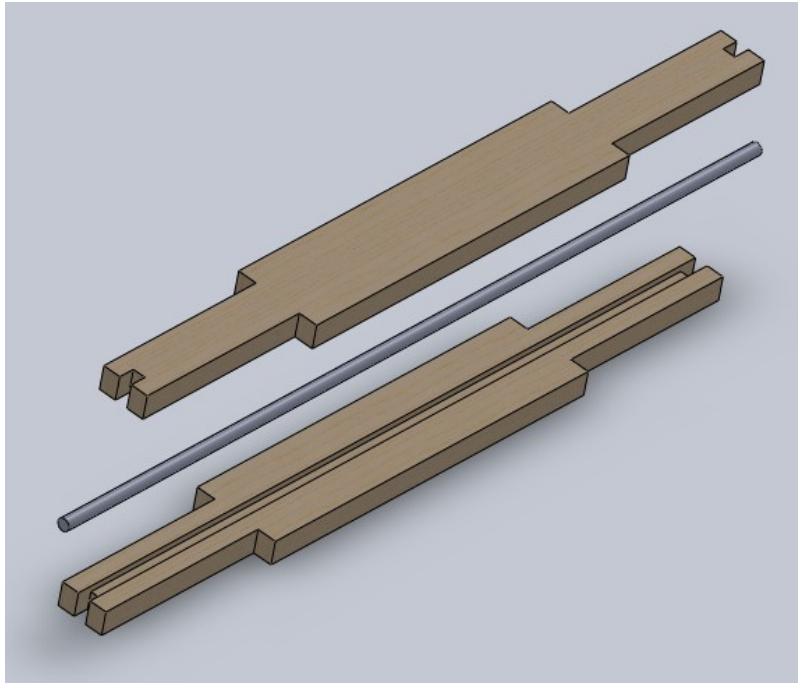
14. Find the inside wheel part. **IMPORTANT: BE SURE THAT YOU HAVE THE INSIDE WHEEL PART.** This has a simple square hole in the middle, not the “H” shape. Add glue to the rung tabs that are sticking up, and add glue to both ends of 3 other rungs. Set these 3 aside and have them ready. Carefully fit the inside wheel down onto the rungs. You will have to tilt the wheel a bit to fit all of them and still leave room for the other 3 rungs.



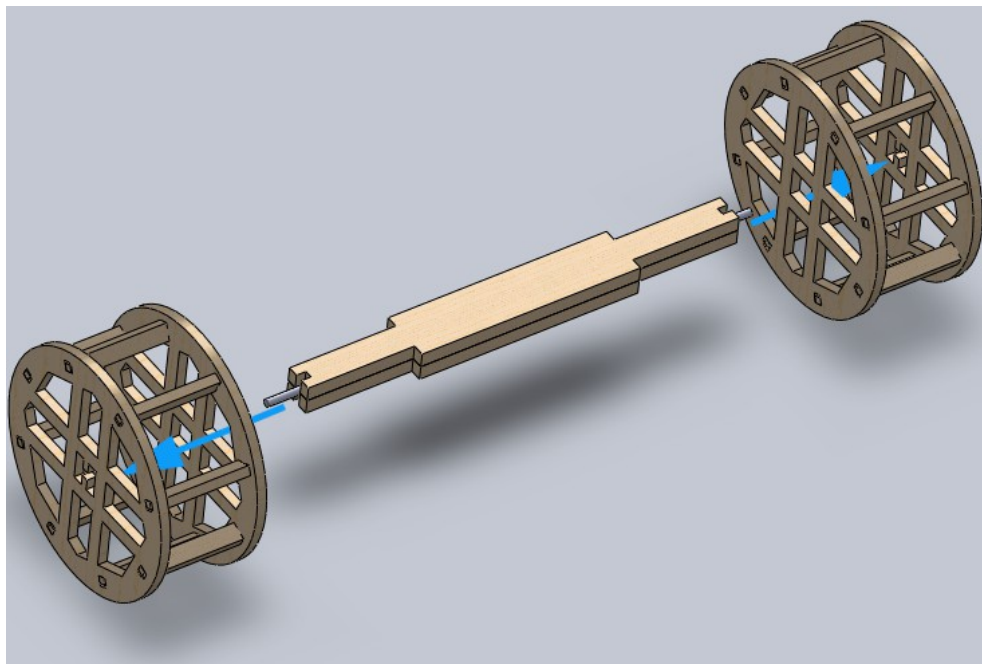
Then carefully insert the other three rungs and gently seat the inside wheel part down onto all 8 rungs. Press to be sure you have it then set this wheel aside. The completed wheel assembly should look like illustration below.



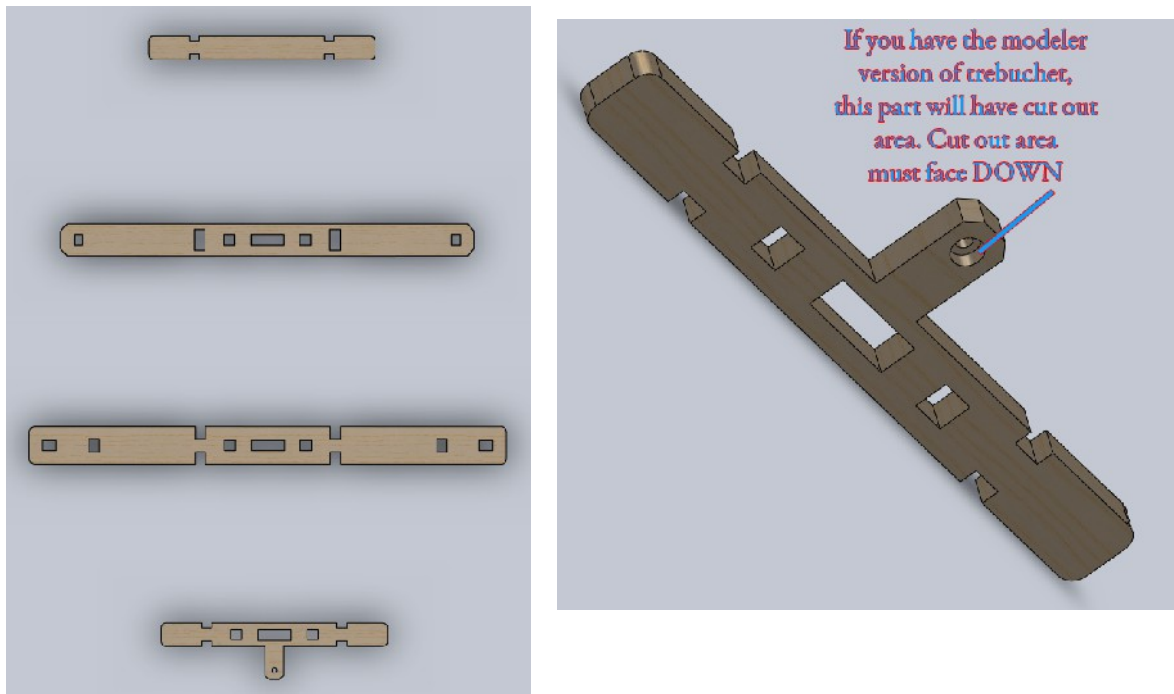
15. Repeat assembly for the other wheel.
16. Locate the two wheel axle halves and the longest of the steel axles. No glue is necessary for these parts. Simply lay the axle into the cut out recess in one of the axle block halves, then lay the other onto it with its recess facing down. The axle will turn inside of the two recesses.



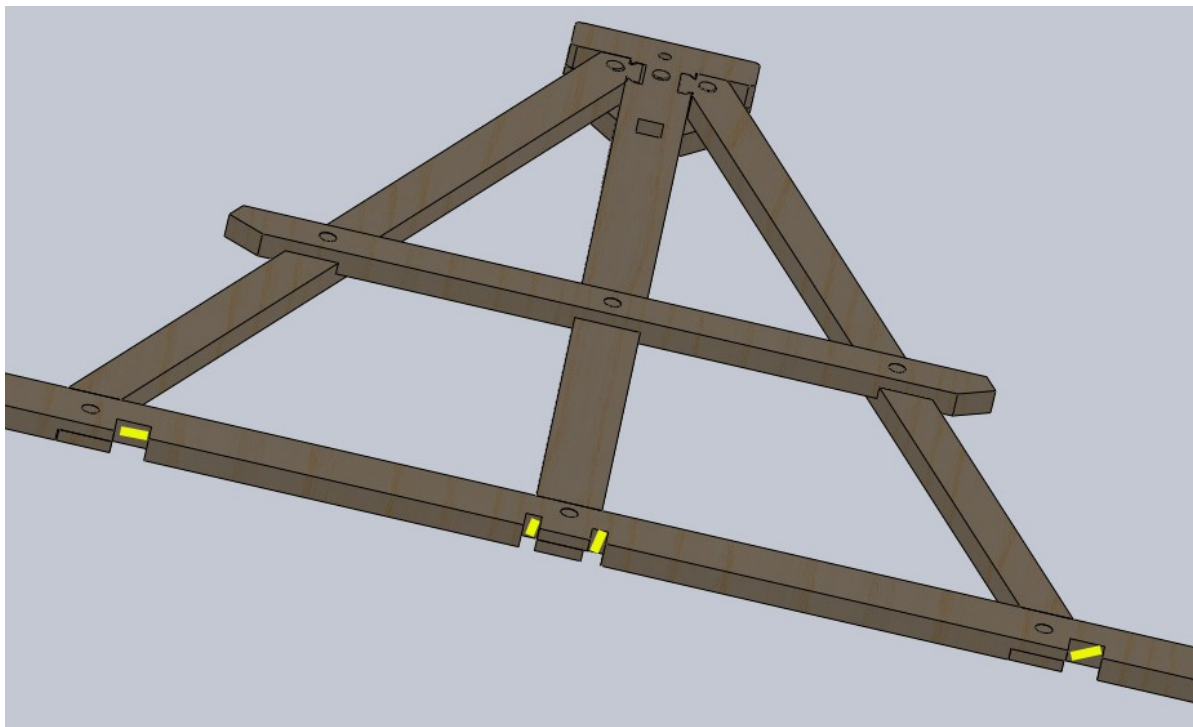
17. Insert the wheel axle assembly into the two wheels as shown. No glue is necessary here. The “H” shape goes to the outside.



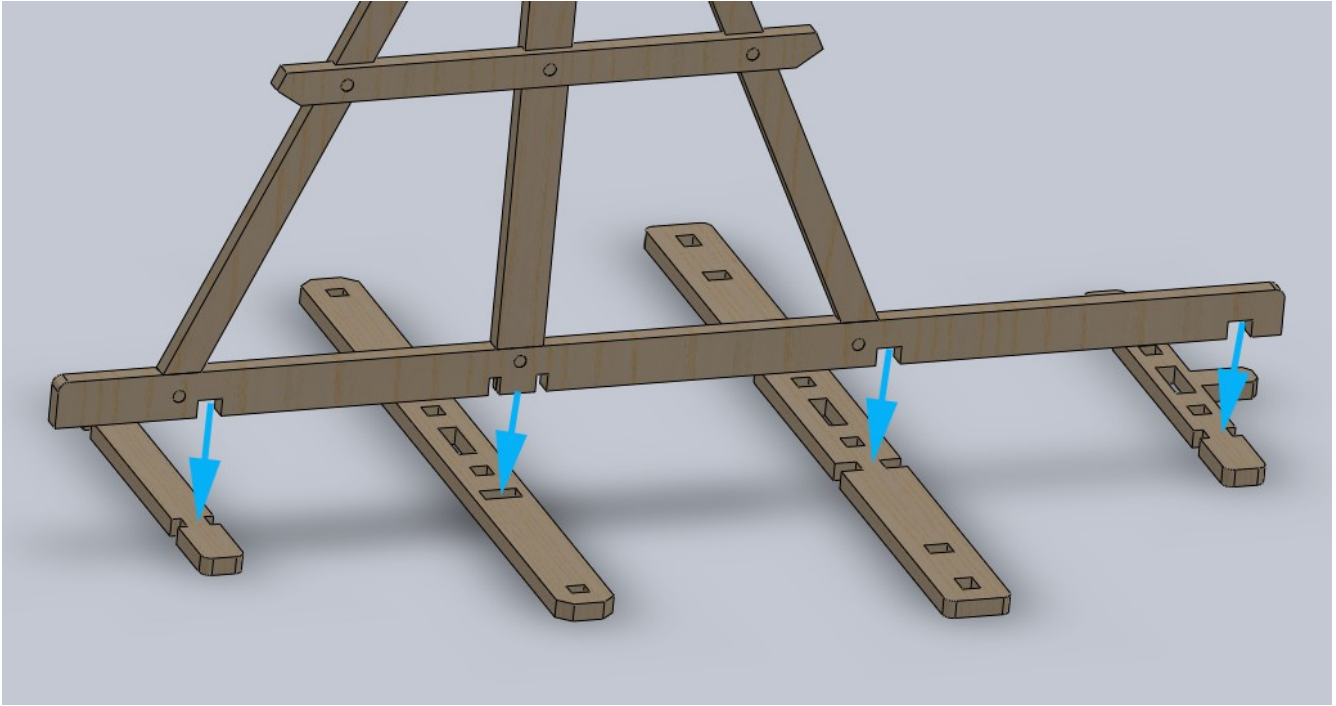
18. Locate the 4 foot pieces and lay them flat on table as shown. The T shaped is the rear of the trebuchet. You should choose the “best” side to be facing up. Note that for the modeler version of the trebuchet, the rear T shaped part must have the round cut out area facing down (see step 37 to understand why).



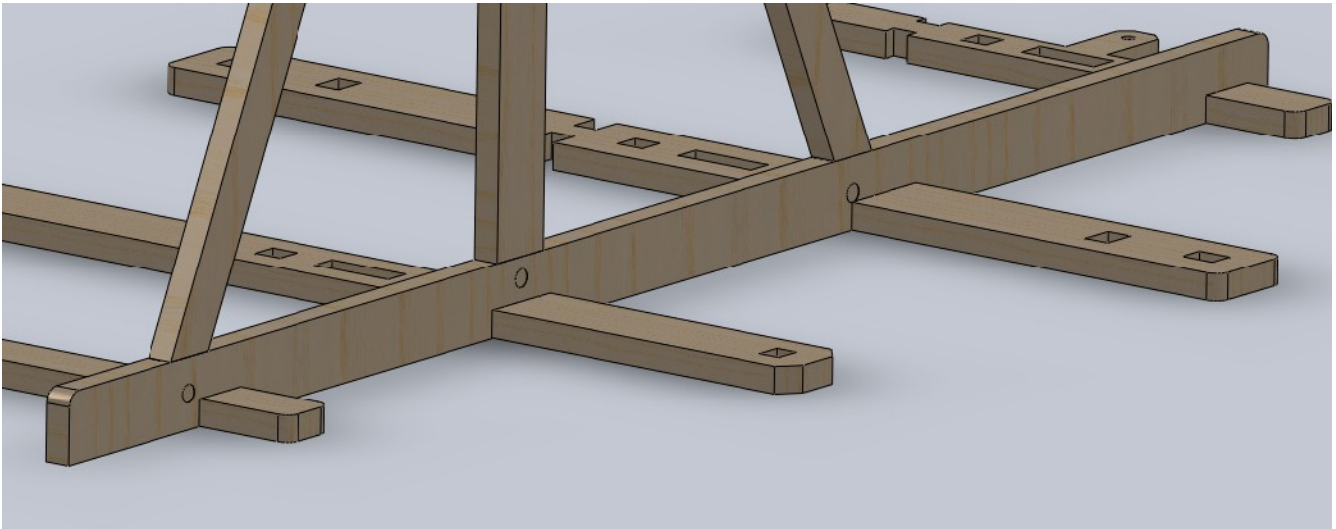
19. Apply glue to the bottom of the joint areas of the left A frame's base as shown.



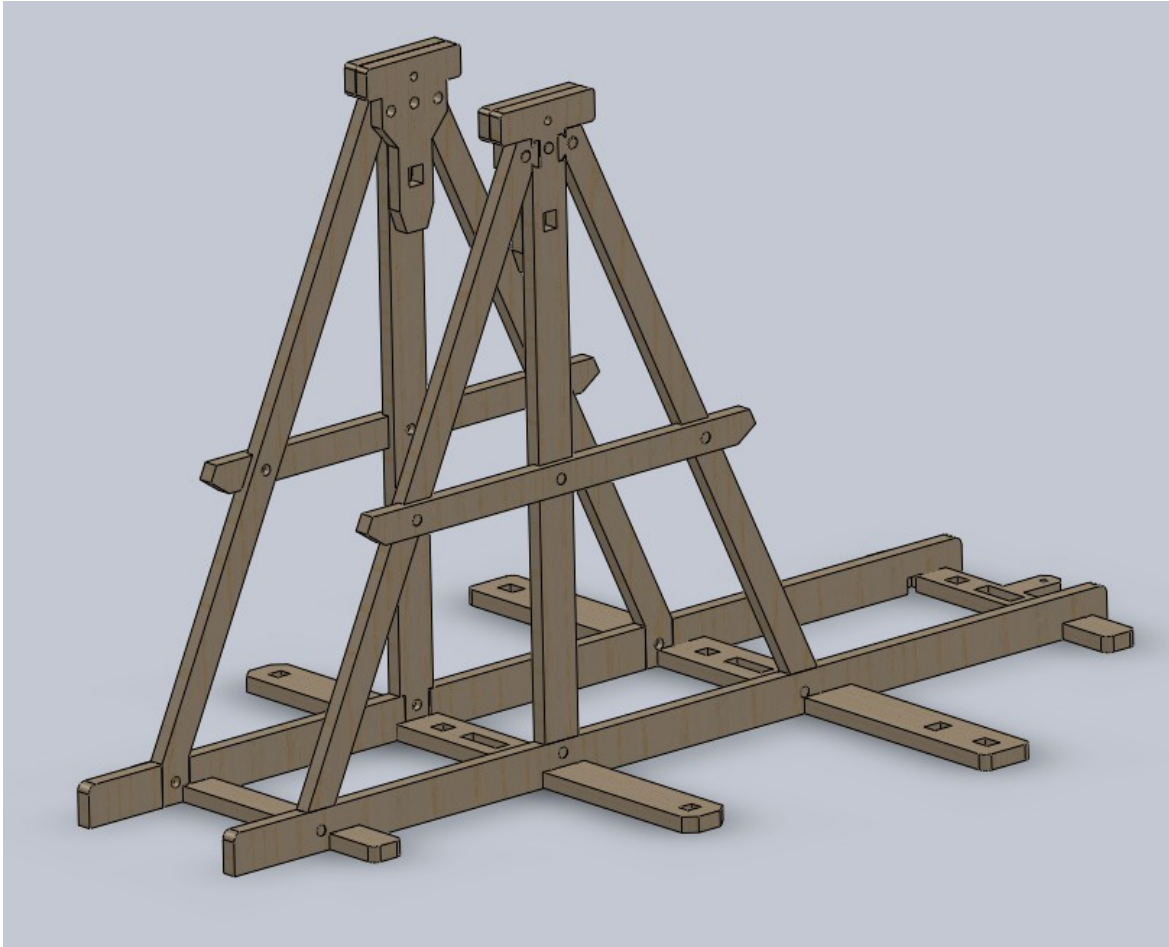
20. Fit the left A frame down onto the joints of the feet parts as shown. The axle block goes to inside and the horizontal cross piece (half way up the A frame) goes to the outside.



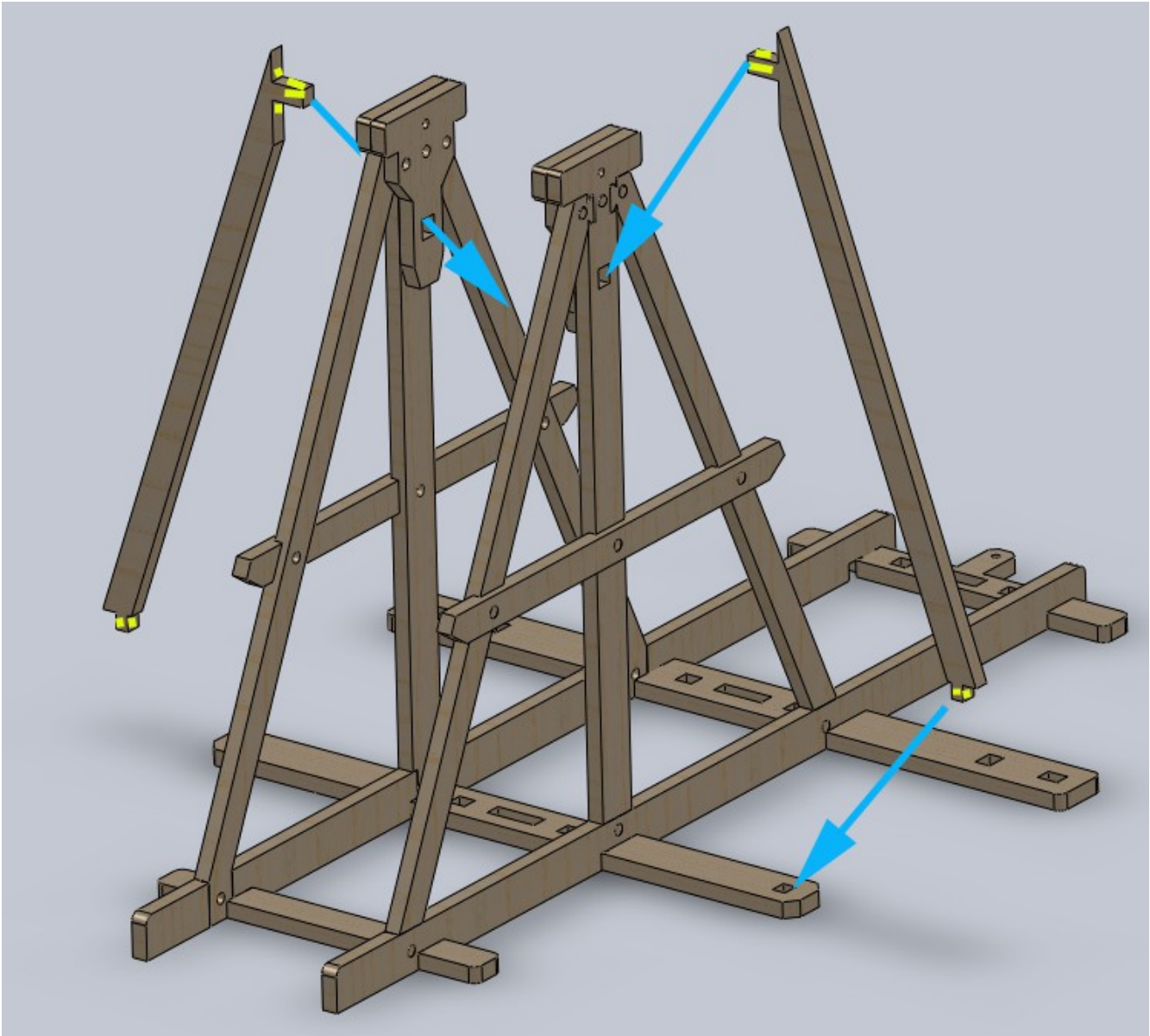
Detail of how step 20 looks when parts are fully seated is shown below



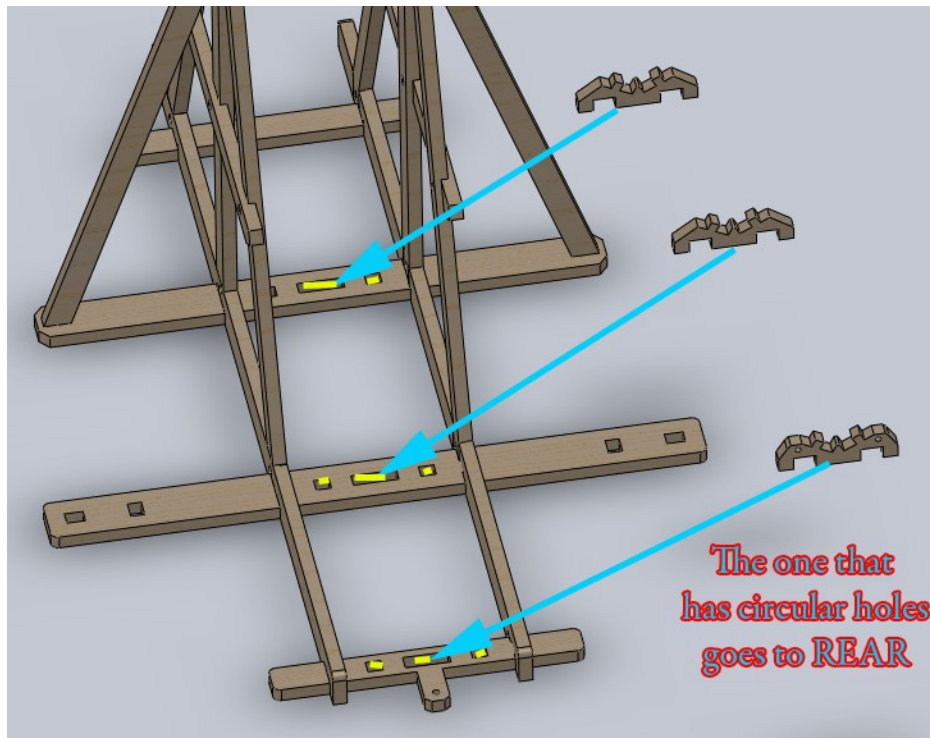
21. Repeat for the right side A frame. Again note that the axle blocks at top of the A frames both face inward, toward each other.



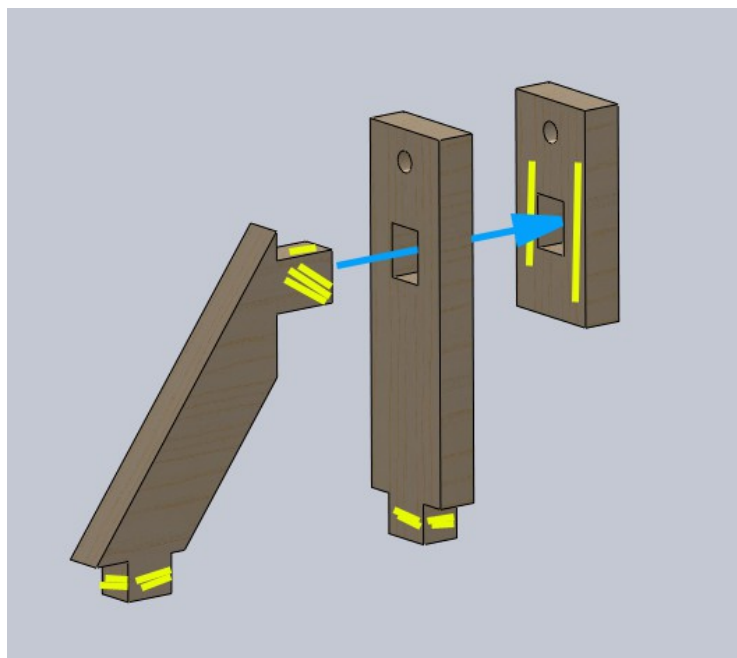
22. Locate the two side strut support parts. Apply glue to areas shown and install them onto the base and A frame assemblies on the both sides.



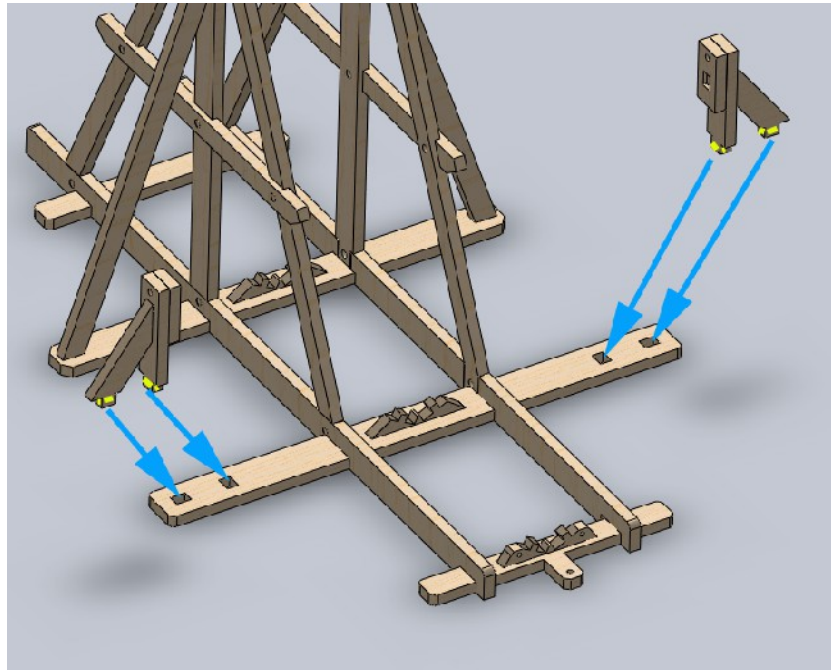
23. Glue and install the 3 trough support braces. Note that one of the braces has 2 circular holes cut in it. This one goes to the rear of the trebuchet.



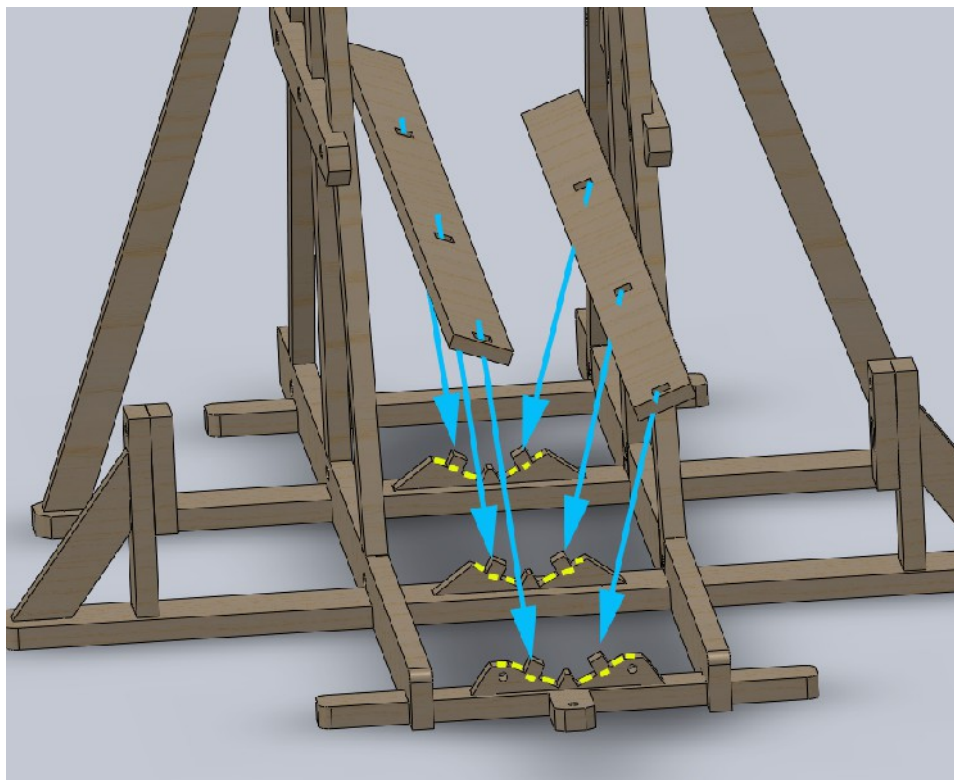
24. Assemble the wheel axle mount for the left side by gluing and installing the parts shown. Repeat this for the other side.



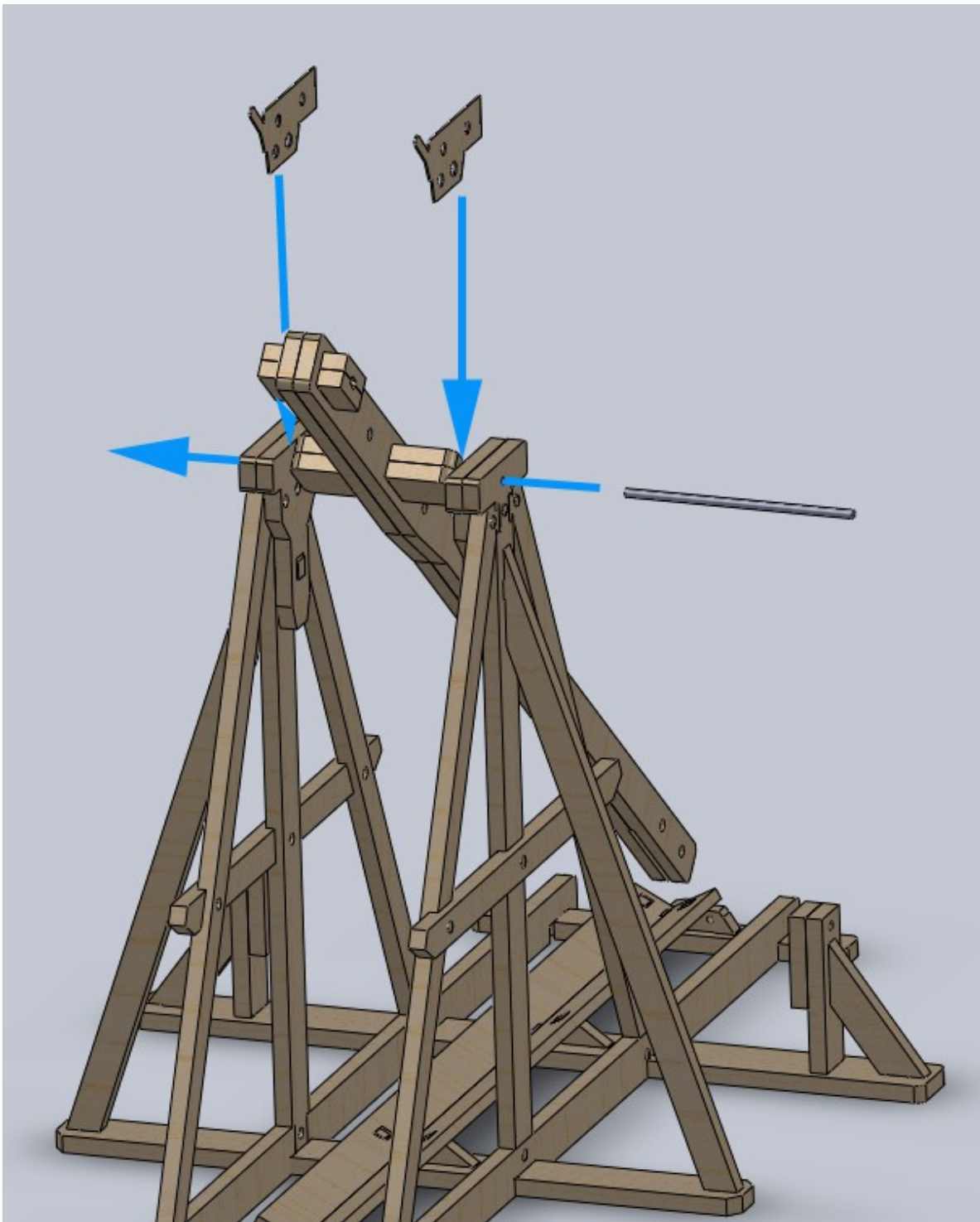
25. Glue and install the wheel axle supports onto the trebuchet frame as shown.



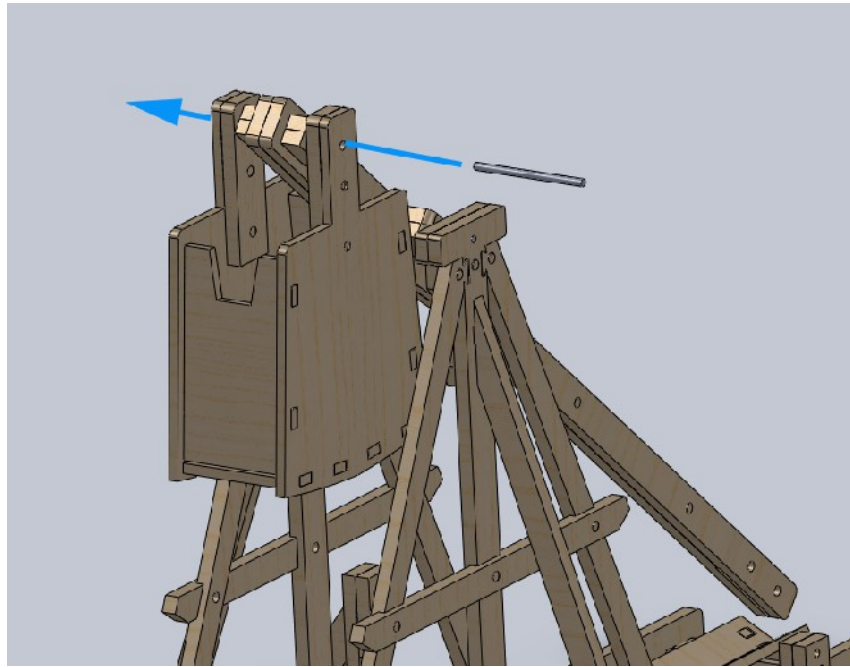
26. Glue and install the trough halves as shown. The square hole that is closest to the end goes to REAR of trebuchet.



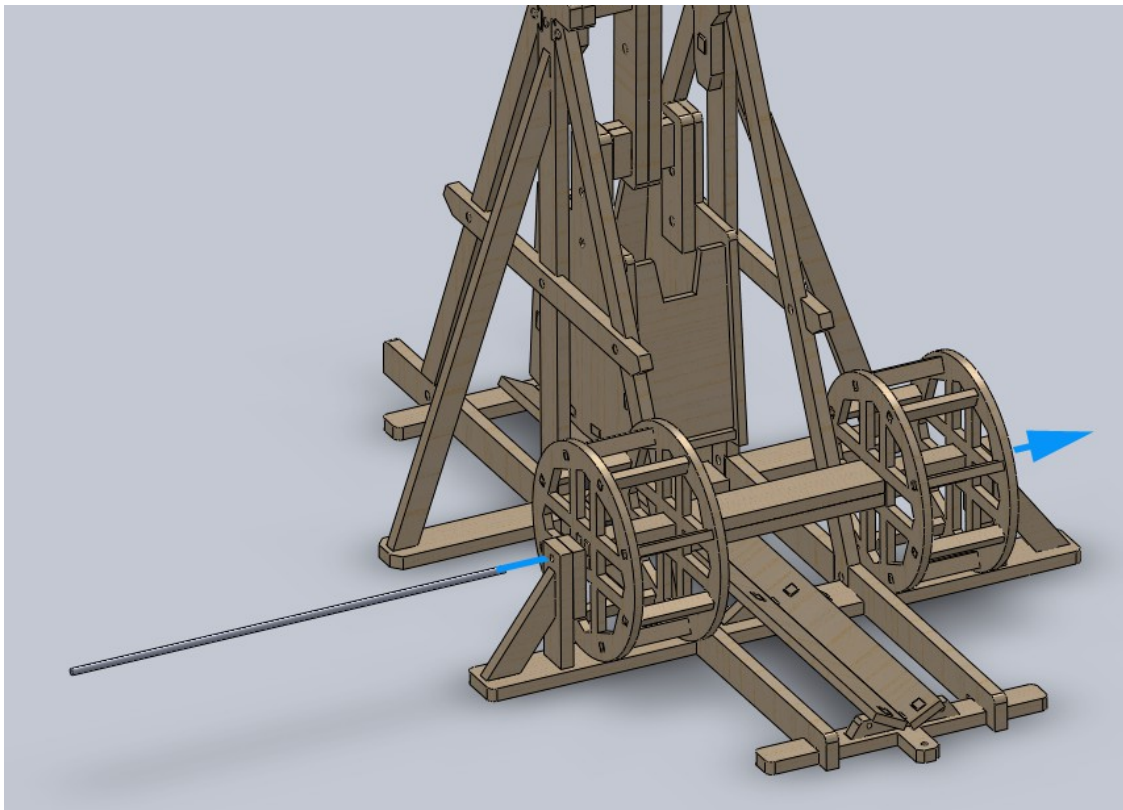
27. Temporarily install the throwing arm onto the A-frames with the middle length steel axle. The purpose of this will be to get the spacing correct between the A frames as the glue dries. You can insert two of the arm end pieces between the arm spacers and the A frame's axle block. No glue should be applied in this step. You can clamp the two A-frames together (you can use a rubber band if you don't have clamps) and let the glue dry. Ideally, let the parts sit overnight but at a minimum follow the directions for the glue that you use.



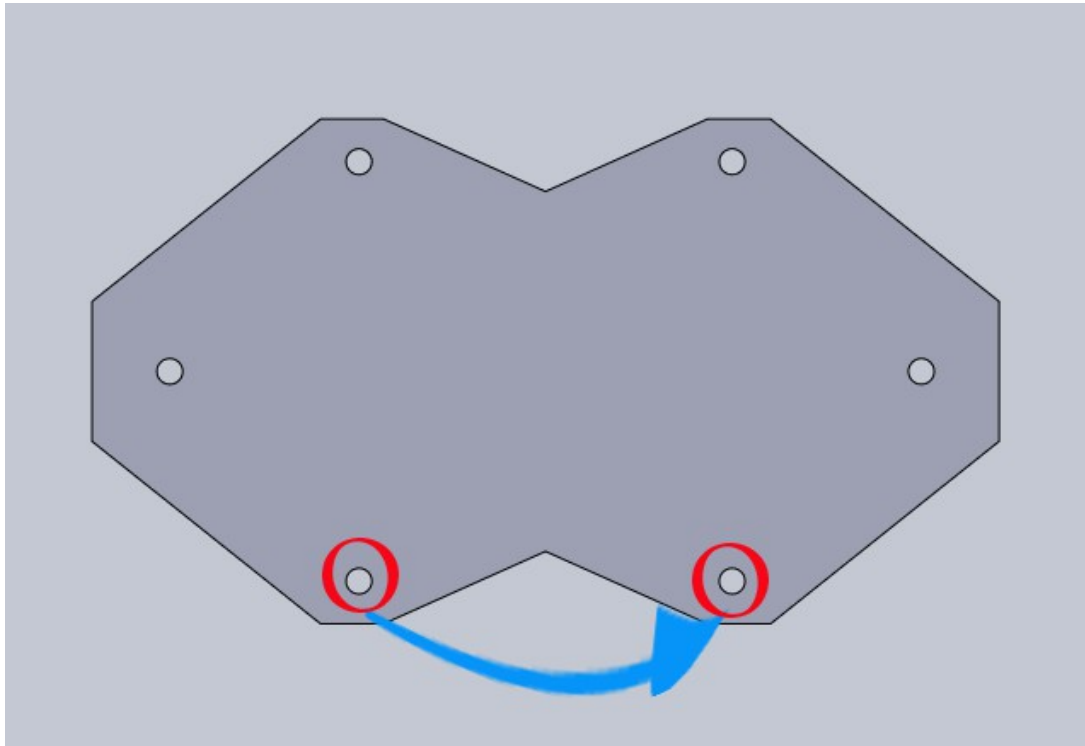
28. After glue dries, continue by adding the counterweight bucket to the throwing arm using the axle. No glue is necessary here at this point.



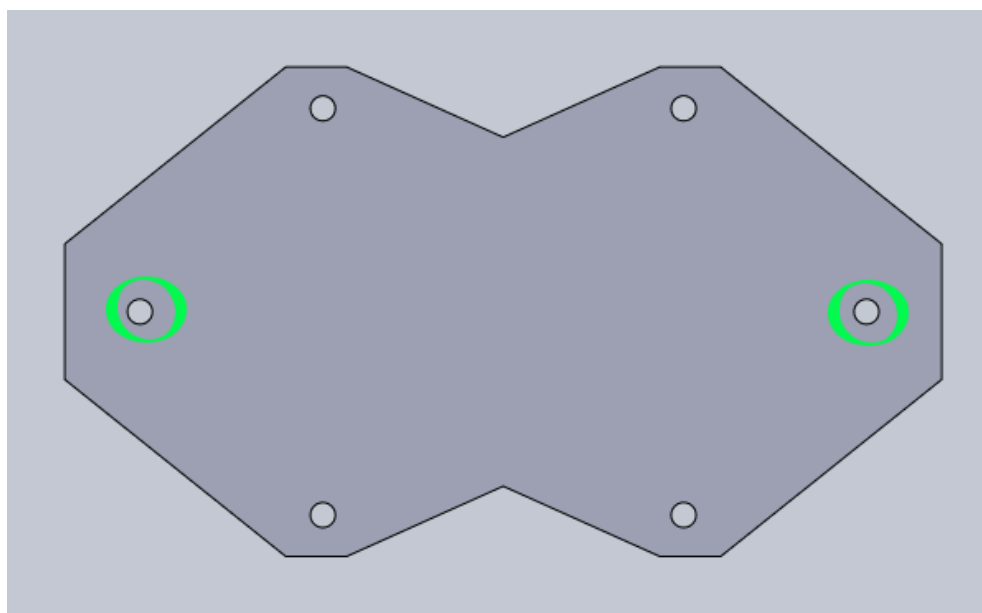
29. Add the wheel assembly with the longest axle onto the trebuchet frame. Again, no glue is necessary.

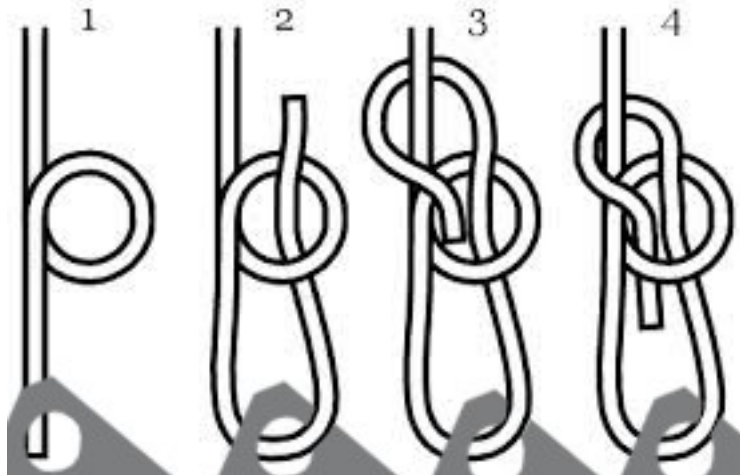


30. Make the sling pouch by folding the sling pouch material in two and then tying the two holes circled in red together. Note that if you have a leather sling, it is advisable that you put the smoothest side on the inside since the ammo will release better from a smooth surface rather than the rougher split leather side. Repeat for the other side of the sling.

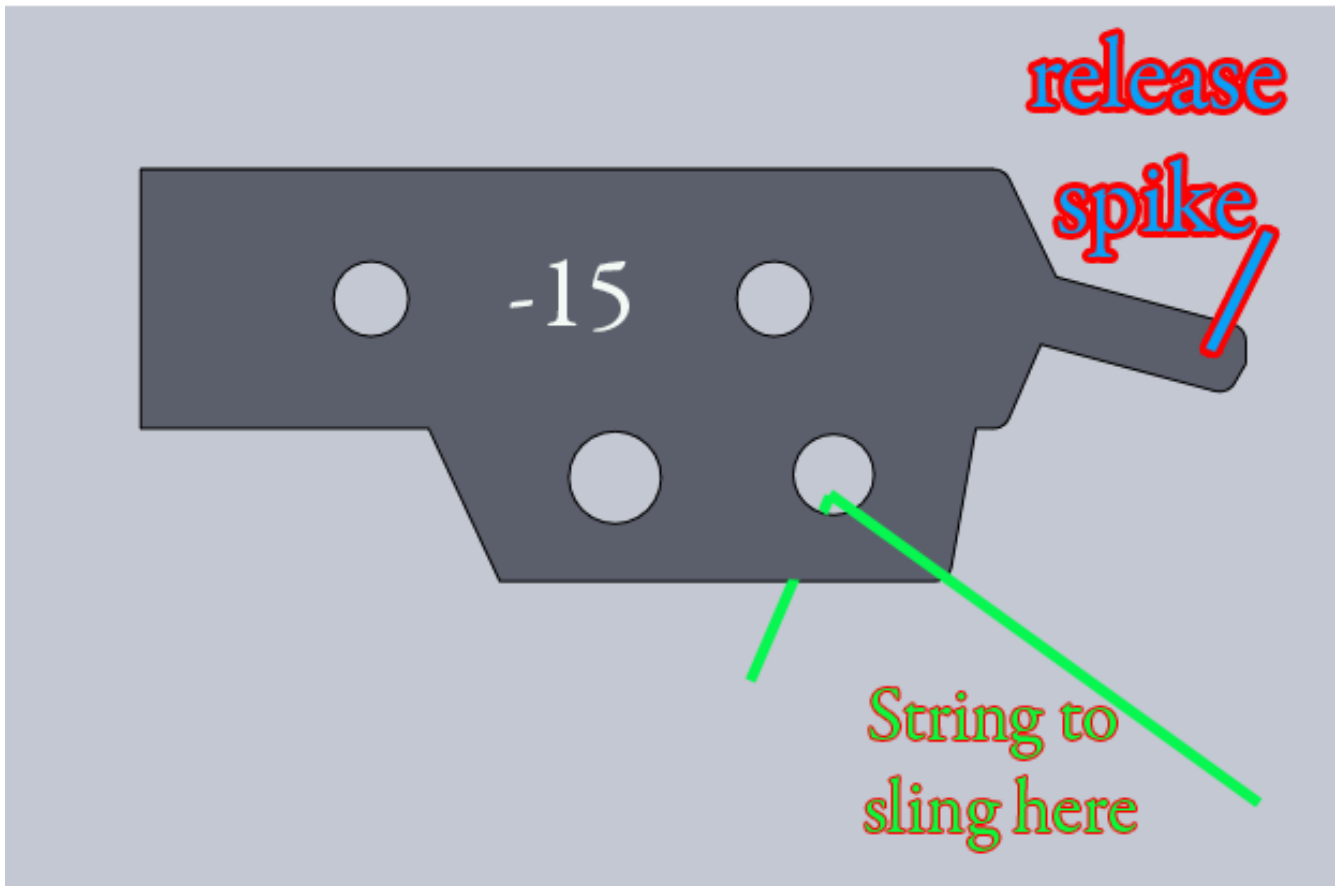


31. Take the two mid length pieces of string that are about 12 inches long and tie to the outside holes of the pouch (circled in green). It is suggested that you use a bowline knot for this attachment. See illustration for how to tie this knot.

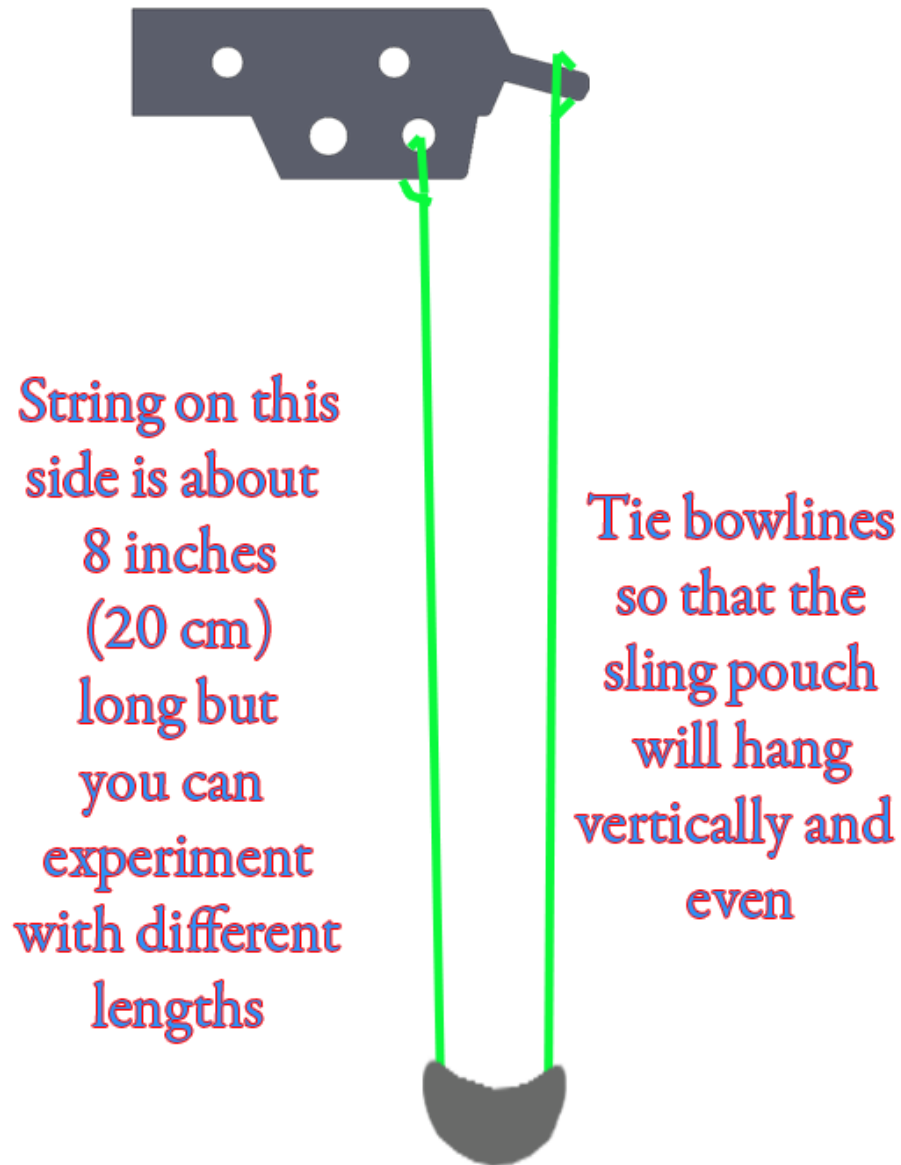




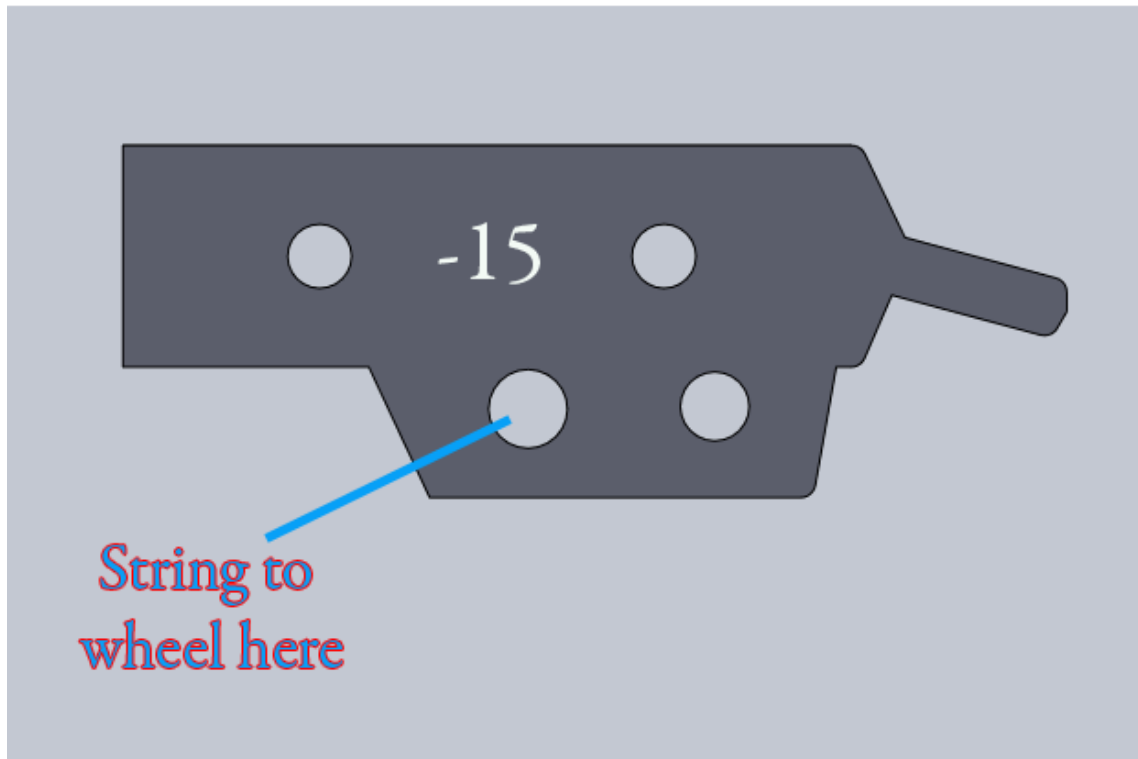
32. With one of the two sling strings, tie a bowline to the rear hole in the arm end piece of your choice. It is recommended that you start with the part marked “-15” (for negative 15 degrees). As you experiment with different ammo types and weights, you may change to another angle setting, but start there for now. Tie the bowline knot so that the distance from the hole to the end that is tied to the sling is about 8 inches long.



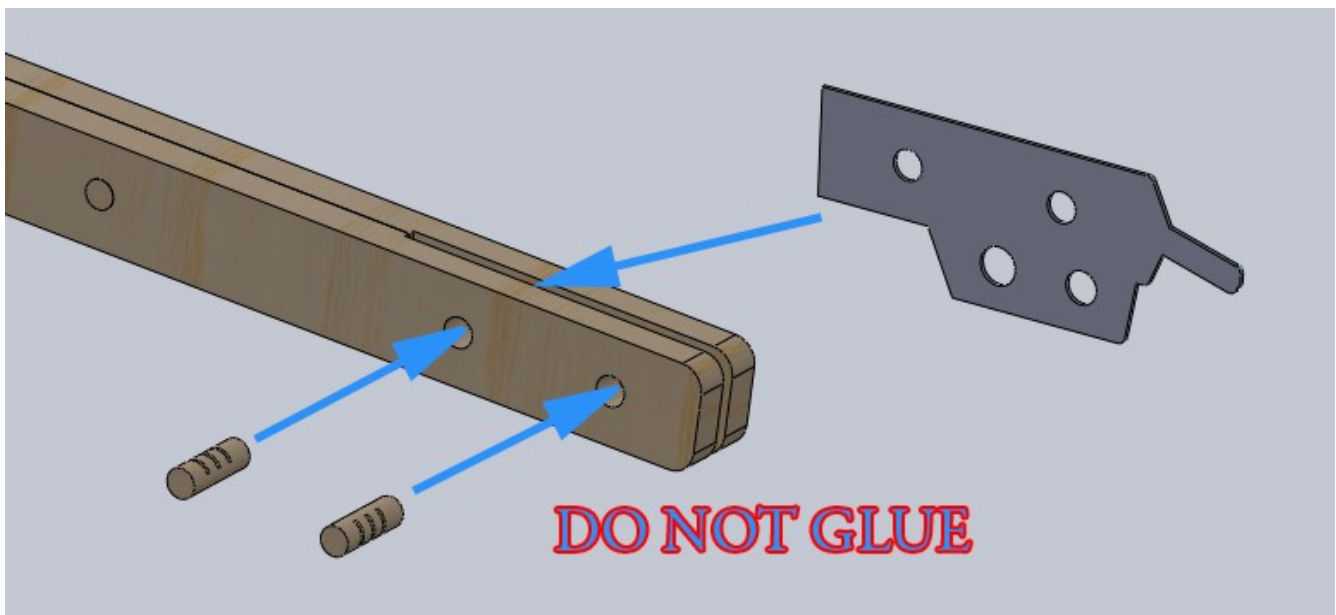
33. On the other sling string, tie a bowline loop in the end. This loop will slip onto the release spike of the arm end part. The length of this string will be slightly different from the other. Tie the loop so that when the loop is on the release spike, the sling pouch will hang evenly between the two strings.



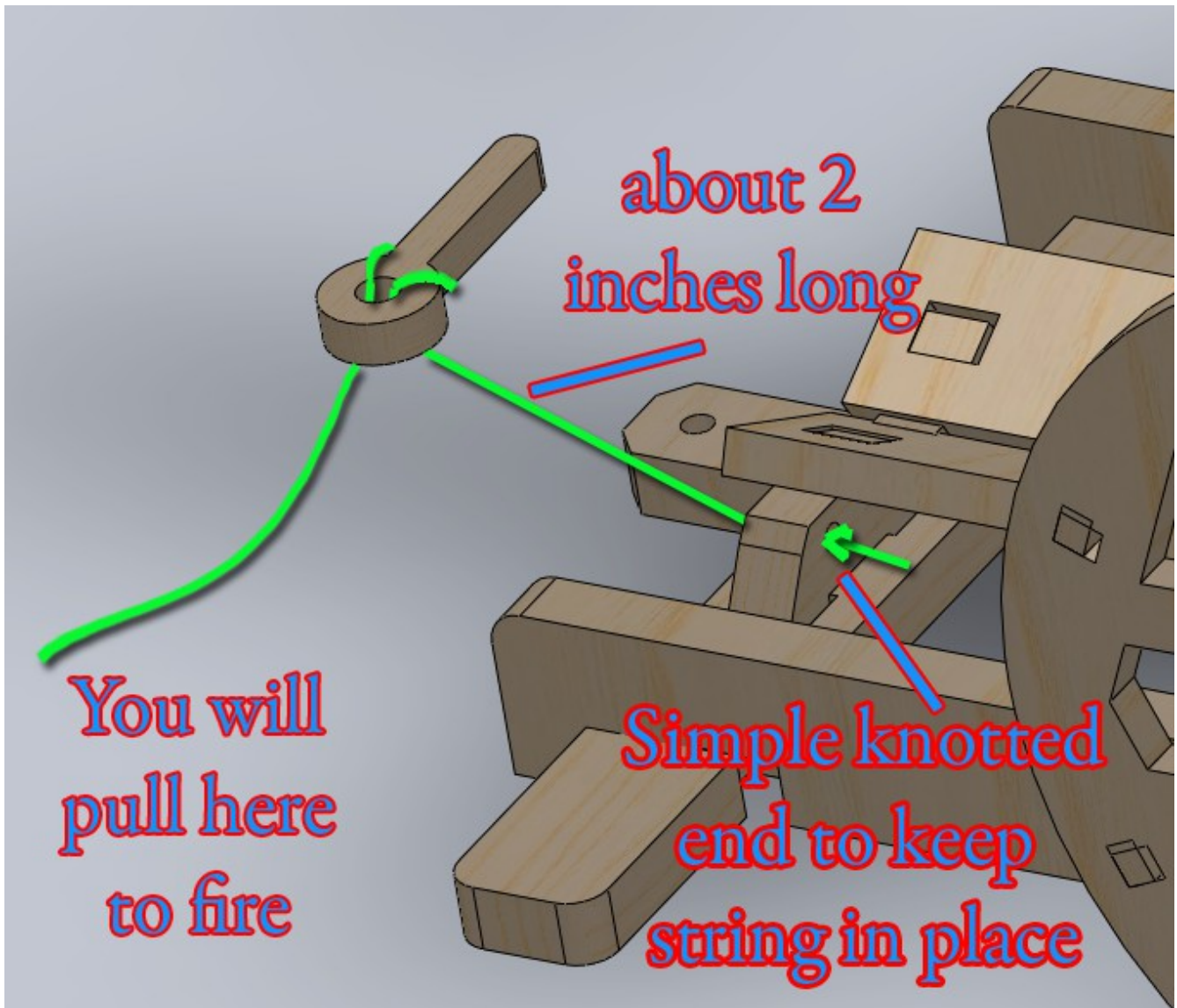
34. With the longest string, tie a bowline to the other hole in the arm end piece as shown.



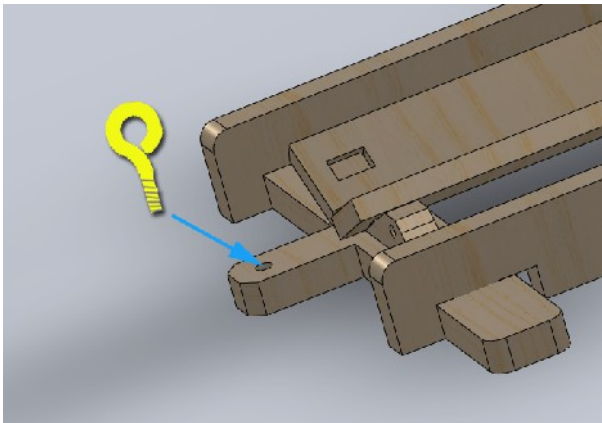
35. Insert the arm end piece into the arm's slot and insert two of the 3 mark dowels to hold it in place. **DO NOT USE GLUE** in this step. Later, you can replace the arm end piece by removing the dowels if desired. The strings are not shown here for clarity.



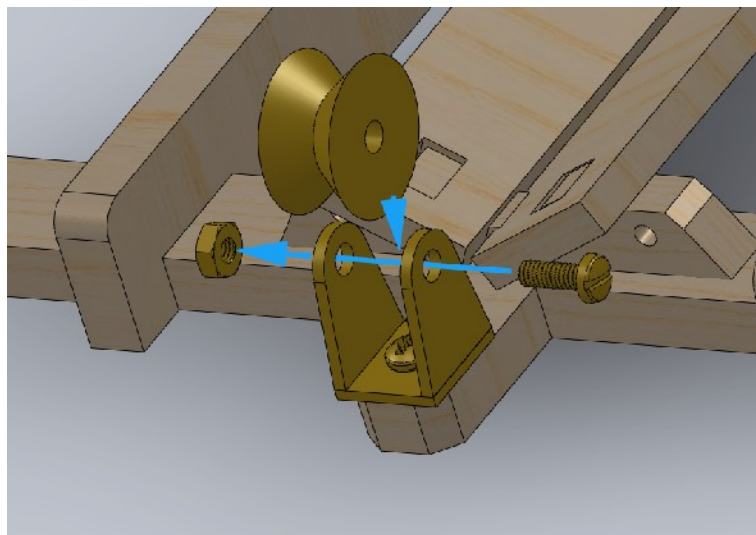
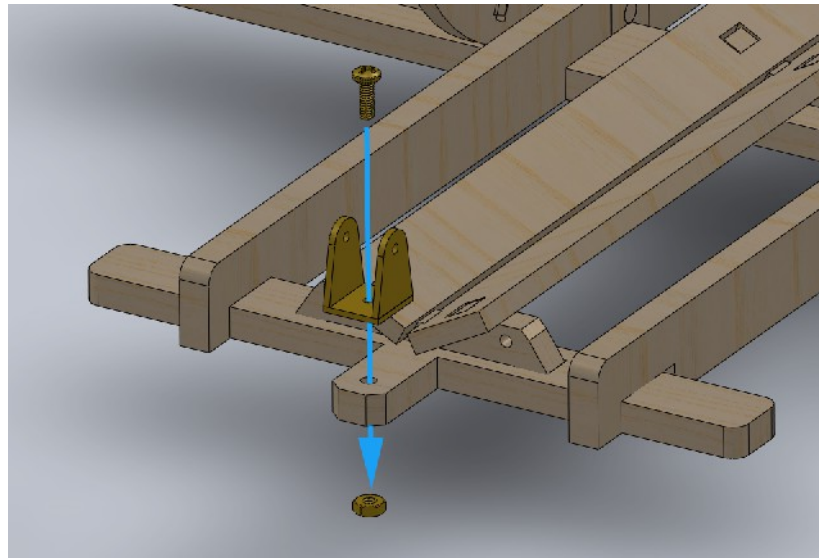
36. Locate the release pin and the remaining short string. Tie a simple knot into the end of the string. If you are left handed, you will probably want to insert string on the other side of the trebuchet. Then run the other end of this string through the hole in the rear trough support. Form a loop at about 2 inches (5 cm) from the trough support and pass the loop through the hole in the release pin. This will give you a string to pull on to fire the trebuchet and also keep the release pin from getting lost. Lay the release pin down for now.



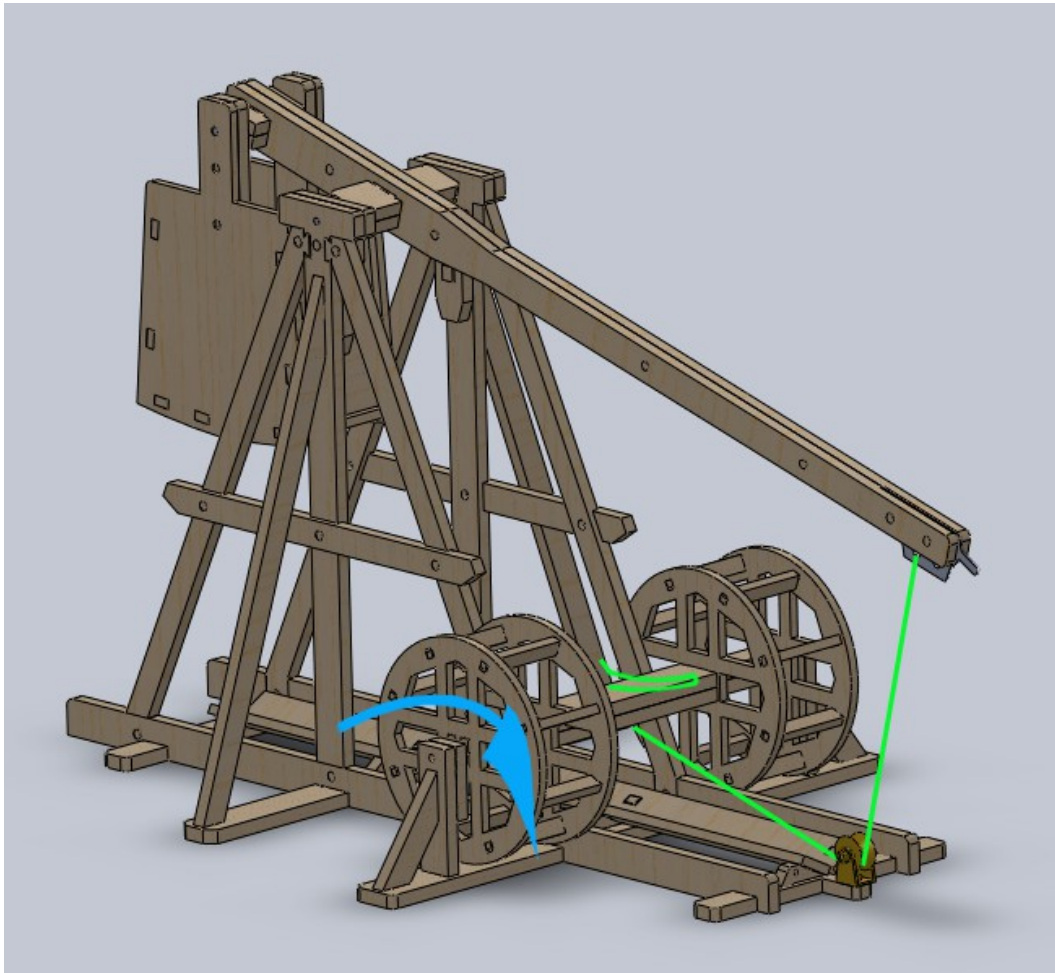
37. Attach either the the eye ring screw or if you have a modeler kit, mount the pulley onto the rear foot piece. Use the Philips head 6 mm M2 screw and M2 nut.



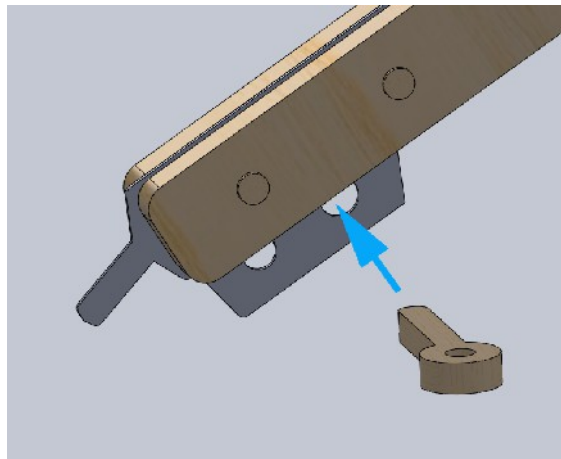
For modeler version, attach the pulley. The nut will seat inside a cut out area in the rear foot bottom.



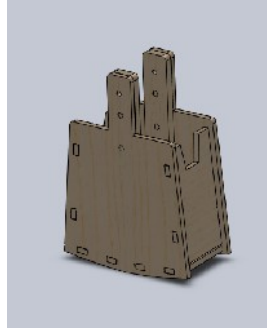
38. Thread the long string through the eye screw or pulley and then lay a loop onto the axle. Rotate the wheel to wind the string onto the wheel which will pull down the arm.



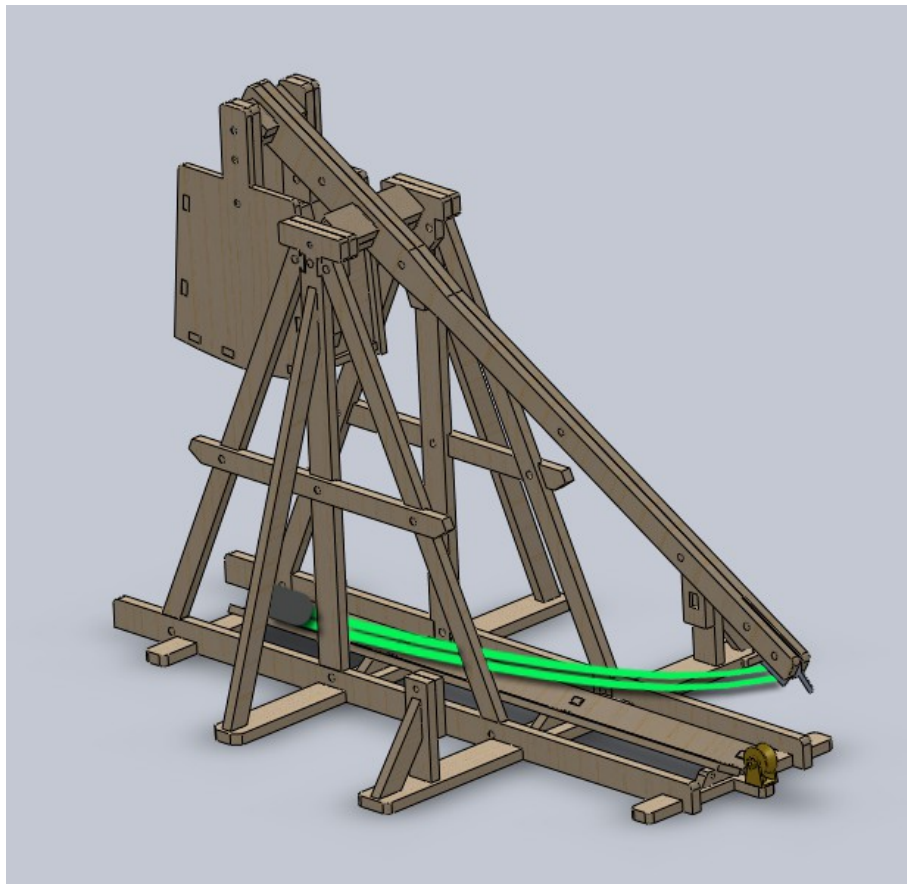
39. Insert the release pin into the same hole as the wheel's string to hold the arm in place. Strings are not shown for clarity.



40. You can fill the counterweight bucket with material of your choice. It is easiest when filling the counterweight bucket to remove it by first removing the axle. The heavier the counterweight is, the longer range you will have. A good material to use here is copper “bee bees” which are used in air pistol bee-bee guns and available at many sporting goods stores. But gravel, sand, marbles, or just plain dirt will work as well. It is good to experiment with different materials and observe the effect on range.



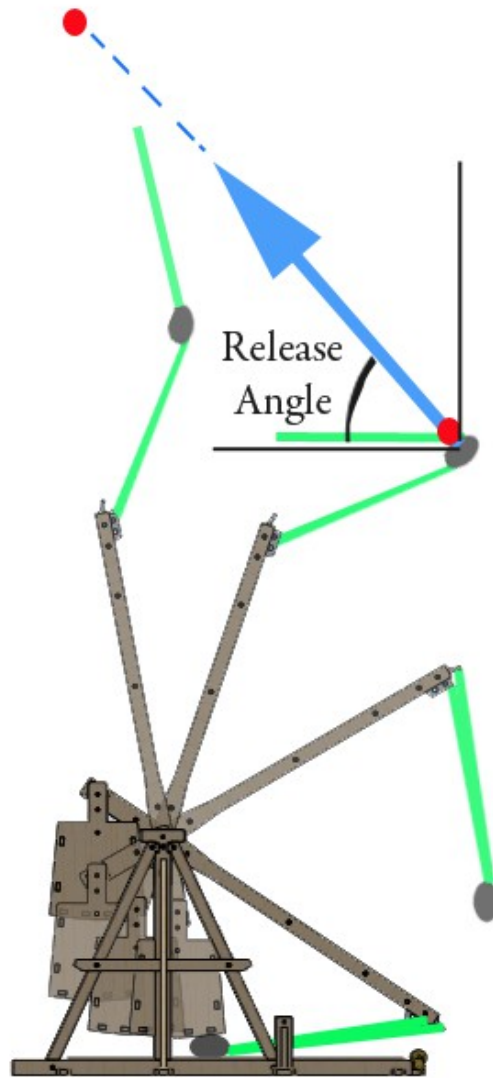
41. Load the trebuchet by placing ammo into the sling and then running the strings beneath the wheel. The sling lays into the trough. The wheel is not shown here for clarity. If you will be firing the trebuchet, you might consider removing the wheel, its axle and string entirely as these will impede loading and slow down the process. Replace the wheel when you want to display the completed trebuchet.



42. Fire the trebuchet by pulling on the release pin's string.

Analyzing and Fixing Problems with firing: The trebuchet is a complex machine and the first time you fire it, you will likely have problems. The ammo will be thrown in the ground only a short distance away, or the ammo won't be thrown at all, or it will throw straight into the air, etc.

To address these problems, you must understand how the machine works. Consider the diagram below. It shows the trebuchet starting at rest. Green lines are the strings, the pouch is gray. As the arm is released, the sling is pulled up with the arm. On the 3rd step, the sling's loop string slides off of the release spike, allowing the pouch to open. The red dot is the ammo. At this point the ammo is thrown up and forward at the RELEASE ANGLE.



Common problems and how to fix them:

Ammo is thrown into ground only short distance in front of trebuchet - Likely, the ammo is being released too late. You should try using a more negative angle on the arm end piece, like -30 or -45.

Ammo is thrown nearly straight up or even backward - This happens with the ammo is released too early. You should try an arm end piece with more positive angle. Like 0 or +15.

Ammo is not released at all - Likely, the pouch is not opening or the ammo is sticking to the pouch. Check that the pouch can open easily. You may also add talcom powder or even common kitchen flour to the pouch to aid in releasing ammo. If you are trying to throw a rock or something that does not have smooth edges this is likely to happen.

Range is too short – This can be many things. Release angle, not enough weight in the counterweight, or the length of the string is too short, or the ammo is too heavy. Fire a few times and concentrate on seeing how the ammo is released. Does it release at about 45 degree angle? If not, vary the arm end piece or the length of the strings.

Arm swings slowly or erratically – check that the arm can swing freely and that the axle is fully seated on both sides. You may need to reset the A-frame pieces to allow good clearance if they are pinching the rotating action of the arm at the spacers. You may be able to fix this also by removing the axle and sanding the arm's spacers, then replacing the arm and trying until the spacing allows free motion.