**BUILD GUIDE FOR JUDO-BOTS**

**CUT**

*Multi-Cutters* cut wood & plastic (like *dowels* and *connector strips*). They do not cut metal.

**PUSH, WIGGLE, TAP**

Push, wiggle or tap *dowels* into holes.

Use a hammer and *slider block* to tap *dowels* farther through holes.

**REA**

Most parts have holes with *teeth*. The *teeth* hold *dowels* (keep dowels from falling out).

A *reamer* removes *teeth* from a hole. This allows a *dowel* to spin in the hole.

Only *ream* holes where dowels should spin.

Never *ream* pulleys, gears, wheels, or any hole a *dowel* stays stuck into.

**SCREWS & NUTS**

Screws (without nuts) can connect parts, and allow them to rotate.

Screws (with a nut) can connect parts, and keep them from rotating.

Do not *ream* holes you will put screws into.

**STOP CLIP**

Press a *stop clip* onto a *dowel* to keep it from sliding or use it as a hook for a string / rubber band. It takes little force to get it on.

**SLIDE STOP**

Cut *slide stop* into sections. Use *slide stop on dowels* to stop *dowels* from sliding through *reamed* holes.

TEACHERGEEK COMPONENTS

Below is the list of “ingredients” you’ll need for one Judo-Bot.
Available as single: SKU 1824-72 or 10 pack: SKU 1824-62. Both include extra parts for your own innovative creations!

- **6 - Connector Strips**
  - 300mm (12’’)

- **6 - Dowels**
  - 76mm (3’’)

- **1 - Slide Stop**
  - 76mm (3’’)

- **8 - Blocks**

- **4 - 4.5mL Cylinders**
  - If using the Maker Cart vinyl tubing roll, cut two sections, 2 ft. in length each.

- **4 - Cylinder Screws**
  - #10 25mm (1’’)

- **6 - 25mm Screws**
  - #10

- **6 - Nuts**
  - #10

- **4 - Zip Ties**
  - 2 ft.

- **2 - 2 ft. Vinyl Tubing**

TEACHERGEEK TOOLS

This isn’t a kit. You’re going to really build (cut, ream, screw) your Judo-Bot. Here are tools you’ll need to get started:

- Reamer
- Multi-Cutter
- Tapping Block
- Hammer
- Pliers
- Screwdriver

Or get the complete TeacherGeek / Maker Tool Set
Single SKU 1823-24
Class Set SKU 1823-85

MATERIALS YOU SUPPLY

- **Tape**

- **Recycling Materials**
  - What else could you use for a Judo-Bot base?

- **Crayon**
  - Rub on dowels to make sliding them easier into holes of components.
Are you ready to R-U-M-B-L-E?!
In this guide, you will build an example *Judo-Bot*.
Design a bot-for-battle using **levers** and **fluid power**.

**CONSTRUCTING THE UPRIGHT**

1. **Cut** two 4 cm (1.5") and one 15 cm (6") **dowels**.

2. **Tap** the **dowels** from **Step 1** into a **connector strip**, four holes in from each end of the strip.

3. **Push** or **tap** a **connector strip** onto the **dowels** from **Step 2**. This will be your **upright**.

4. **Ream** the top two **holes** at one end of your **upright**.

5. **Insert** the 15 cm (6") **dowel** from **Step 1** into the **reamed** holes from **Step 4**. Let 5 cm (2") hang off both sides.

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6. **Cut** two 15 cm (6") **dowels**.

7. **Tap** the **dowels** from Step 6 into the **first hole** on each end of a **connector strip**.

8. **Push or tap** a **connector strip** onto the **dowels** from Step 7. This is your Bot’s base.

9. **Place** the **upright** from Step 5 in the **base**. **Stretch** the base to **align** the **dowel** with the 16th hole of the strips.

Congratulations! Your frame is finished.
Hydraulic systems use fluid to transmit power. Using cylinders and tubing, you will create a hydraulic “control” system to move your Judo-Bot.

10. **Fill** two 4.5 ml cylinders with water. **Submerge** the cylinder barrel in water. Pull the piston out to fill the barrel completely with fluid.

**Tip:** to work properly, no air bubbles should be in the cylinders or tubes.

11. **Attach** a 2 ft. tubing section to one filled cylinder from Step 10.

12. Fill the tubing from Step 11 with water. Pull the piston back, then push in to fill the tubing with fluid. The barrel will be empty.

**Tip:** Use a cup or glass to catch fluid.

13. **Attach** the water-filled tubing from Step 12 to the second cylinder from Step 11.

14. Keep the tubing attached with a cylinder screw. Insert the screw into the hole aside each cylinder’s tip.

15. **Repeat** Steps 10-14 to create another hydraulic system. These will power your Judo-Bot.

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16 Ream one of the holes on one cylinder’s piston from a hydraulic system from Step 15.

17 Cut a 15 cm (6”) dowel.

18 Insert the dowel from Step 17 into the reamed hole from Step 16.

19 Center the piston on the dowel. Slide a 4 mm (0.15”) piece of slide stop on each side of the piston to keep it in place.

If you are going to do the optional Fluid Power Lab, now’s the time!

Documents at teachergeek.com/learn
Place the **cylinder** from Step 19 into the **frame** from Step 9. Stretch the frame to align the dowel 8 holes from the **upright**.

**Insert** the **cylinder pegs** between the **upright**'s connector strips.

**Cylinder Pegs**

▲ Congratulations! The first half of your Judo-Bot is finished.

Test how it moves - use the **hydraulic system** to move the upright up and down. Attach a weight to the upright’s end (piece of clay, cup of pennies).

Change the **fulcrum** of your upright’s cylinder - what height makes the weight easier to lift?

**Mechanical Advantage**: trading distance for force

Try clay!
LEVER ARM

22. Attach two blocks to the top holes of the upright from Step 21. Tighten with two nuts and screws through the block’s center hole.

23. Cut the corners off one end of a connector strip.

Tip: No nut is necessary for the lever arm’s screw. It stays loose to rotate.

24. Attach the connector strip from Step 23 to an upright’s block from Step 22 with a screw. This is your lever arm.
25. **Attach** a cylinder from the second hydraulic system from **Step 15** to the upright. **Insert** the cylinder **peg** to the **block** as shown.

26. **Attach** the piston to the lever arm with a **screw**.

27. **Attach** the two hydraulic systems together to form a **control panel**. Use a **nut** and **screw** as shown.

**Tip:** Cable ties keep cylinders in place if the peg slips out.

**Congratulations!**

You have built an example Judo-Bot. However, you can make it better!

If you are going to do the optional Judo-Bot Challenge, now’s the time!

Documents at teachergeek.com/learn
This build guide is for an example Judo-Bot frame. In the Engineering Challenges, you can design and re-design your build and add end effectors for battle. Create the ultimate bot to compete in tournaments! Will you win? Find out more: teachergeek.com/learn

Design, Create, Innovate

Your example Judo-Bot doesn’t have to look this way. Reposition the lever arm-cylinder from Step 26 to fit in the upright or place the cylinder (fulcrum) closer or further up the arm. The possibilities are endless!

Applying force a long distance from the fulcrum allows just a little effort to lift a large load. Applying force a short distance from the fulcrum means more effort to lift the load a shorter distance.

Levers trade distance for force.