

ADVANCED HYDRAULIC ARM



Hydraulics are *AMAZING!*
Use the power of water to control a machine.

This guide will help you create
your own Advanced Hydraulic Arm.

Perfect for Grades: 7+
Difficulty: Advanced



GO

Build
Guide

Lab
Activity

Design &
Engineering
Challenge

You are
HERE

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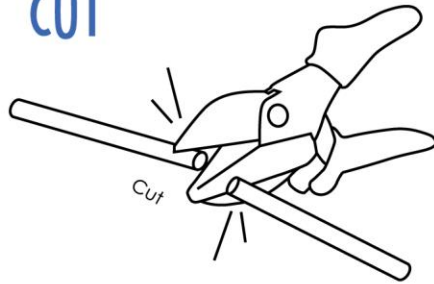


THINKING AHEAD

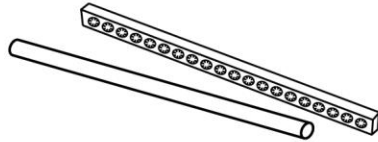
What kinds of objects can you
move with different gripper designs?

Built it, try it, change it. Design and engineer your most imaginative mechanisms with TeacherGeek™ components. Combine them with recycling bin and other materials.

CUT



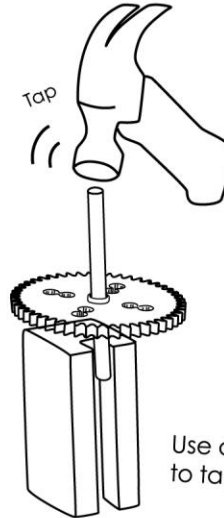
Multi-Cutters cut wood & plastic (like **dowels** and **connector strips**). They do not cut metal.



PUSH, WIGGLE, TAP



Push, wiggle or tap **dowels** into holes.



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

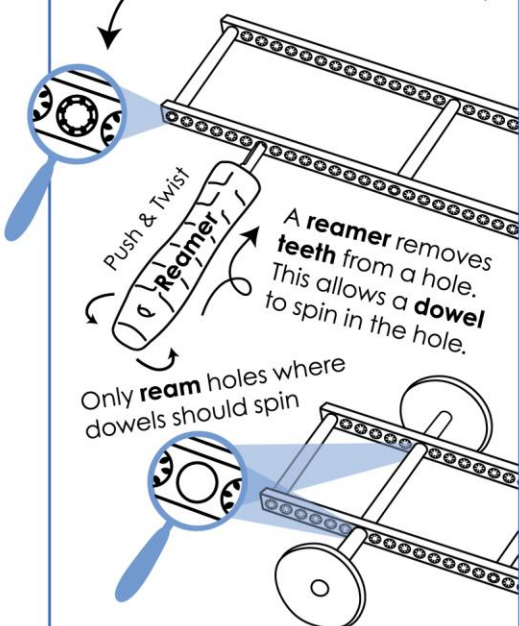
QUICK TIP!



Use a **crayon** or **soap** on the end of a **Dowel** to make building easier.

REAM

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



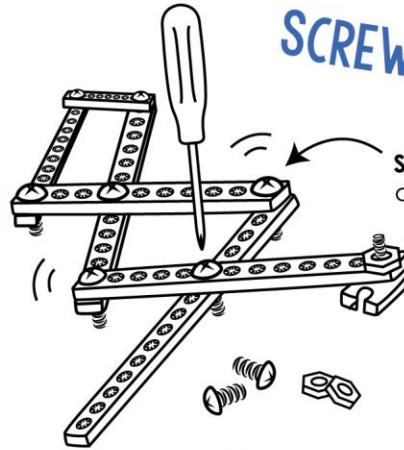
A **reamer** removes **teeth** from a hole. This allows a **dowel** to spin in the hole.

Only **ream** holes where dowels should spin

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

SCREWS & NUTS

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



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

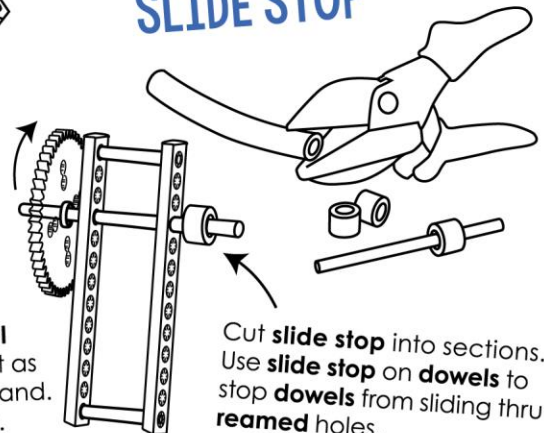
Screws (with a nut) can connect parts, and keep them from rotating.

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 thru **reamed** holes.

More resources available at teachergeek.com.
Adult supervision required for children 12 and under.

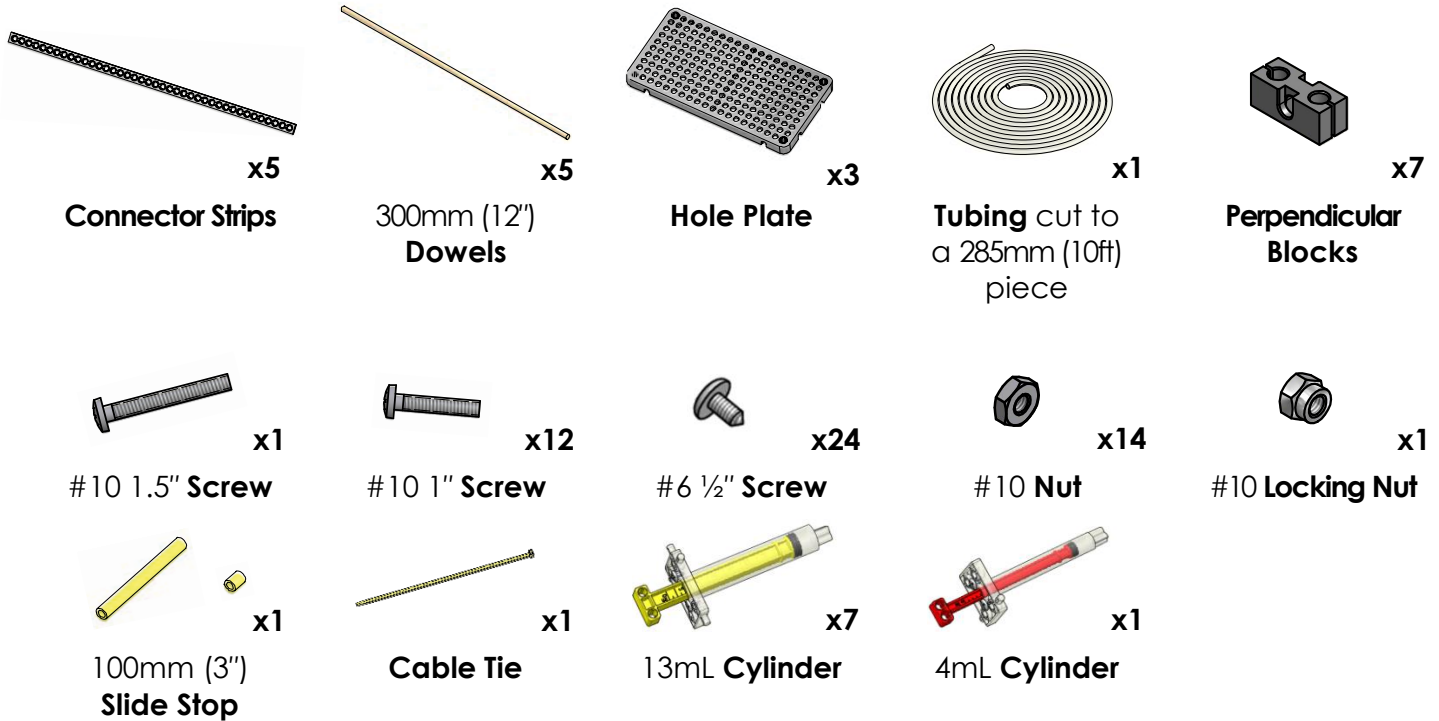
ADVANCED HYDRAULIC ARM



TEACHERGEEK COMPONENTS

Below is the list of "ingredients" you'll need for each Hydraulic Arm Build.

Available as single: SKU 1823-08 or 10 pack: SKU 1823-09. Both include extra parts for your own innovative creations!



TEACHERGEEK TOOLS *Perfect for sharing in groups of 3 and 4!*

Time to break out those tools and start building! Remember to be kind and share with others.



MATERIALS YOU SUPPLY

Go on your own scavenger hunt to find these items. Try building with all kinds of materials!



ADVANCED HYDRAULIC ARM

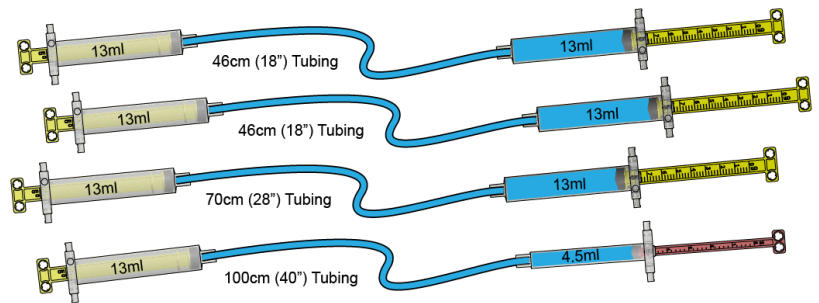
LET'S GET STARTED

Hydraulic systems are the foundation of how this build design functions. Follow the steps below to **connect** and **fill** cylinders to create your own hydraulic system.



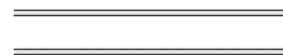
No Bubbles

Please note: in order to work properly, there can be no air bubbles in the cylinders or tubes.



1 Cut tubing into the following lengths:

2 46cm (18")



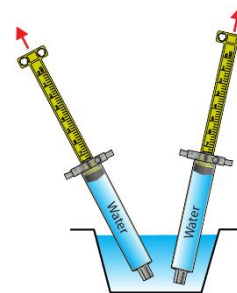
1 70cm (28")



1 100cm (40")



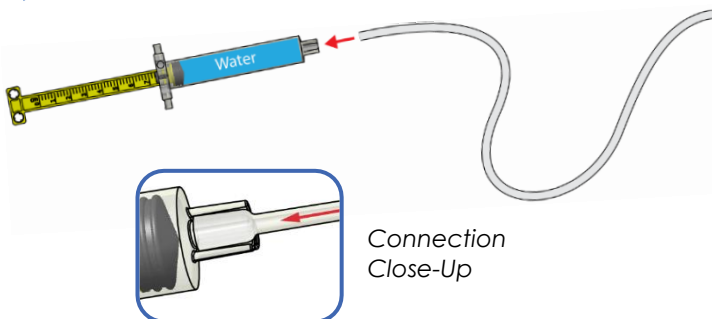
2 Fill the seven 14mL **cylinders** and one 4.5mL **cylinder** with water by **pushing** the **piston** all the way in and **submerging** the **tip** under water; pull back to fill completely with water. Remember: no air bubbles



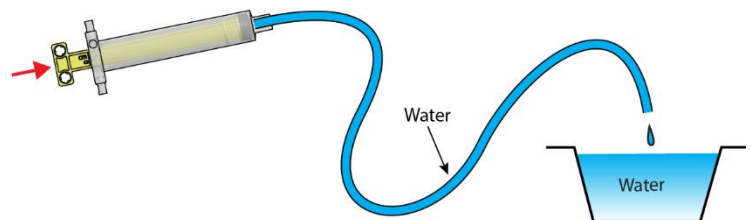
Quick Tip

Use food coloring to make seeing the water easier.

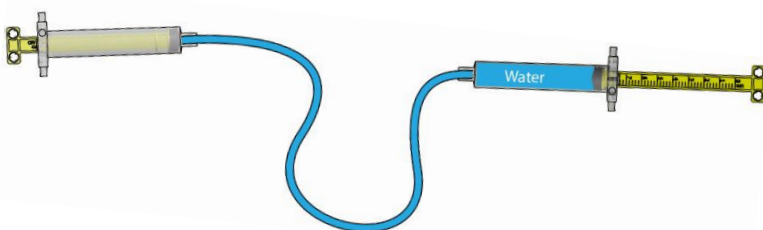
3 Attach the cut tubing pieces from **Step 1** to four of the **filled cylinders** from **Step 2**.



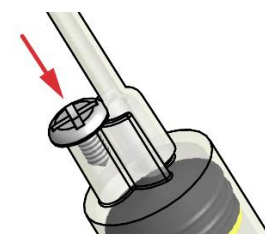
4 Over a **cup**, push the **cylinder piston** to completely fill the **tubing** with water. Remember: no air bubbles



5 Attach the water filled tubing to the remaining water filled **cylinders** from **Step 2**.



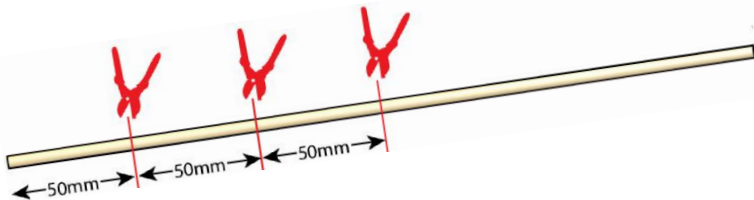
6 Insert a #6 1/2" screw into the hole aside the **cylinder's tip** to prevent the **tubing** from disconnecting.



ADVANCED HYDRAULIC ARM

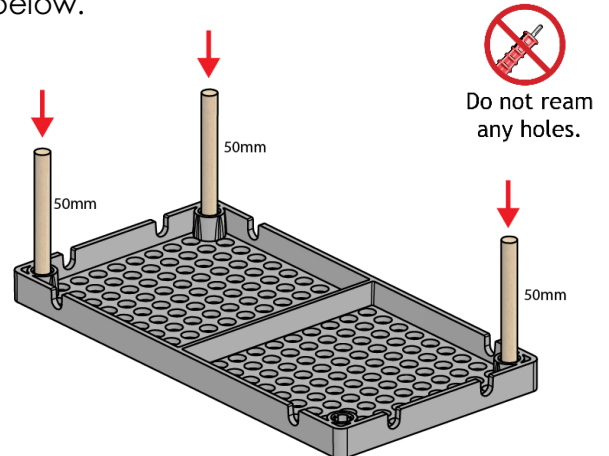
7

From the **end** of a **dowel**, measure and **cut** three 50mm (2") sections - save the extra, you will use this later.



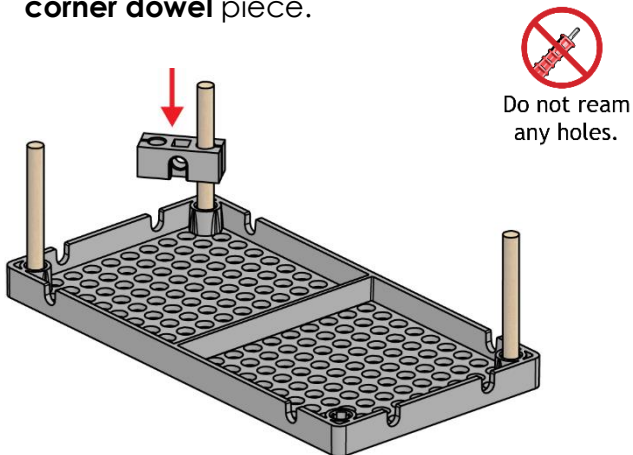
8

Insert the cut **dowels** from **Step 7** into the **outside corners** of a **hole plate** as shown below.



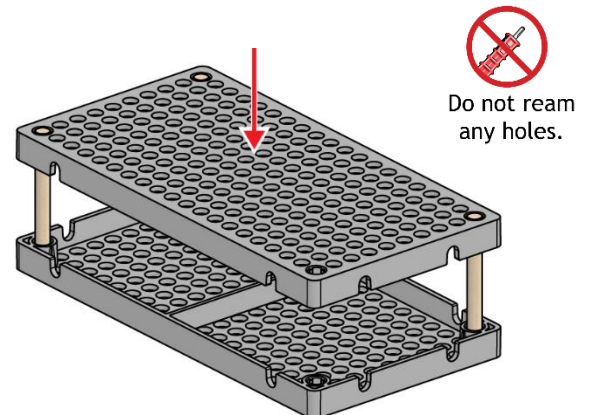
9

Slide a **block** halfway onto the **corner dowel** piece.



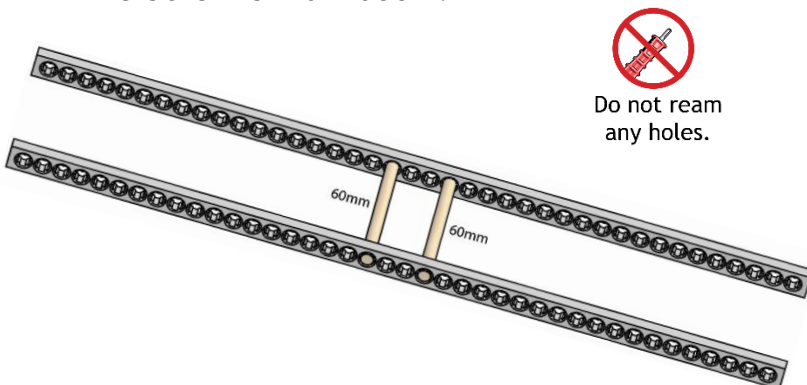
10

Push another **hole plate** onto the **dowels** from **Step 3**, sandwiching them in place. This piece will be the waist for your arm.



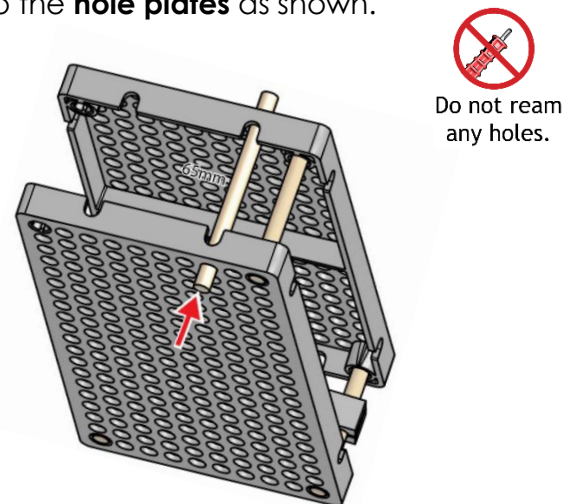
11

Cut two 60mm (2 3/8") **dowels** and insert into two **connector strips** as shown below to create the **main boom**.



12

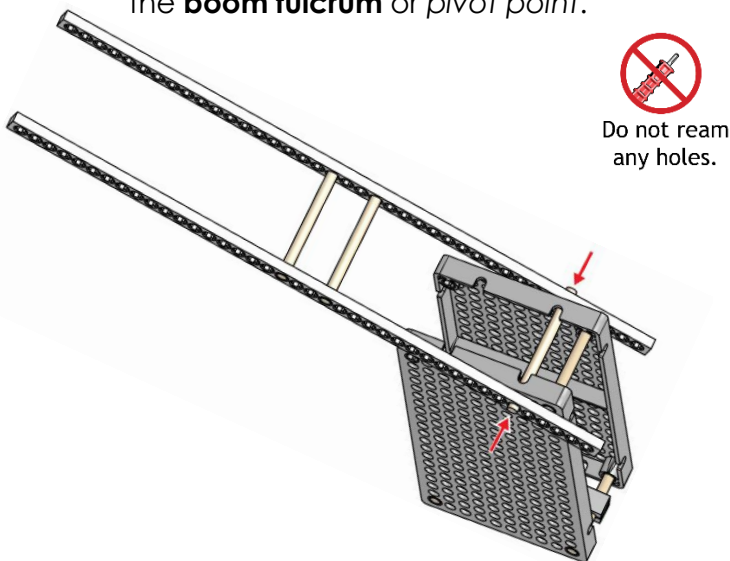
Cut a 65mm (2 5/8") **dowel** and **slide** into the **hole plates** as shown.



ADVANCED HYDRAULIC ARM

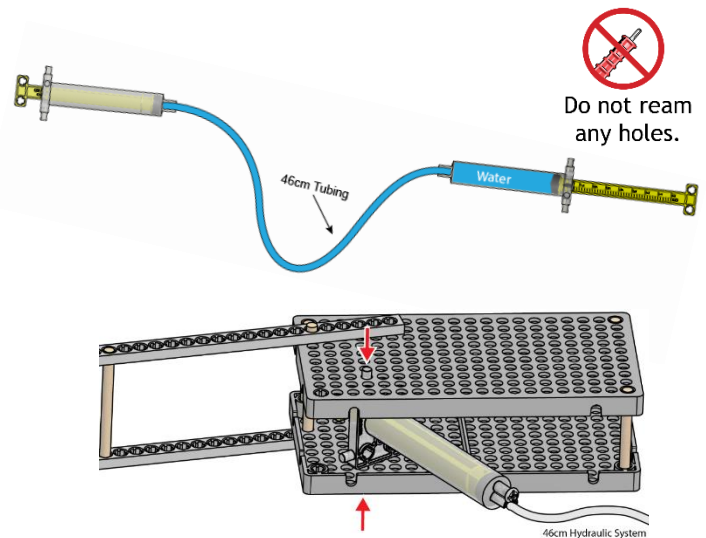
13

Secure the **main boom** to the arm waist by tapping or pushing the **connector strips** around the **dowel** from **Step 12**. This creates the **boom fulcrum** or **pivot point**.



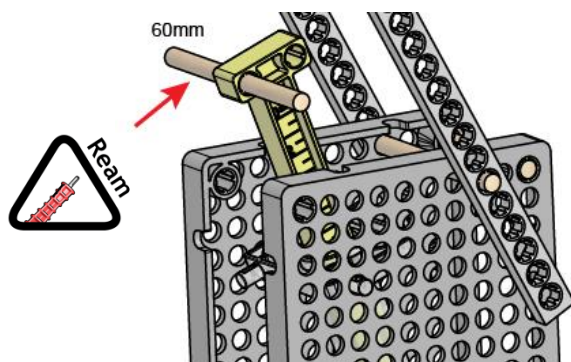
14

With one of the 46cm (18") **hydraulic systems** from **Steps 1-6**, insert one of the **cylinder ends** inside the two **hole plates**.



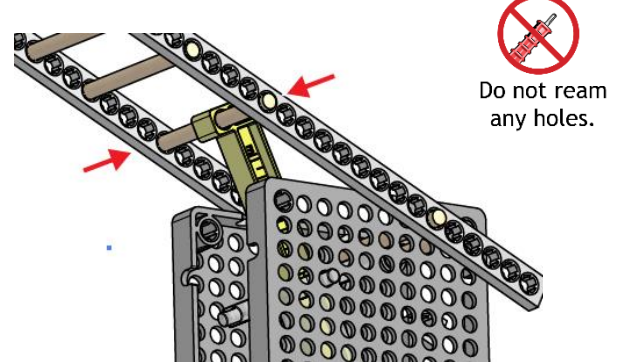
15

Ream the **hole** shown on the **cylinder's piston**, cut a 60mm (2 3/8") **dowel** and **slide** through the hole.



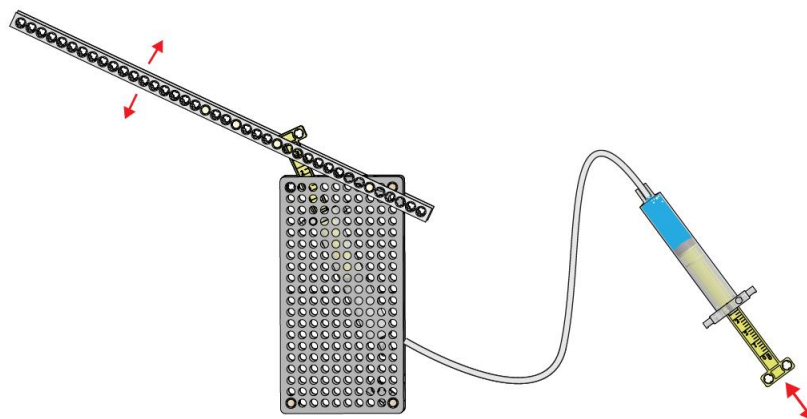
16

Spread the main boom apart slightly and **insert** the **dowel** from **Step 15** into the **connector strips**.



17

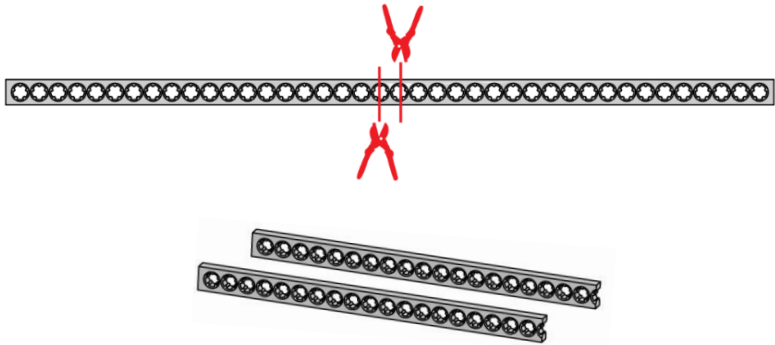
This is the **shoulder** for your **arm**. The **boom** should **move** as the **cylinders** are **pushed** and **pulled**.



ADVANCED HYDRAULIC ARM

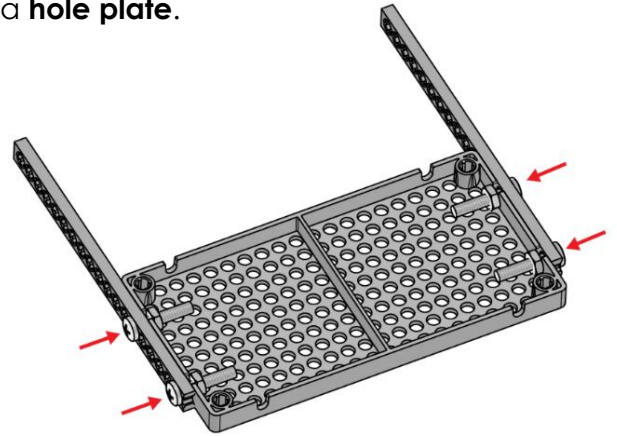
18

Cut a **connector strip** in half 15 cm (16") to get two equal pieces. Since **connector strips** do not have a center hole, **cut** as shown below.



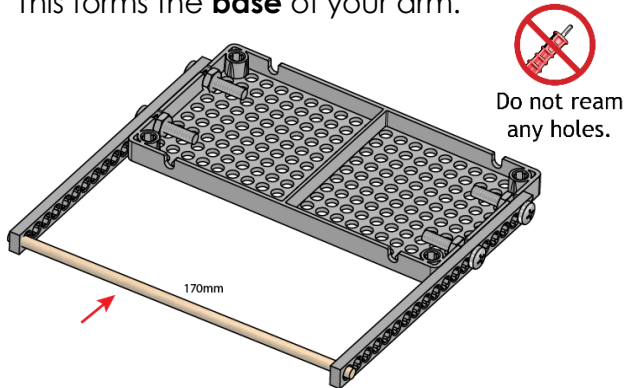
19

Use four #10 1" **screws** and #10 **nuts** to attach the **connector strips** from **Step 18** to a **hole plate**.



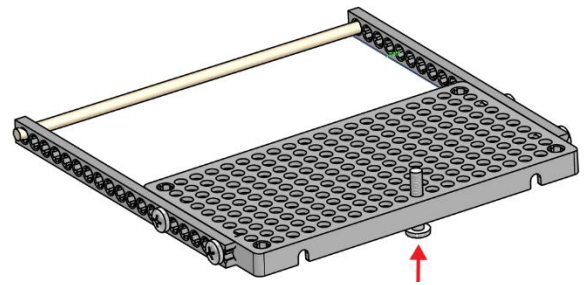
20

Cut a 170mm (6 5/8") **dowel** and **slide** into the last holes of the **connector strips**. This forms the **base** of your arm.



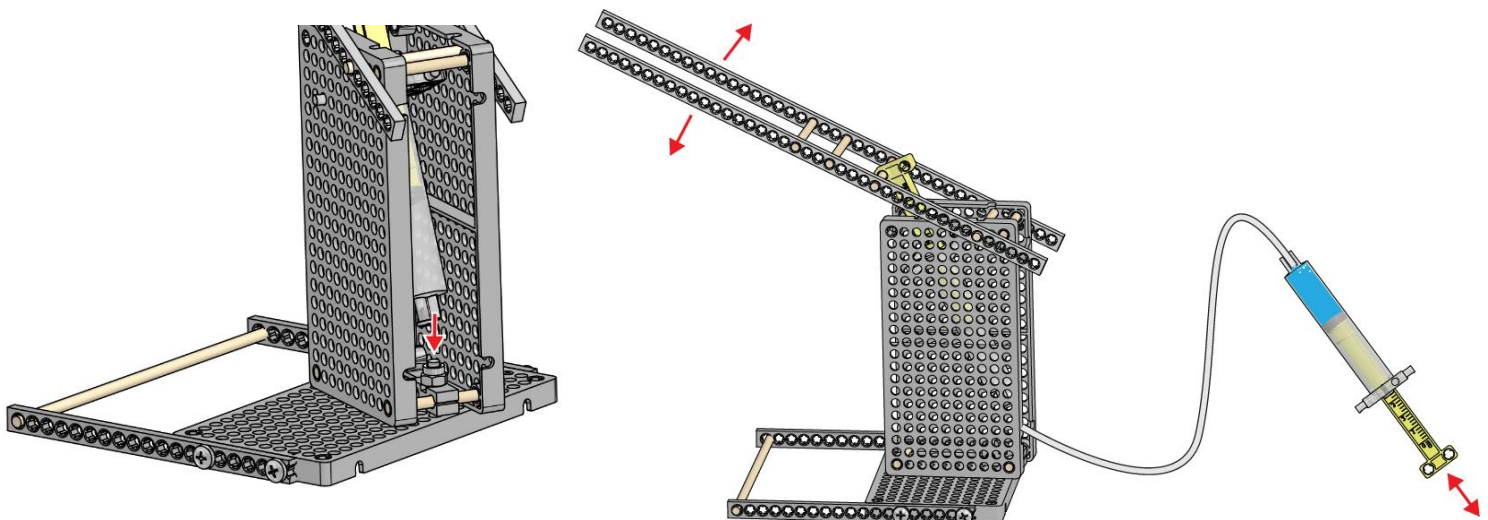
21

Feed a #10 1" **screw** up from the bottom and through one of the **back-center holes** of the base's **hole plate**.



22

Attach the arm's waist to the base by feeding the **screw** from **Step 21** through the **center hole** of the **block** from **Step 9** and **fasten** the #10 **locking nut** to the **screw** to hold the waist to the base. The **screw** and **nut** should be loose enough to allow the waist to easily turn on the base.



ADVANCED HYDRAULIC ARM

23

Create the forearm by **cutting** two 40mm (1 5/8") **dowels** and inserting them in between two **connector strips**.

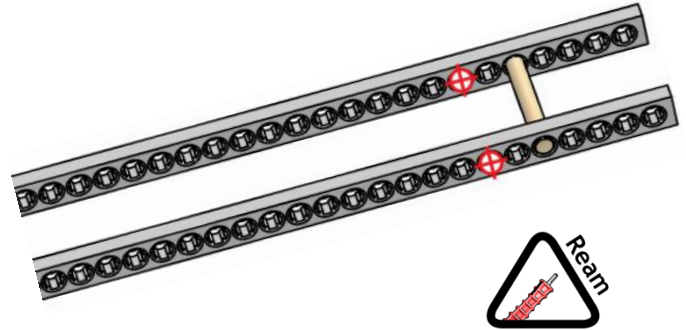


Do not ream any holes.



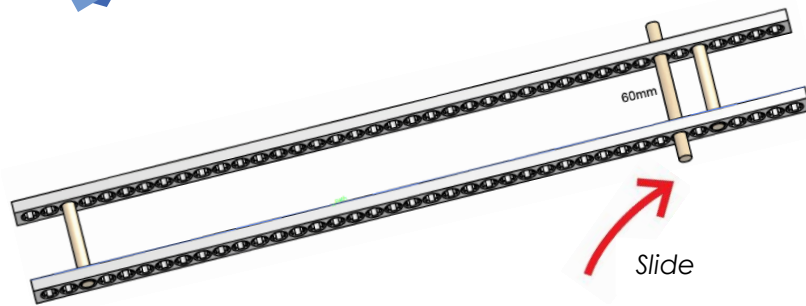
24

Ream the two **holes** marked with a .



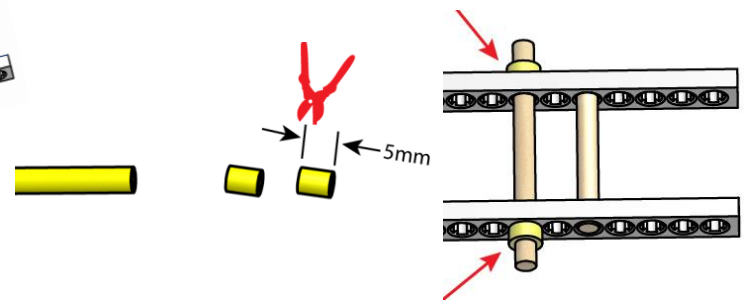
25

Cut a 60mm (2 3/8") **dowel** and **slide** it into the **reamed holes**.



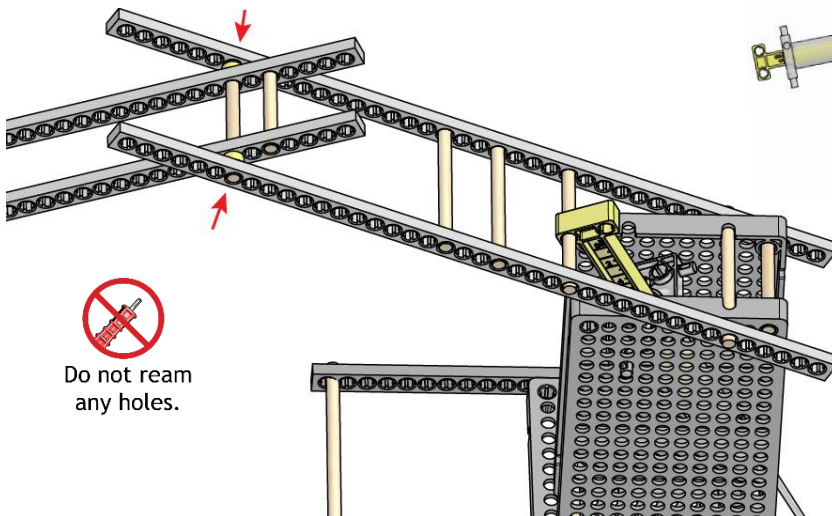
26

Cut **slide stop** into two 5mm (3/16") sections and **slide** it onto the outside of the 60mm **dowel**. This becomes the forearm.



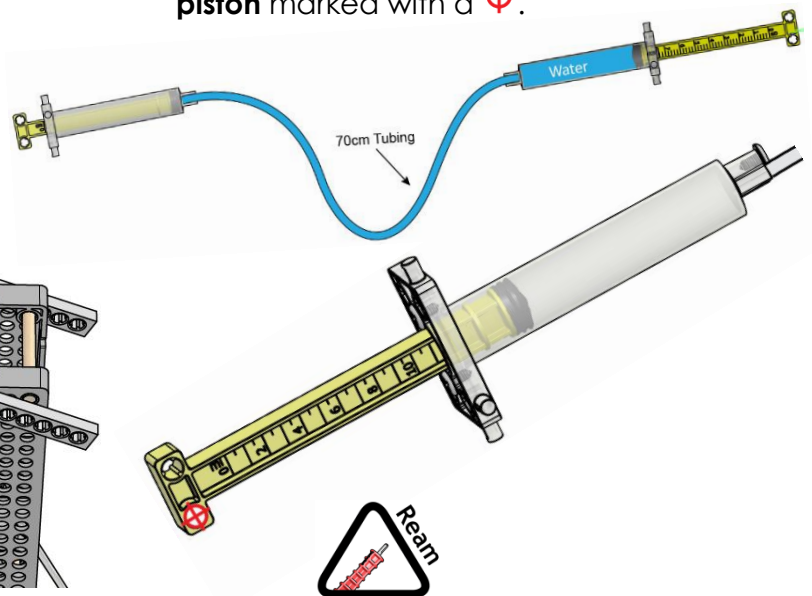
27

Insert the forearm **dowel** inside the **connector strips** of the main arm to create the elbow.



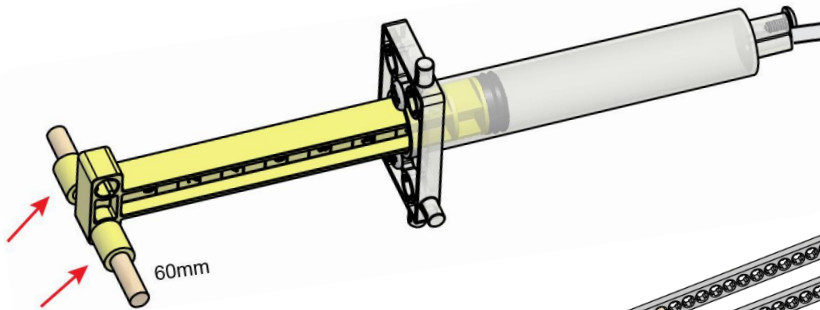
28

Use the of the 70cm (28") **hydraulic systems** from **Steps 1-6**, and **ream** the hole on the **piston** marked with a .

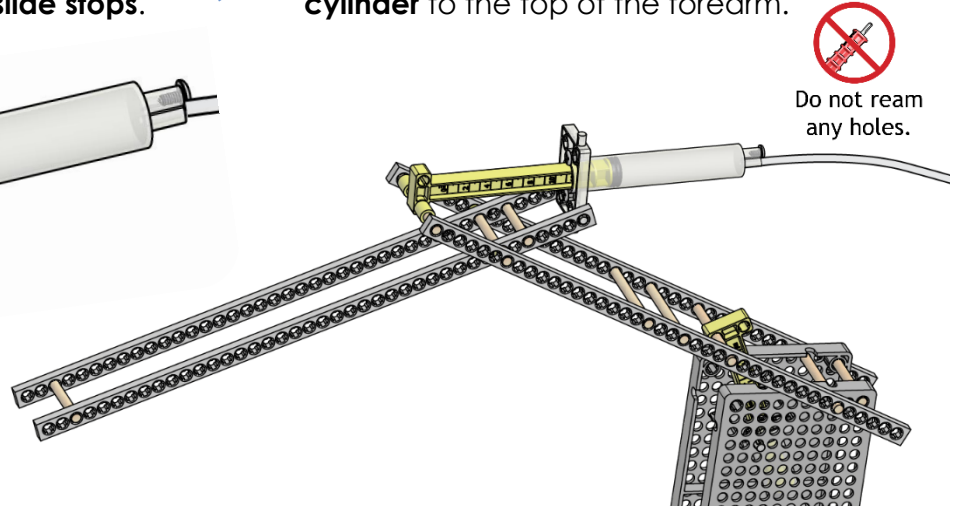


ADVANCED HYDRAULIC ARM

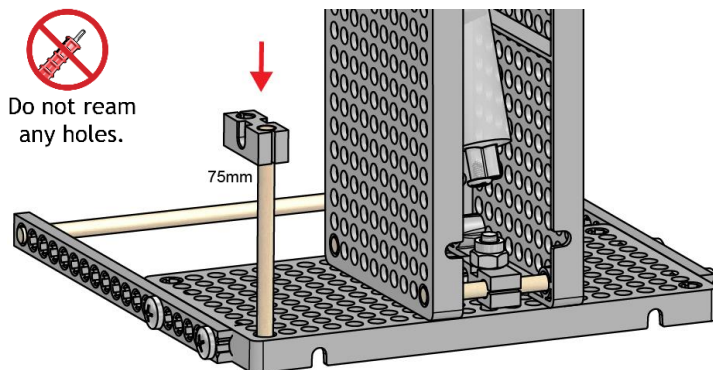
29 Cut a 60mm (2 3/8") **dowel** and **slide** it into the **reamed hole** of the piston from **Step 28** and secure with two sections of **slide stops**.



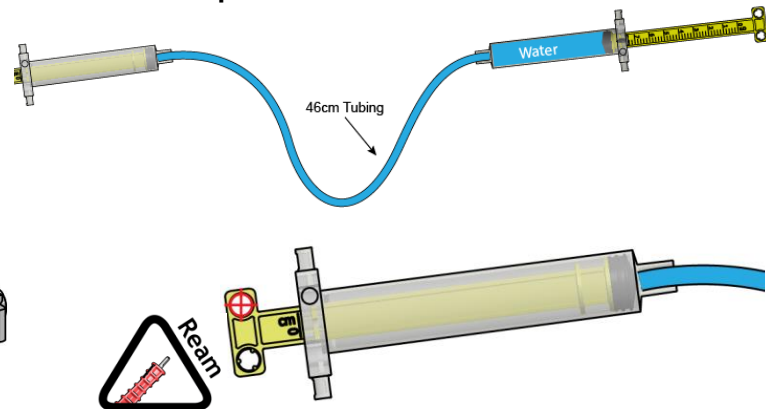
30 Insert the **dowel** end of the **piston** to the top of the main arm and the pegs of the **cylinder** to the top of the forearm.



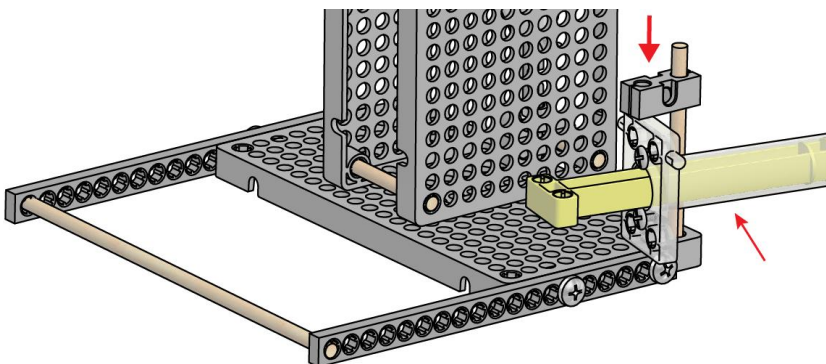
31 Cut a 75mm (3") **dowel** and push, wiggle, or tap into the **corner** of the **base's hole**. **Top** with a **block**.



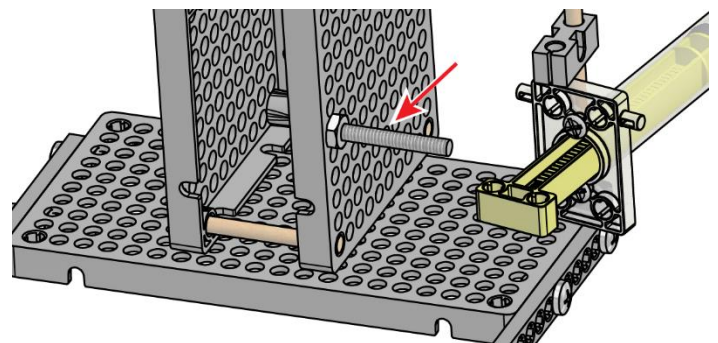
32 Use the remaining 46cm (18") **hydraulic systems** from **Steps 1-6**, and **ream** the **hole** on the **piston** marked with a \oplus .



33 Insert the **pegs** of the **cylinder** in between the base's **hole plate** and the **perpendicular block** from **Step 31**.



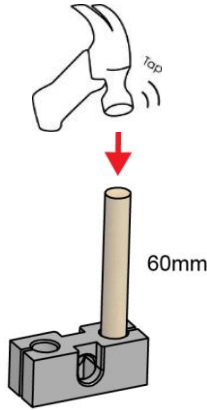
34 Place a #10 1.5" **screw** through the **hole plate** of the waist and **secure** with a #10 **nut**.



ADVANCED HYDRAULIC ARM

35

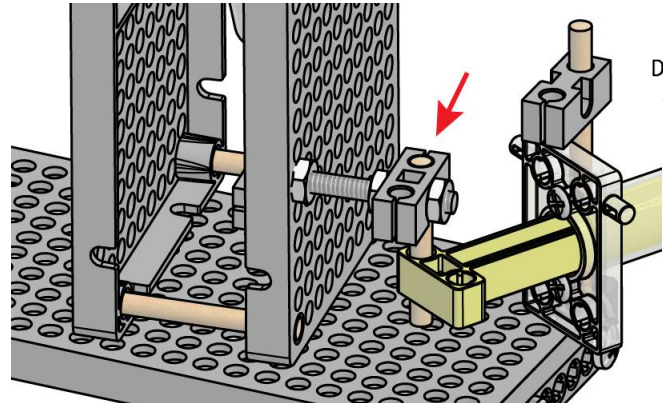
Cut a 60mm (2 3/8") **dowel** and **tap** into the **outer hole** of a **perpendicular block**.



Do not ream any holes.

36

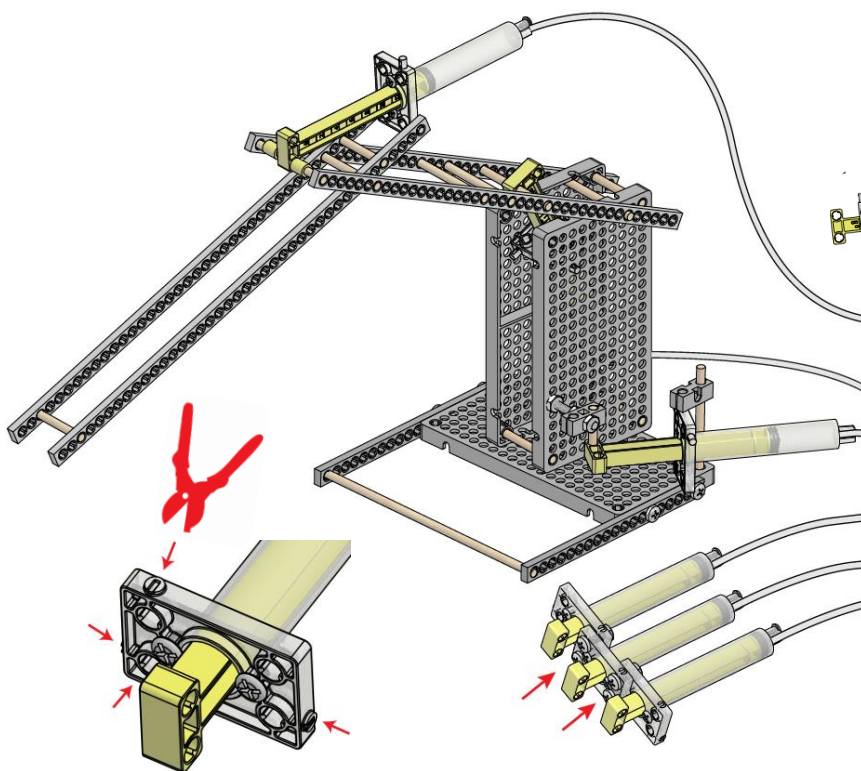
Insert the **dowel** from **Step 35** into the **reamed hole** of the **cylinder's piston** and attach the **block** (through the **center hole**) to the **screw** by using two #10 **nuts** on each side of the **block**.



Do not ream any holes.

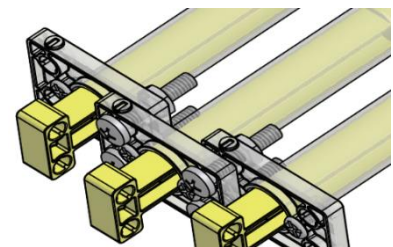
37

Cut the **pegs** off the three **cylinders** that are attached to your arm and use #10 1" **screws** and #10 **nuts** to attach the **cylinders** together to form a **control panel**.



Let's create an **end effector**: a device or tool that is connected to the end of a robot arm (as a hand) and remains controlled by a hydraulic system.

Use the remaining **hydraulic system** from Steps 1-6 (the 13mL **cylinder** connected to the 4.5mL **cylinder**) and cut off the **pegs** of the 13mL **cylinder** and **screw** it to the control panel as well.



Design & Create Your Own End Effector

Think of what tasks your robot could perform, such as gripping, suction, scooping, dispensing, or welding.



Now is the time to **Design & Create** your own end effector. Use guide as example.

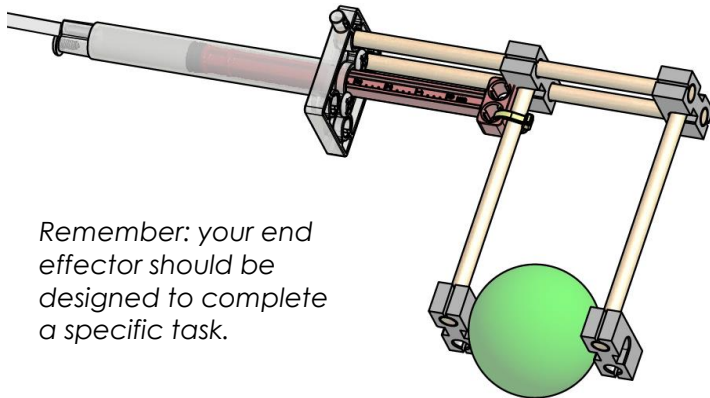
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ADVANCED HYDRAULIC ARM

EXAMPLE GRIPPER

End Effector Options:

- A Create this example gripper (end effector).
- B Create your own end effector.
- C Create the example gripper and then change it into your own end effector.



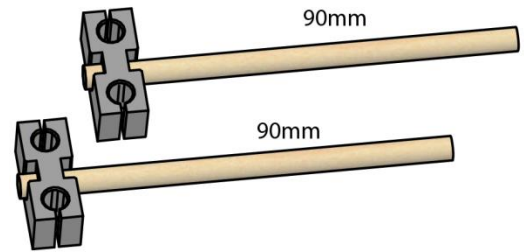
Remember: your end effector should be designed to complete a specific task.

38

Start to create the **gripper** by **cutting** two 90mm (3½") **dowels** and push, wiggle, or tap into the **center holes** of two **blocks**.



Do not ream any holes.

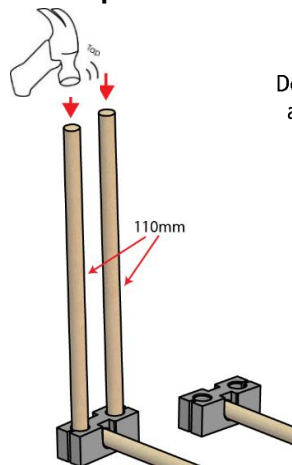


39

Cut two 110mm (4¾") **dowels** and push, wiggle, or tap into the **outside holes** of one of the **blocks** from **Step 38**.

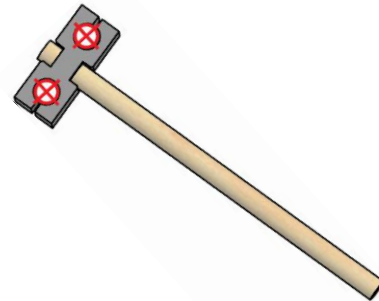


Do not ream any holes.



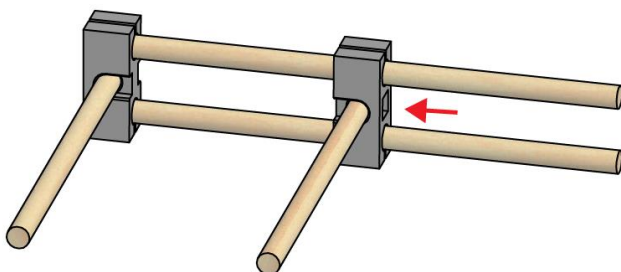
40

Ream the **holes** marked with the  symbol on the remaining **open block** from **Step 38**.



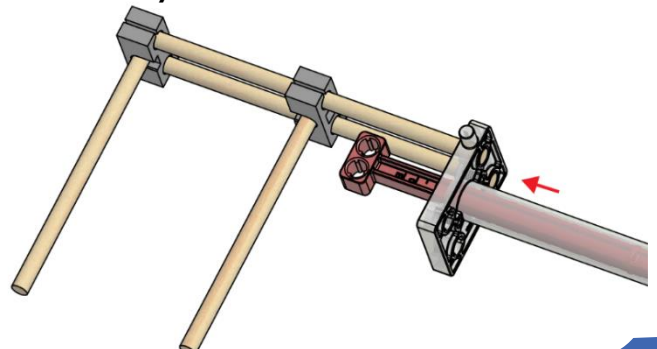
41

Slide the **reamed block** from **Step 40** onto the 110mm (4¾") **dowels** from **Step 39**.



42

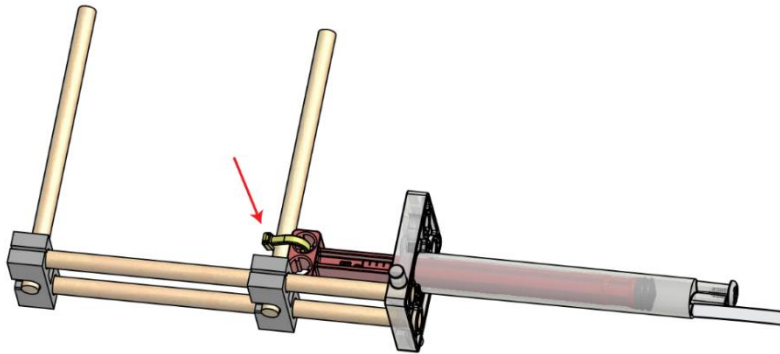
Insert the two **dowels** into the **holes** of the 4.5mL **cylinder**.



ADVANCED HYDRAULIC ARM

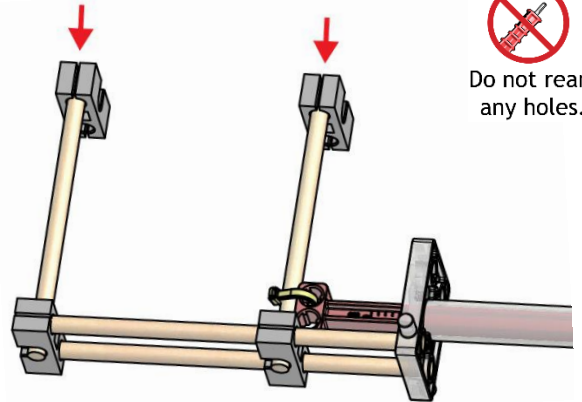
43

Use a **cable tie** to attach the **cylinder's piston** to the **dowel** with the **sliding block**.



44

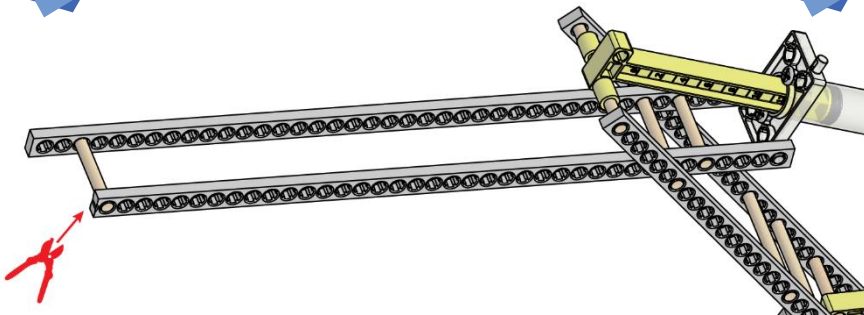
Place two **blocks** on the **ends** of the 60mm (2 3/8") **dowels** to complete the gripper.



Do not ream any holes.

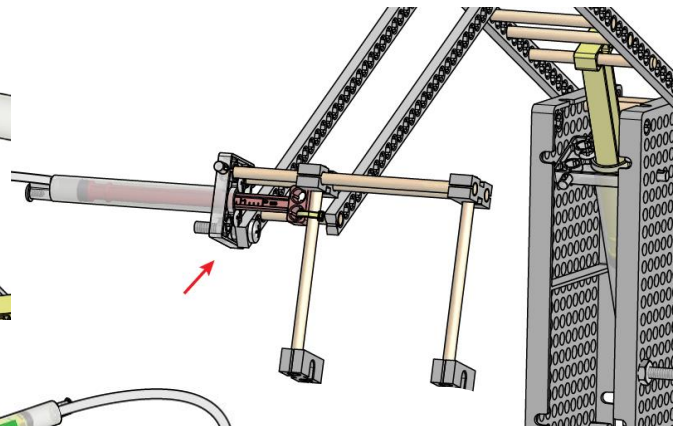
45

Cut the last two **holes** off the **connector strips** of the forearm.



46

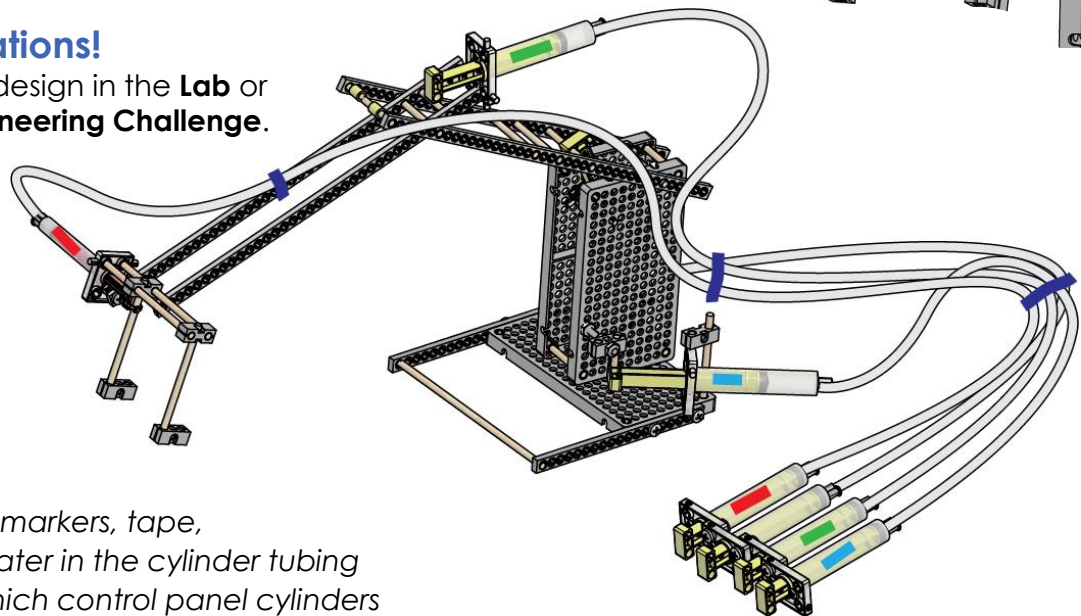
Use a **screw** and **nut** to **attach** the gripper to the forearm.



47

Congratulations!

Now try your design in the **Lab** or **Design & Engineering Challenge**.



Quick Tip

Use different markers, tape, or colored water in the cylinder tubing to identify which control panel cylinders connect to which arm parts.

ADVANCED HYDRAULIC ARM

INSPIRATION

Create your own **end effector** to complete all kinds of tasks. Try building an end effector that will perform gripping, suction, scooping, dispensing, or welding actions.

Use TeacherGeek components and recycling materials to achieve your goal.

