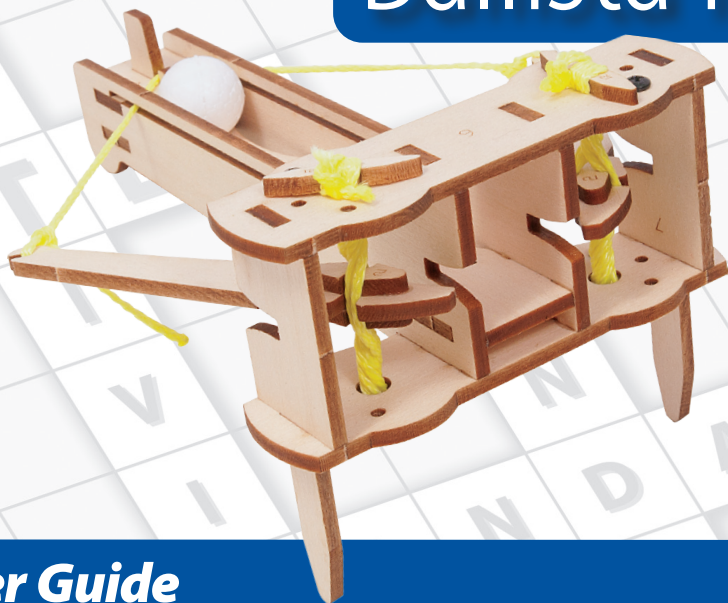


Torsion Ballista Kit



User Guide

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EDUCATION

60001 V1022

Cautionary and Warning Statements

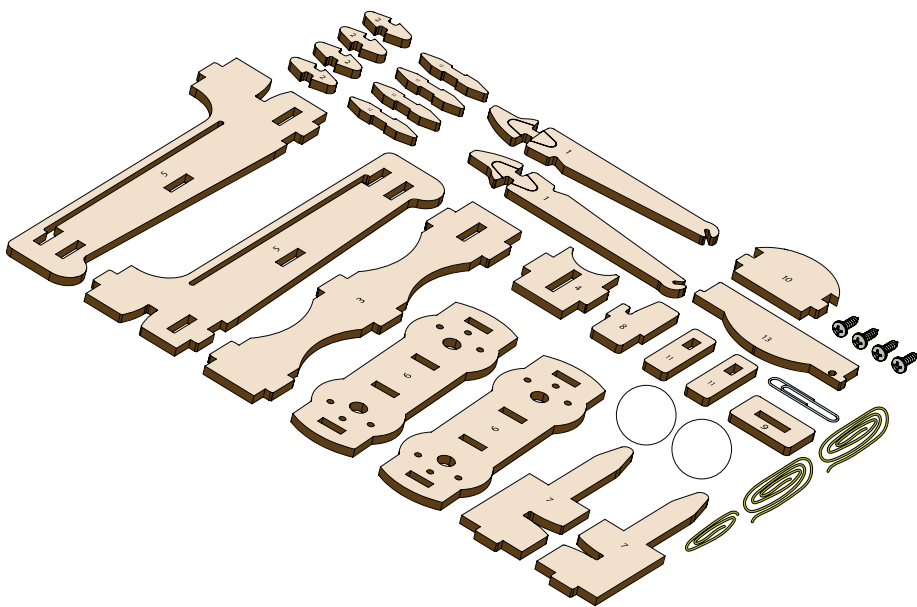
- This kit is designed and intended for educational purposes only.
- Use only under the direct supervision of an adult who has read and understood the instructions provided in this user guide.
- Read warnings on packaging and in manual carefully. Use this device only as directed.
- Anyone operating the Torsion Ballista or nearby during its operation should wear safety glasses.
- Never use a sharp object as a projectile. Never fire at a living thing.
- Use this device only in the manner discussed and illustrated within this guide. Misuse of this product can cause serious injury.
- Do not aim at people.
- Always exercise caution when using sharp tools.

How It Works

During the Middle Ages, people used torsion as the force to operate a catapult. Torsion is the strain in a material that is twisted – when the material is released, it resists this strain by unwinding. Catapult operators twisted ropes tightly around the catapult arm and then released them. The catapult's arm would react by springing up and releasing the ammunition. The same principle is used to power this kit.

Materials Included

- 2 basswood sheets with laser-cut parts
- 4 screws
- 3 pieces of string
- Paper clip
- 2 Styrofoam balls (projectiles)



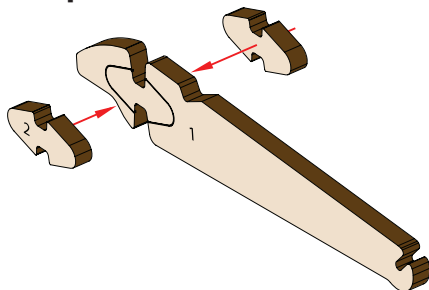
Items Required (not included)

- Small screwdriver
- Ruler
- White glue (such as HD Bond II)
- Needle-nose pliers (optional)
- Scissors

Assemble the Bow Arms

1. Pop out the parts from the basswood sheets. Note they are numbered for construction purposes.
2. Lay a Part 1 faceup. Glue a Part 2 over the notched area on the outline that fits Part 2. Repeat this for another Part 1 and 2.
3. When the glue is dry, turn over each Part 1 and glue another Part 2 on the other side as shown. Let dry.

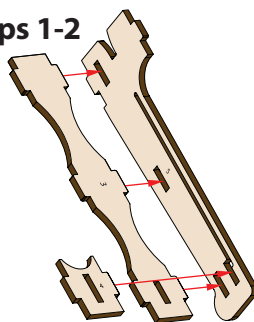
Steps 2-3



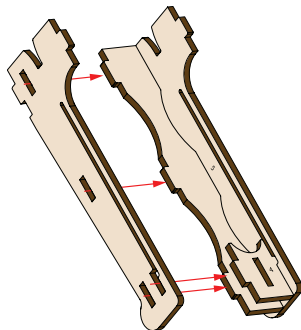
Build the Housing Frame

1. Glue Part 3 into the three notches so it is perpendicular to Part 5. Make sure that the slot in Part 3 is toward the narrow end of Part 5.
2. On Part 5 is a long, narrow slot. Glue Part 4 into this so it is perpendicular to Part 5. Make sure the curved side of Part 4 faces as shown.
3. Glue the other Part 5 on top of Parts 3 and 4 so it is parallel to the first Part 5.
4. Without glue, insert the square end of Part 8 into the groove on Part 4 of the housing frame. The top of Part 8 has a hook cut into it – the hook should face the inside of the frame.
5. Under the frame, Part 8 will extend a bit – place Part 9 over it. Push up on them until the bottom of the Part 8 hook is level with Part 4. Add a dab of glue around the outside of Part 9. Let dry.

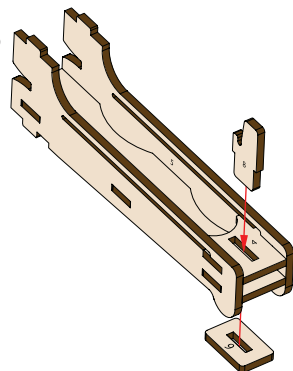
Steps 1-2



Step 3

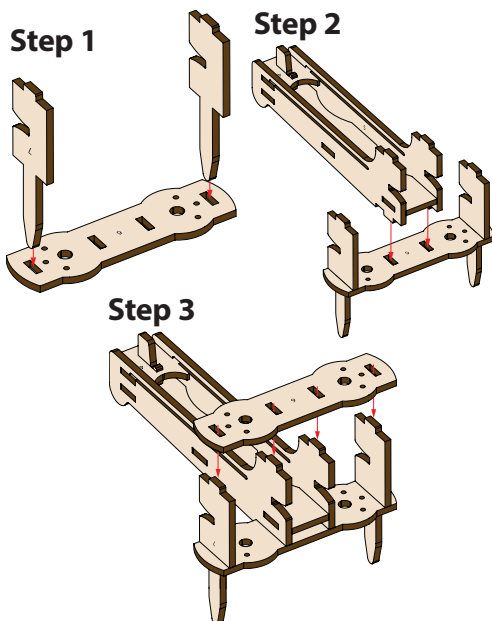


Steps 4-5



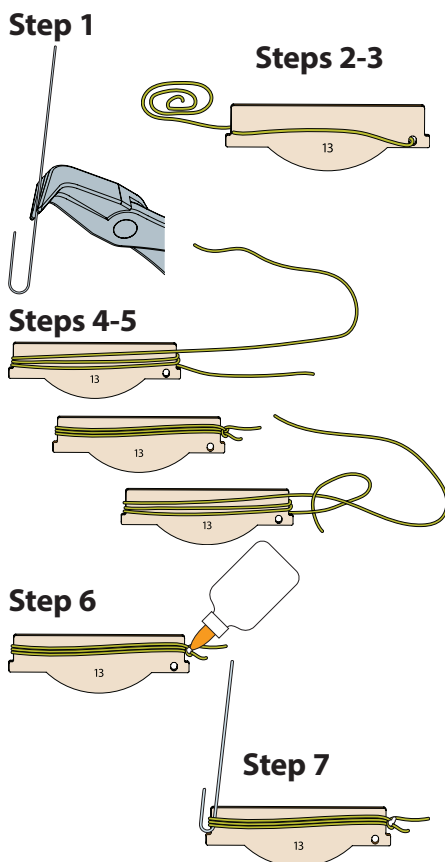
Add the Bow Arm Frame

1. Take a Part 6 and glue the leg of Part 7 into a slot on one of the ends of Part 6. Repeat with the other Part 7 in the other end of Part 6. Make sure the notches on each Part 7 face the same direction.
2. Glue the notches on the bottom front of the housing frame into the slots of the Part 6 that has the Part 7s attached. Do this so the Part 7 notches face the back of the ballista.
3. Glue the other Part 6 on top of the four notches of Parts 7 and the housing frame. Let dry.



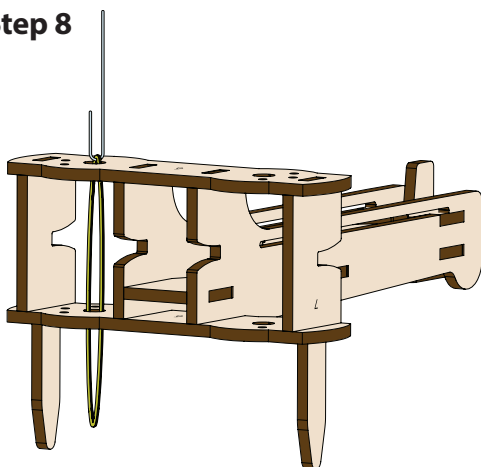
Attach the Torsion String

1. Straighten the paper clip except for a hook at one end.
2. Locate Part 13 and the string. This part will help create the loops of string that will be needed for the torsion component of the ballista.
3. Take one end of the string and thread it through the hole on Part 13. Pull enough string to equal the length of Part 13.
4. Loop the string around Part 13 three times so you have three complete loops.
5. With the string still wrapped around Part 13, pull the string out of the hole. Now, take the two ends of the string and tie them in a knot.
6. Place a dot of glue on the knot to hold it in place. Let it dry.
7. Use the paper clip to remove the knotted and glued string from Part 13.



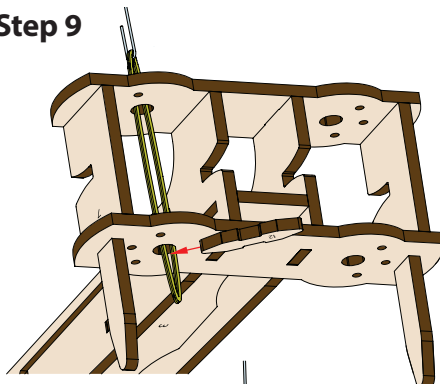
8. Use the paper clip to thread the string through one of the big holes on top of the bow arm frame, taking the paper clip out the opposite hole as shown. Do not pull the string through all the way – leave a loop of string above the frame.

Step 8

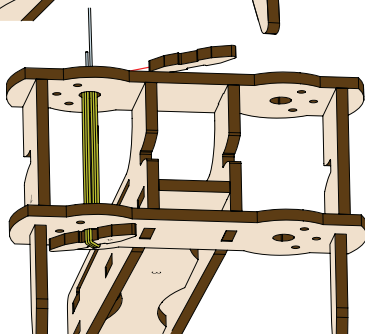


9. Insert a Part 12 (keeper) into the loop. Pull the string tight. With the loop on the end with the clip hook, insert another keeper. Remove the hook.

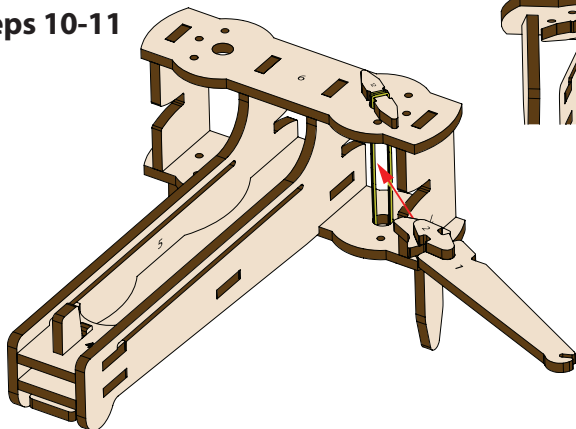
Step 9



10. Separate the six strings into two sections, making an opening between the sections.
11. Insert the wider end of one bow arm in between these string sections so the grooves on either side of the arm fit into the bow arm frame as shown.

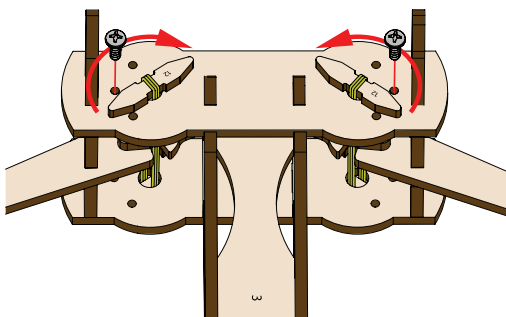


Steps 10-11



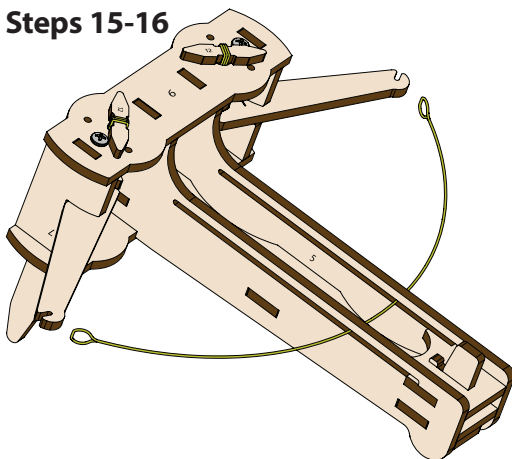
12. Turn the string keeper on top one time in the opposite direction that the bow arm works (for the right arm, turn counterclockwise; for the left arm, turn clockwise). Holding the top keeper in place, turn the bottom keeper one time in the same direction as the top.

Steps 12-14



13. Place a screw on the top and bottom of the bow arm frame to hold the keepers in place.
14. Repeat the procedure in Steps 2-13 for the other side of the ballista, making sure to turn the string clockwise. Try to make the tension between the two arms even.

Steps 15-16

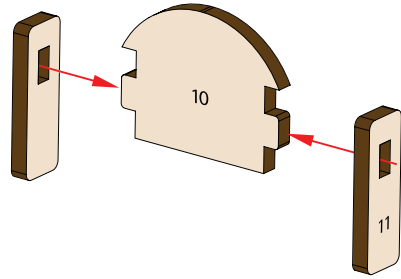


15. Take the extra string and tie one end around the groove at the end of a bow arm. Thread the string through the long narrow grooves on Parts 5.
16. Tie the other end to the other bow arm so the string is snug and pulling back the arms just a few millimeters. Make sure the bow arms are even and then apply some glue to the string knots.
17. If needed, remove the screws and even the tension in the two bow arms. Then, replace the screws.

Get Ready to Launch

1. Gather all Parts 10 and 11. Glue the Parts 11 onto either side of the Part 10. Let dry.
2. Check all your joints and make sure everything moves freely. You are ready to test your ballista!

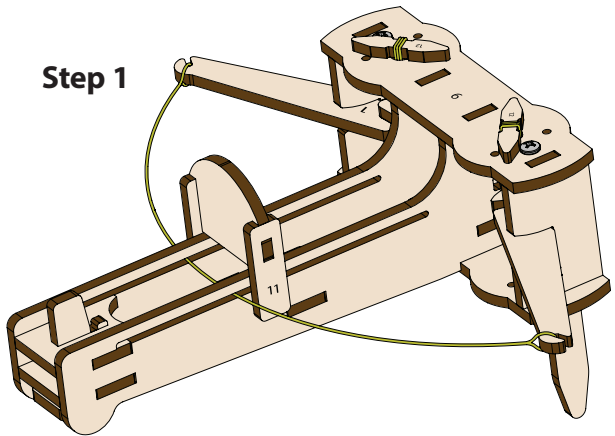
Step 1



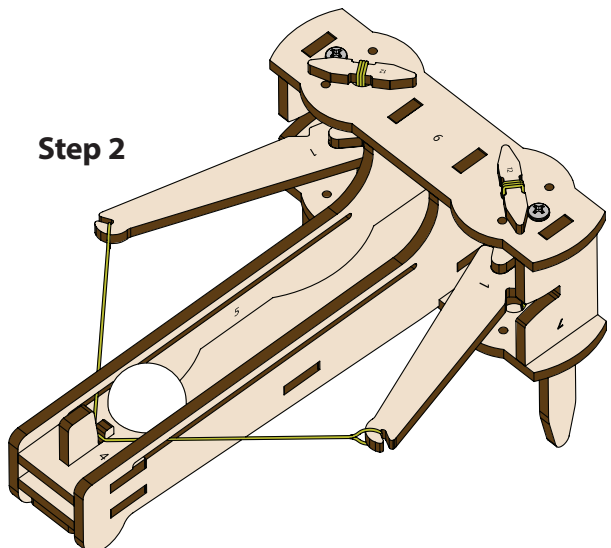
Ready, Aim, Fire!

1. Carefully, place the ballista where you wish to fire it. Holding onto the ballista at the back end with a finger under the trigger (Part 8), use the device made in the previous section to pull back the string to the trigger (Part 11), use the device made in the previous section to pull back the string to the trigger. Holding it in place, push up the trigger to secure the string.
2. Place a Styrofoam ball in front of the trigger. Push down the trigger, and the ball will fly!

Step 1



Step 2



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