The bots are assembled from four components built separate from one another: the base, the stand, the arm, and the hydraulic system. The hydraulic system uses plastic syringes as pistons and water as the hydraulic fluid.

Step 1: Materials, Tools, and Design Criteria

- Craft sticks
- Craft cubes
- Cubes with 5/32" hole (larger pack size)
- 1/8" dowels
- Decorative woodcraft (optional)
- 10ml Luer slip plastic syringes (larger pack size)
- Vinyl tubing
- Adhesive bumpers
- 4" cable ties
- Hot glue guns
- Hot glue sticks
- Utility cutter
- Food dye for coloring water (optional)

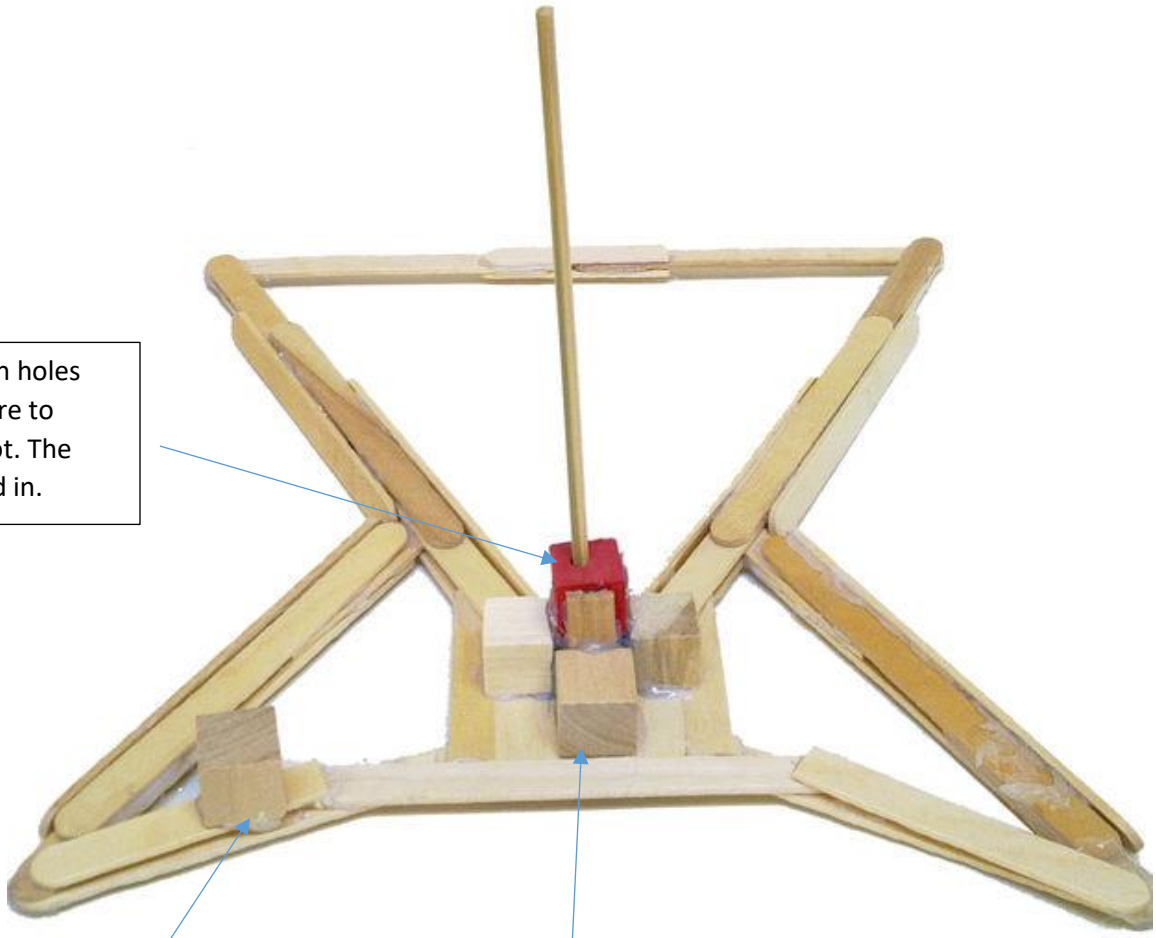
JudoBot Criteria

1. The base of each JudoBot must fit within a 10-inch square. This is to prevent students from building sprawling robots that cannot be flipped.
2. Material limitation: craft sticks (50), craft cubes (10), cubes with holes (10), syringes (4), adhesive bumpers (10), decorative woodcraft/extra woodcraft (5), everything else within reason.

Material limitations are in place to promote resourcefulness and to reduce cost. Also, clever students can no longer pile hundreds of sticks onto their bot in order to make it too heavy to move.

You may choose to use other materials. This is what I use because I need to streamline my materials to fit with the other projects in my program, as well as keep the cost per project low.

Step 2: The Base

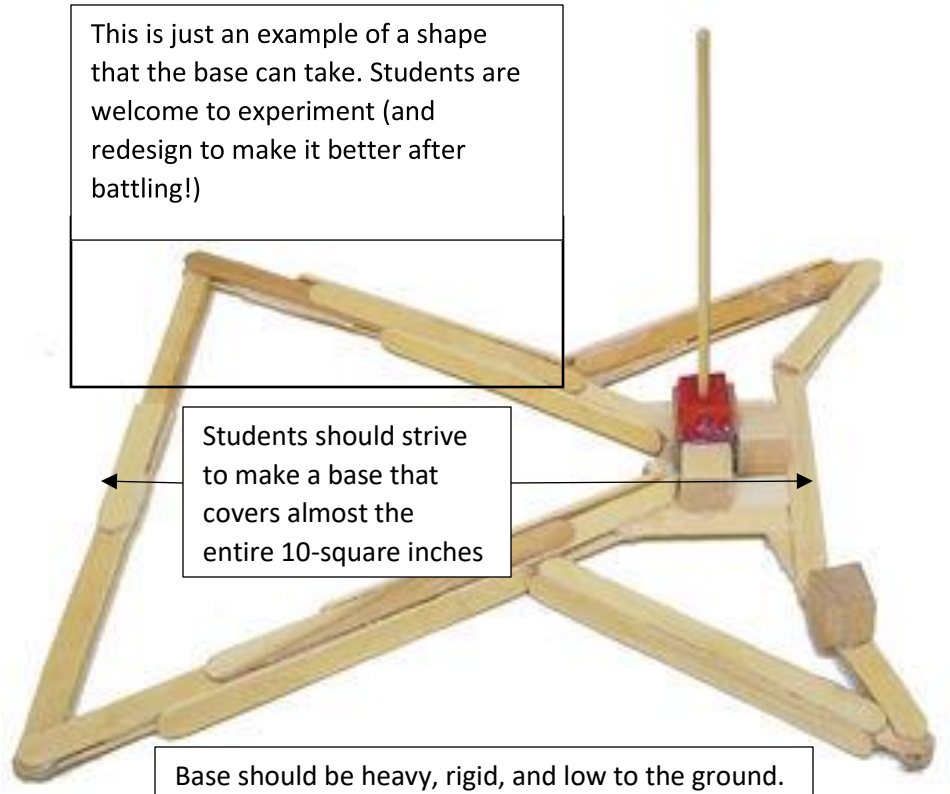


Two cubes with holes are stacked here to create the pivot. The skewer is glued in.

Additional cubes support

This cube elevates the piston that actuates the pivot. The position of this cube doesn't have to be exact as long as it is behind the pivot and a few inches away.

This is just an example of a shape that the base can take. Students are welcome to experiment (and redesign to make it better after battling!)



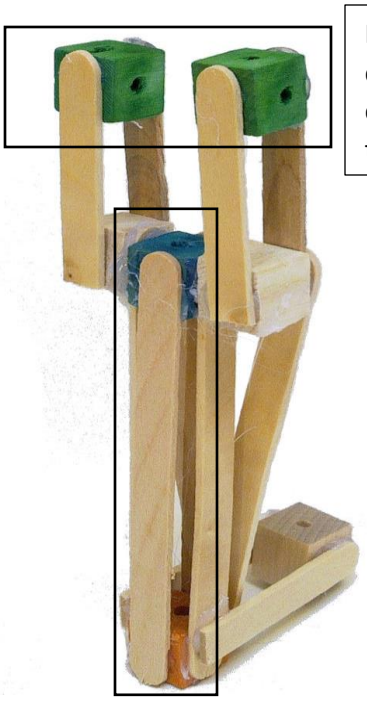
Students should strive to make a base that covers almost the entire 10-square inches

Base should be heavy, rigid, and low to the ground.

Bumpers are placed under the base to prevent the bot from sliding around. Position your bumpers carefully to achieve maximum stability (for example, under the pivot is where the most weight is sitting)

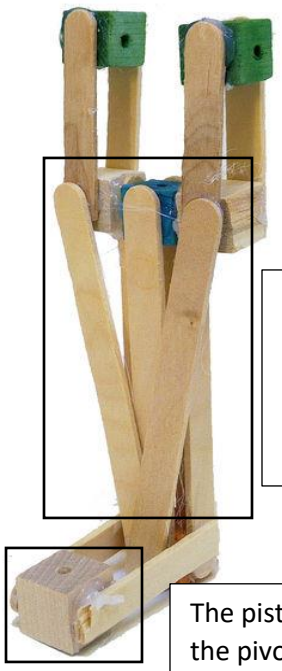
Although the bumpers have an adhesive backing, they should be glued on.

Step 3: The Stand



Insert a skewer through these cubes with holes during construction to ensure that the holes are aligned.

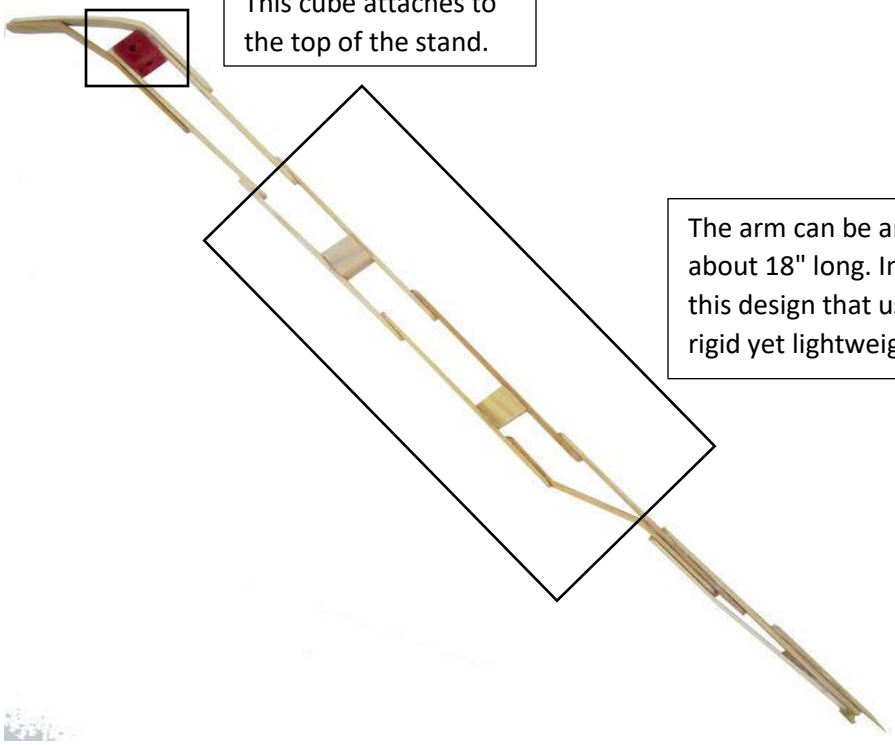
Pivot column is built around two cubes with holes.



'V' shape in the back adds stability and makes the stand look better, but it isn't necessary.

The piston that actuates the pivot column will connect to this cube.

Step 4: The Arm and the Wedge

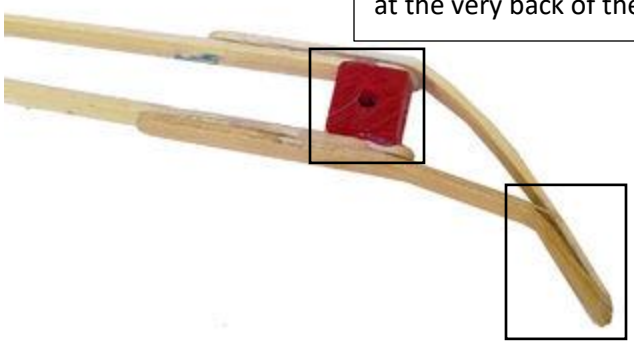


This cube attaches to the top of the stand.

The arm can be any length and shape. This one is about 18" long. In my experience, I have found that this design that uses two cubes and 14 sticks is very rigid yet lightweight.

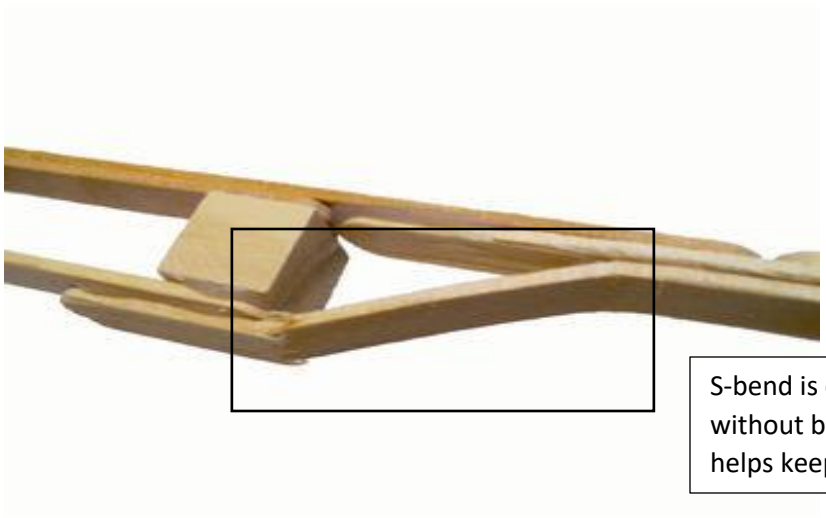
The arm can be any length and shape. This one is about 18" long. In my experience, I have found that this design that uses two cubes and 14 sticks is very rigid yet lightweight.

This cube should be positioned at the very back of the arm



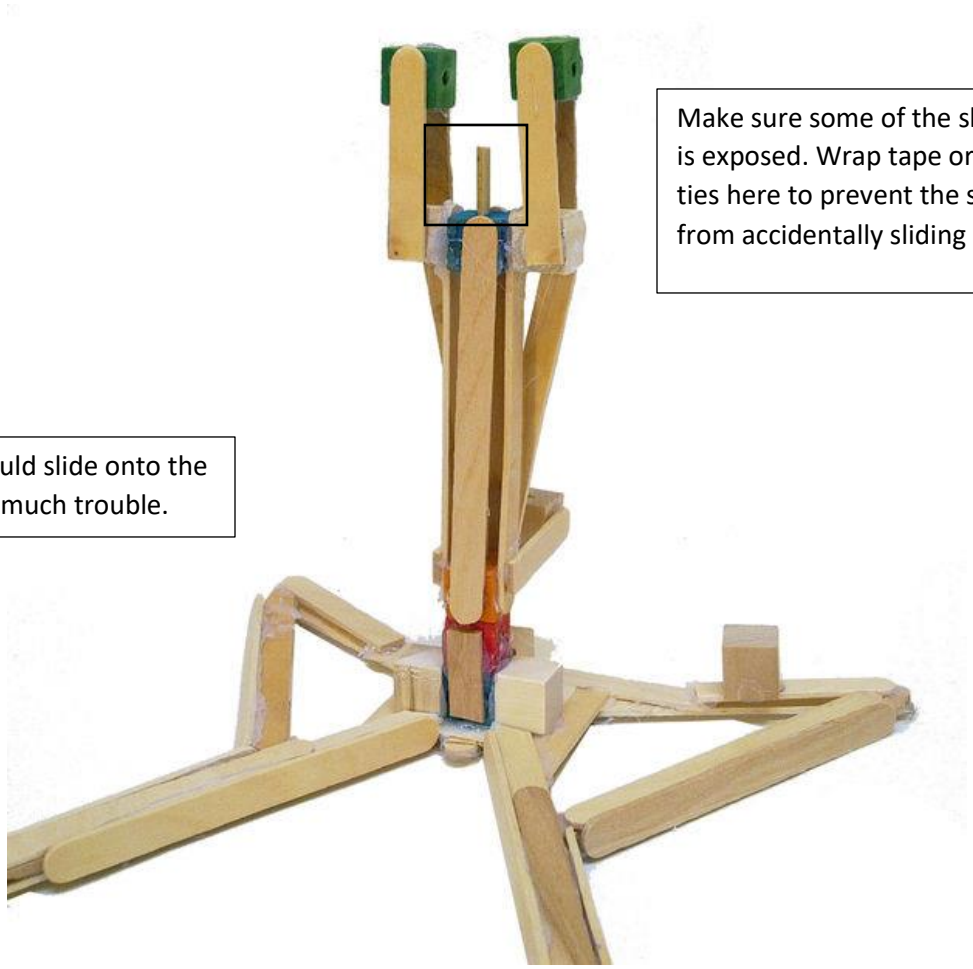
This isn't necessary, but these bent sticks prevent the arm from rising too far up, which helps to avoid accidentally flipping one's own JudoBot backward.

The design of the wedge is a crucial since it will determine how effective your bot is at getting under the opponent. The tips of the wedge should



S-bend is created by cracking a stick without breaking it. Looks cool and helps keep the arm rigid.

Step 5: Assembling the Pieces



Make sure some of the skewer is exposed. Wrap tape or cable ties here to prevent the stand from accidentally sliding off.

The stand should slide onto the pivot without much trouble.

Use another small piece of skewer to attach the arm. Again, wrap tape or cable ties around the ends here to prevent the skewer from sliding out.

Step 6: Make a Hydraulic System

Holed cube is glued onto the end of one piston in each system

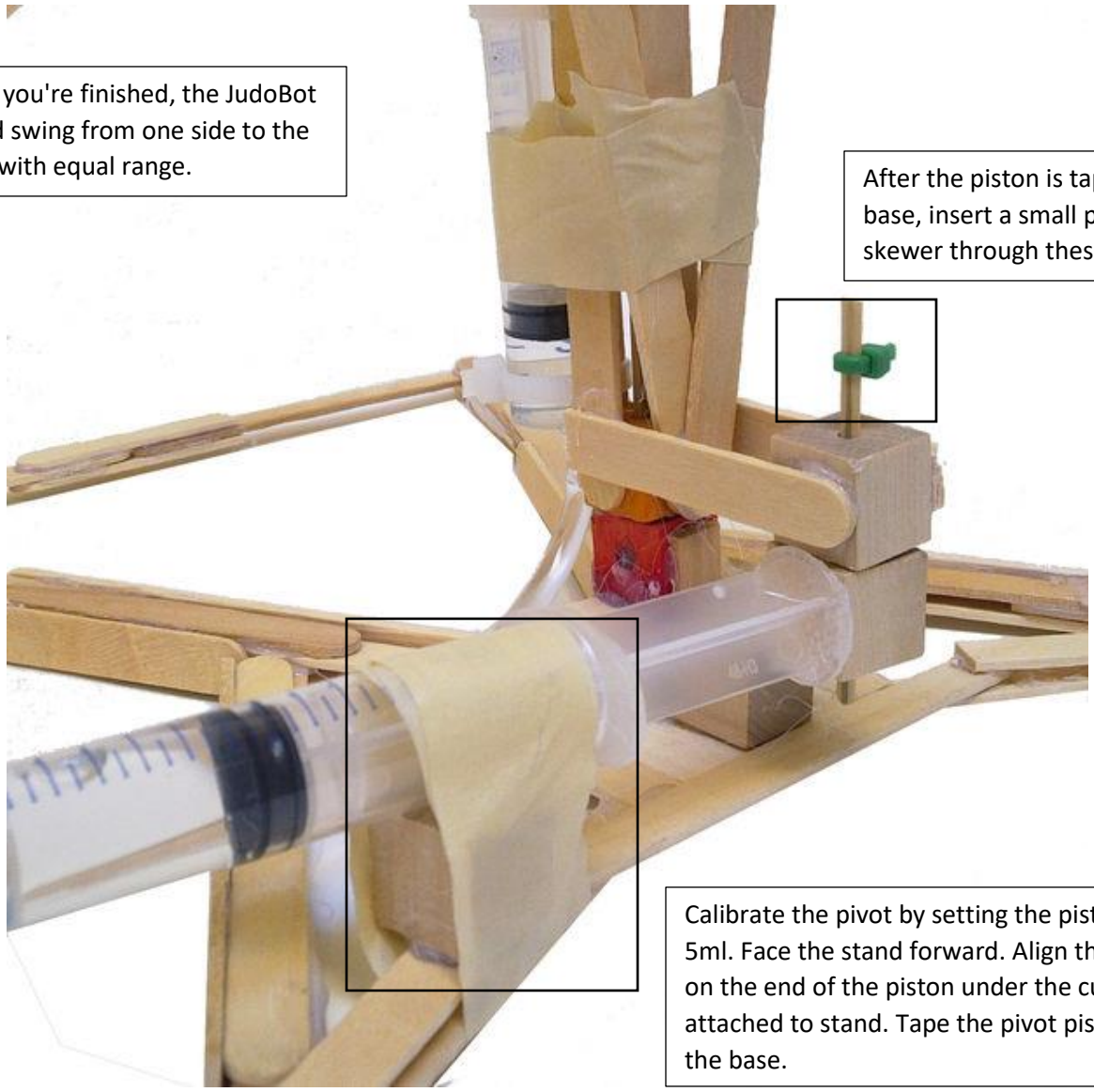
This part can be a bit tricky for students. Although the process is fairly simple, it isn't easy to commit to memory by watching it done once or twice. You may want to outline these steps on a whiteboard:

1. Connect tubing to one syringe
2. Fill completely with water
3. Point the tip of the syringe up and push on the plunger. This expels all of the air and fills the tubing with water
4. Refill halfway and set aside
5. Submerge the tip of the second syringe and repeatedly pump the plunger to expel air. Fill halfway

6. Connect the syringes and try it out. If the total amount of water in either syringe exceeds the 10ml mark then there is too much water in the system. There should be little to no air bubbles, too.
7. Glue on a holed cube to the end of one plunger in each set

For extra fun, use food dye to color the water

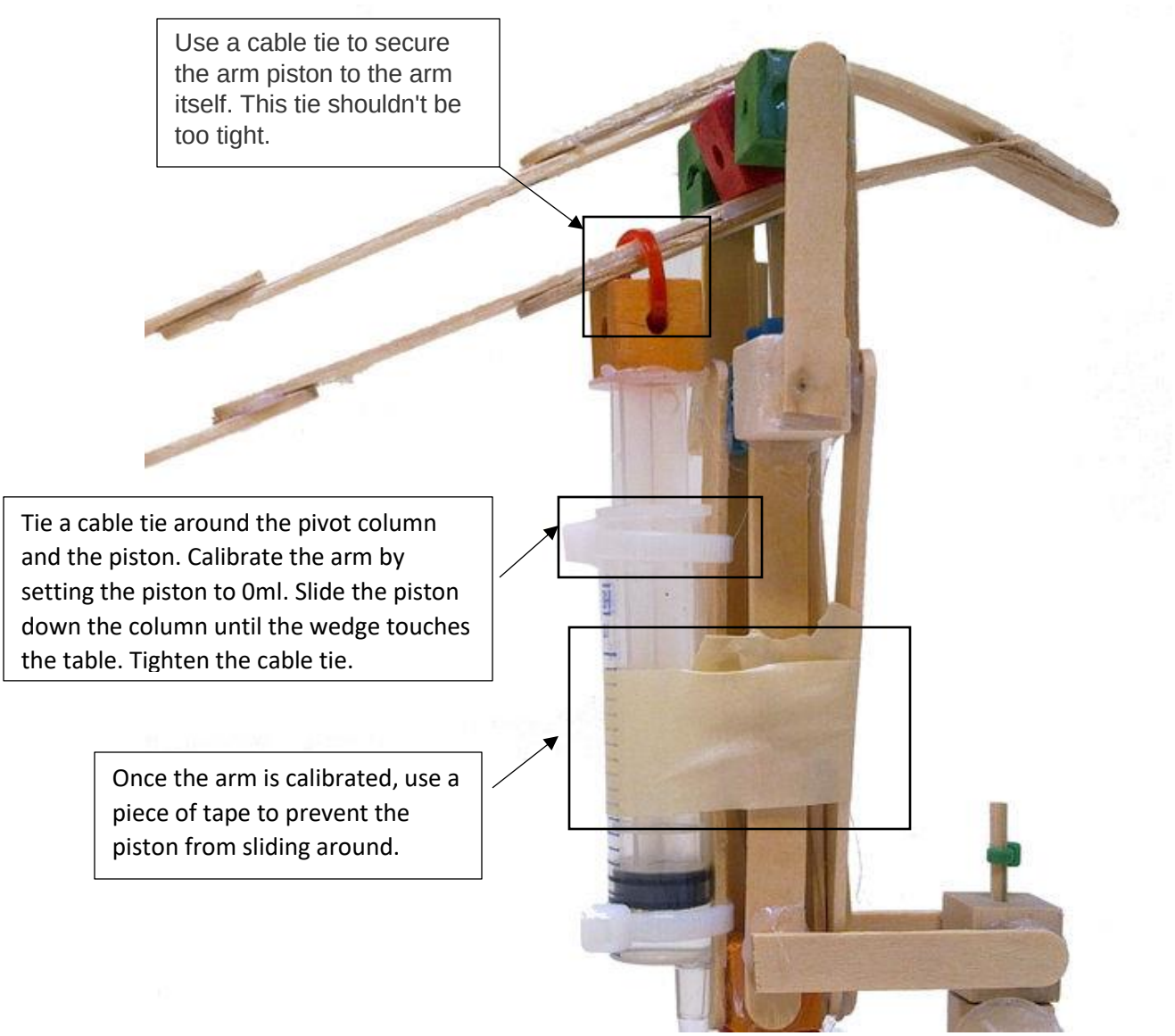
Step 7: Attaching the Pistons



When you're finished, the JudoBot should swing from one side to the other with equal range.

After the piston is taped to the base, insert a small piece of skewer through these cubes.

Calibrate the pivot by setting the piston to 5ml. Face the stand forward. Align the cube on the end of the piston under the cube attached to stand. Tape the pivot piston to the base.



Step 8: Battle Time!!

The arena consists of two 10" squares spaced apart by 2" - 4" drawn onto a tabletop (depicted in the video). Ideally there should be about 6" between the sides of the squares and the edge of the table.

Rules of engagement:

1. JudoBots begin by squarely facing each other with the front of the base touching the edge of the square and the arm completely extended.
2. On the count of three, fight!
3. There are three ways to win a fight: flip your opponent, push your opponent off of the table, or if your opponent experiences a hydraulic failure.
4. A stalemate occurs when the bots are both active but unable to reach one another.
5. A draw occurs if both bots are either flipped or have fallen off.

6. Students cannot touch the JudoBot with their body during battle.
7. Students must strive to control their JudoBot with precision.

Hydraulic failure most often occurs when the plunger is yanked out of the syringe. Repairs are not as straightforward as filling the lines, so emphasize the importance of operating the JudoBots with precision. If you see a student recklessly pulling on the syringe in the heat of battle, call for a time out. It's better to spend a few seconds reminding your student to slow down than it is to spend a minute or two fixing the line.

The first time students battle it will look like two poorly programmed machines bumbling into each other. This is normal - it just takes some practice before getting the hang of the controls and basic tactics.

Step 9: Presenting This Information to Your Class

I break this project up into two parts: 1. Construction and assembly, and 2. Attaching the hydraulics and battling

1. Prepare two working JudoBots and an extra hydraulic system before class.
2. Demonstrate how to operate one JudoBot in front of your class. Tell them right away about the importance of operating the JudoBot with precision, and show them what happens when a piston is yanked on too hard.
3. Let each student have a chance to operate a JudoBot, though not in combat. This allows the students to experientially grasp what hydraulics are, which is necessary because you will be referring to that concept a lot.
4. Afterwards, have the students focus on you as you disassemble a JudoBot into it's 4 components: base, stand, arm and hydraulic system. Show students the key features of each part, such as the materials used for the pivot column and how it operates. Do not explain how to create or attach the hydraulic system yet.
5. Once you feel confident that the students comprehend how to construct each part, allow them to access the materials and begin.
6. At the beginning of the second part of class, show the students how to create a hydraulic system and outline each step on the board. You may want to show them a second or third time. Demonstrate how to attach each hydraulic system to the JudoBot
7. Finally, remind your students to operate their bots with precision once again! Never yank unrestrainedly on the controls.
8. Once the battling begins, continue to allow your students to redesign and build. Oftentimes the very first design includes some flaws that need to be worked out.