

## **Judo bot:**

**Aim:** To build a working JudoBot out of craft sticks, craft cubes and a hydraulic system using syringes.

**Learning outcomes:** Basics about hydraulics, glue, pressure, structural stability, learn about Design Build Test cycle.

**Overview:** This is a 3.5 week lesson. While building the Judo bots the following criteria are needed to be met:

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.

Below here is a tentative timeline

WEEK 1.5 – The base and the Stand are to be completed: original designs and modifications are encouraged.

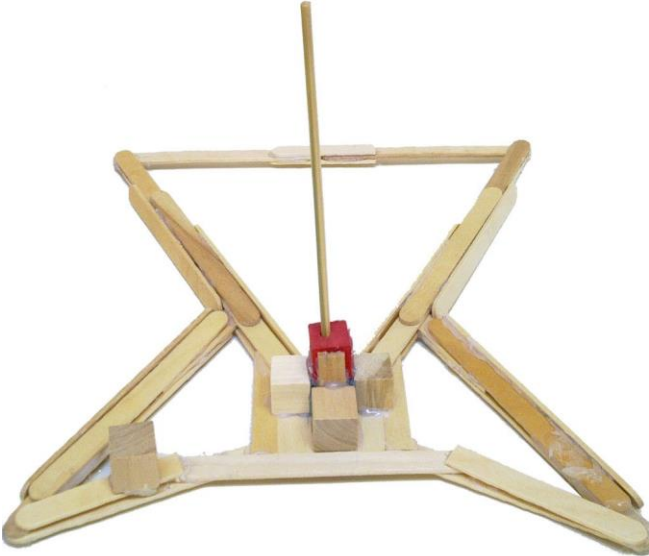
WEEK 2 – The Arm, wedge and assembling and trouble shooting

WEEK 3 – Making the Hydraulic system, attaching the system, Battle If time permits.

## **Step 1: Materials, tools, and design criteria**

- Craft cubes
- Craft sticks
- Cubes with 5/32" holes\*
- Robust wooden skewers 1/8" diameter
- Decorative woodcraft (optional)
- 10ml Luer slip plastic syringes
- Vinyl tubing
- Adhesive bumpers
- 4" cable ties
- Hot glue guns
- Glue sticks

**STEP 2 : The Base**



### STEP 3 : The Stand

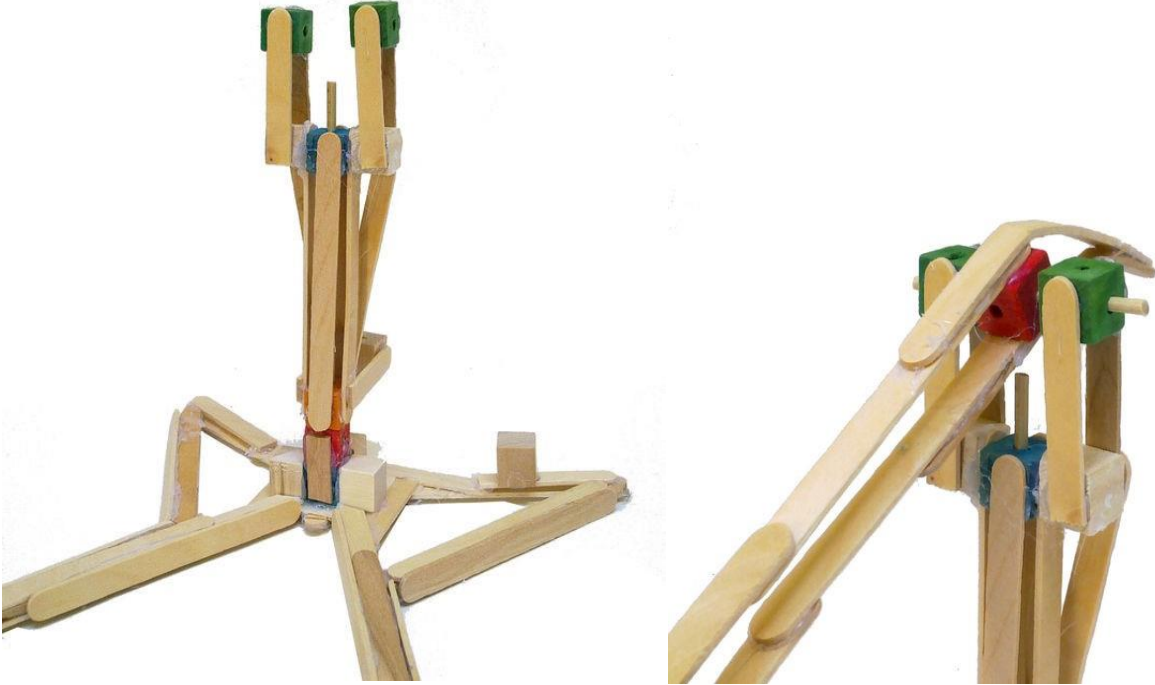


- Insert a skewer through Green cubes with holes during construction to ensure that the holes are aligned.
- V' shape in the back adds stability and makes the stand look better, but it isn't necessary.

**Step 4: The Arm and the Wedge**



## **Step 5: Assembling the bot**

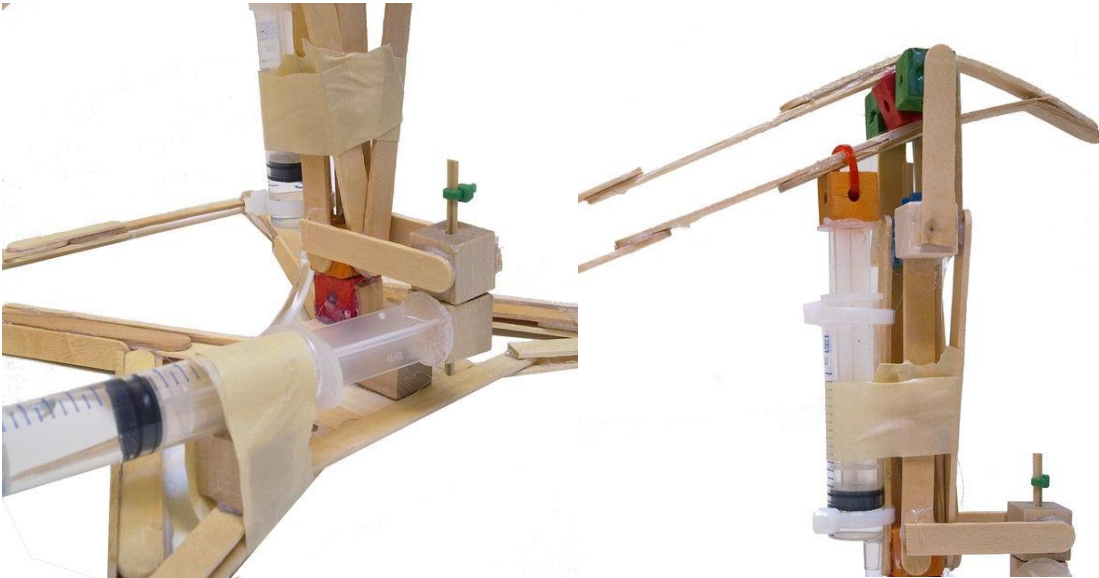


## **Step 6: Make a hydraulic system**

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



## **Step 8: Battle Time!!**

The arena consists of two 10" squares spaced apart by 2" - 4" drawn onto a tabletop. 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.

