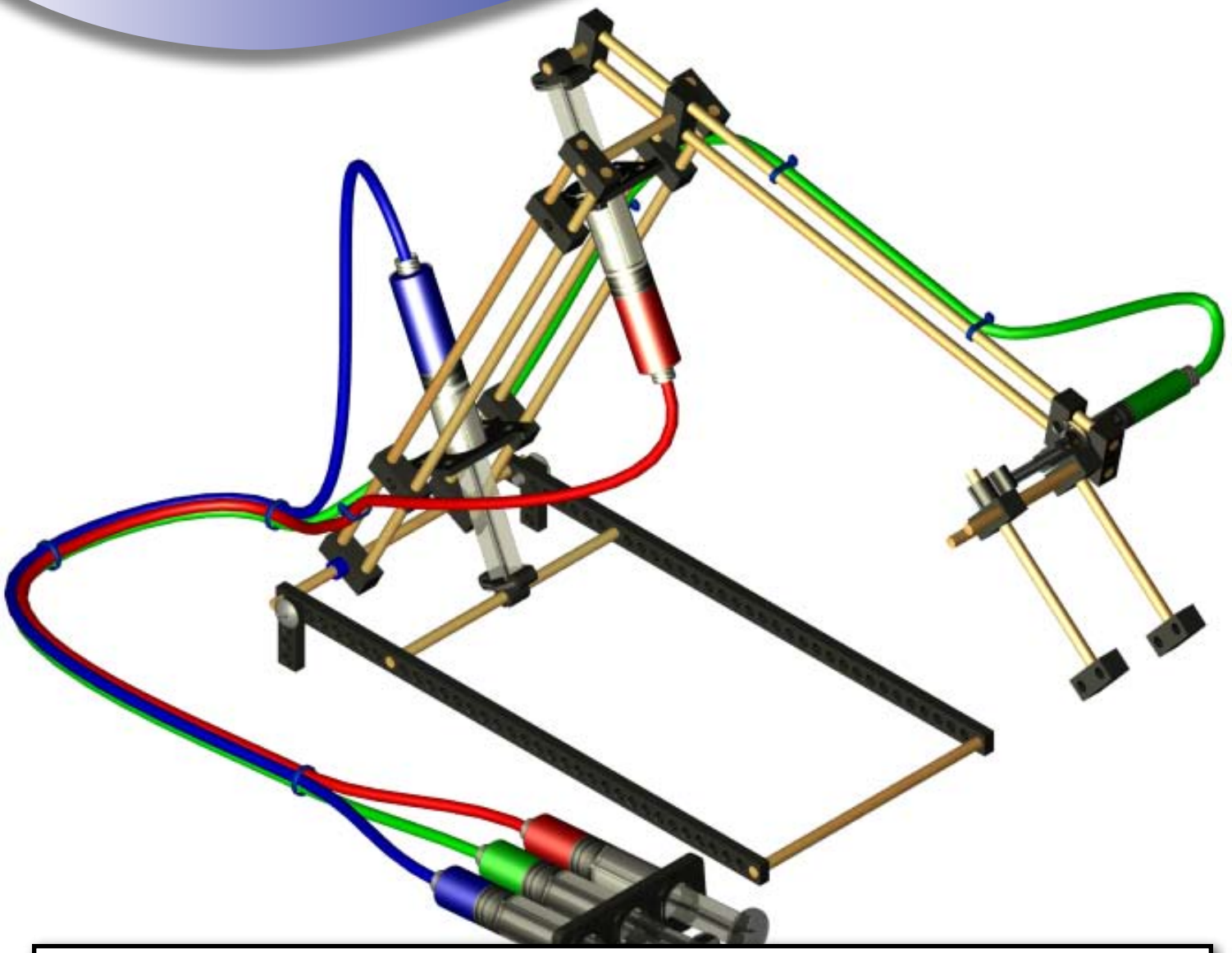
Hydraulic Arm Kit



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PAGES CONTAIN WATERMARKS, PRINTING HAS BEEN DISABLED

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Unleash Your Creativity!

Hydraulic Arm Kit

Parts List

Parts To Build One hydraulic Arm:

5 Large Syringes (10cc)

1 Small Syringe (3cc)

1 Control Panel Mount

2 Syringe Mounts

11 Feet of Hydraulic Tubing

1 Small Syringe Clips

2 Large Syringe Clips

2 Link Strips

16 Perpendicular Adapters

8 5mm x 24” Dowels

2 #12 - 1/2” Screws

1 Inch of Slide Stop Material

8 Zip Ties

"Kit" Can Be a Bad Word:

Don't think of this as a kit. Think of it as a bag full of endless solutions. Although the end of this guide contains step-by-step instructions for creating a hydraulic arm, we encourage you (your students) to try and develop new and different designs.

Because, in design and engineering, there is never one right answer…

TeacherGeek Easy Engineering Series products are designed to encourage innovation and alternative designs. We encourage you to use the Easy Engineering Components to create your own brilliant solutions.

Because, your first idea is rarely your best…

TeacherGeek Easy Engineering Series products are designed to be redesigned; they allow you to quickly change and evolve your designs.

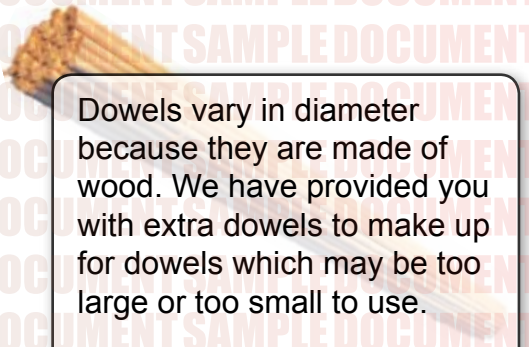
Because, possibilities are endless…

TeacherGeek Easy Engineering Components can be easily combined with other materials and products (Raid the recycling bin, wood, metal, broken toys, etc.)

Hydraulic Arm Competition Ideas:

Design an arm that will:

- reach the greatest distance to deliver a given object
- pick up the heaviest possible object
- deliver the most objects in a given amount of time
- function in an assembly line
- have a system to weigh the object it picks up
- battle against another arm for an object
- rotate as well as reach and grab



Dowels vary in diameter because they are made of wood. We have provided you with extra dowels to make up for dowels which may be too large or too small to use.

Other Documents That Could Help You With This Activity:

Download

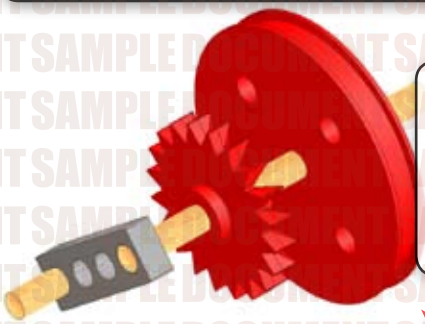
Document:	Path:	Access Code:
Easy Engineering Guide	teachergeek.org/easy_engineering_guide.pdf	No Code Required
Easy Engineering Ruler	teachergeek.org/ruler.pdf	No Code Required

Dowels and Holes

Easy Engineering™ Components come with holes that are the perfect size for a press fit with dowels.

A press fit is one where the dowel is fixed and not able to rotate or slide once it's in the component hole. A press fit is good for creating rigid structures.

Press fits are good for structural connections.



Press fits are good for gears, pulleys and levers that turn together on the same dowel (axle).

Learn how to use a reamer on page 3

Reaming Holes

Slide Fit

A Slide Reamer makes it easier to push or pull a dowel through a hole.

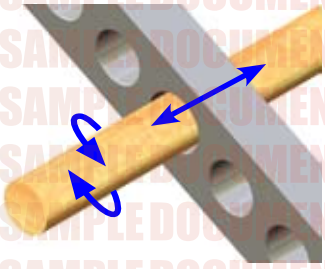
*Having trouble getting a dowel into a hole? Ream it with the Slide Reamer.

This hole in the perpendicular adaptor was reamed with the Slide Reamer to make it easier for it to slide to the middle of the dowel.

Loose Fit

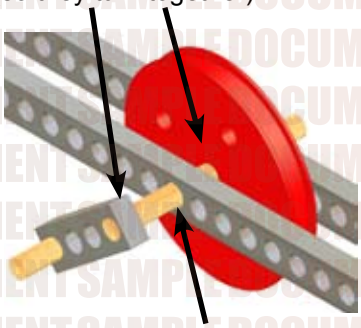
The Loose Reamer creates a hole that dowels can freely rotate in and slide through.

A loose fit is typically used to support axles, wheels and pulleys. It is also used for pivot points.



The dowel moves freely in the loose fitting hole.

The crank and pulley are press fit onto the same dowel (so they turn together).



The link strip holes that the dowel needs to rotate in were reamed with the Loose Reamer.

The Loose Reamer creates a hole that is larger than the dowel.

How to Ream Holes

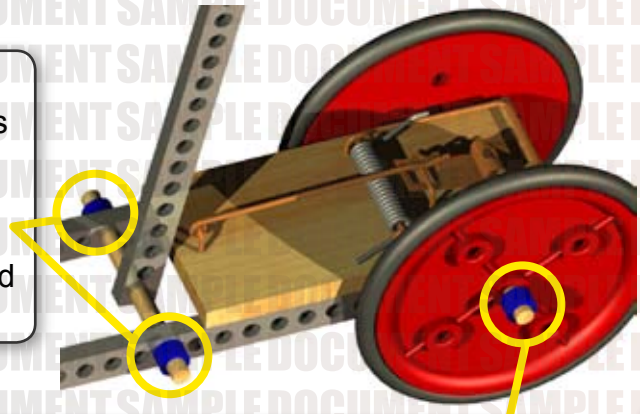
Pull and push the reamer in and out of the hole.

Turn the reamer inside the hole.

To further enlarge a hole, as you ream it, move the end of the reamer around so it is not in line with the hole.

Side-Stop Material

Slide-Stop Material comes in long lengths. It must be cut into 6mm (~1/4") sections before it can be used.



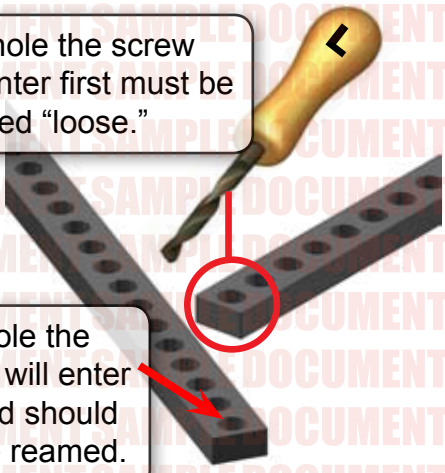
Slide-Stop Material keeps dowels from sliding back and forth in "loose" reamed holes.

Slide-Stop Material keeps components with "loose" reamed holes from sliding back and forth on dowels.

Screws

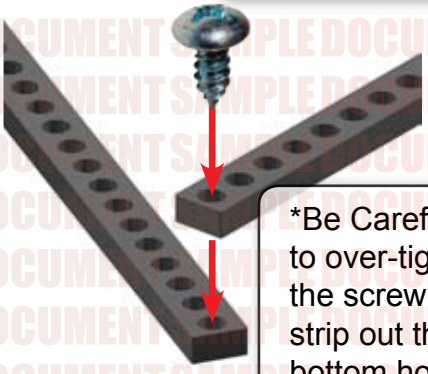
Screws can be used to attach two components together.

The hole the screw will enter first must be reamed "loose."



The hole the screw will enter second should not be reamed.

Turn the screw into both components.



*Be Careful not to over-tighten the screw and strip out the bottom hole.

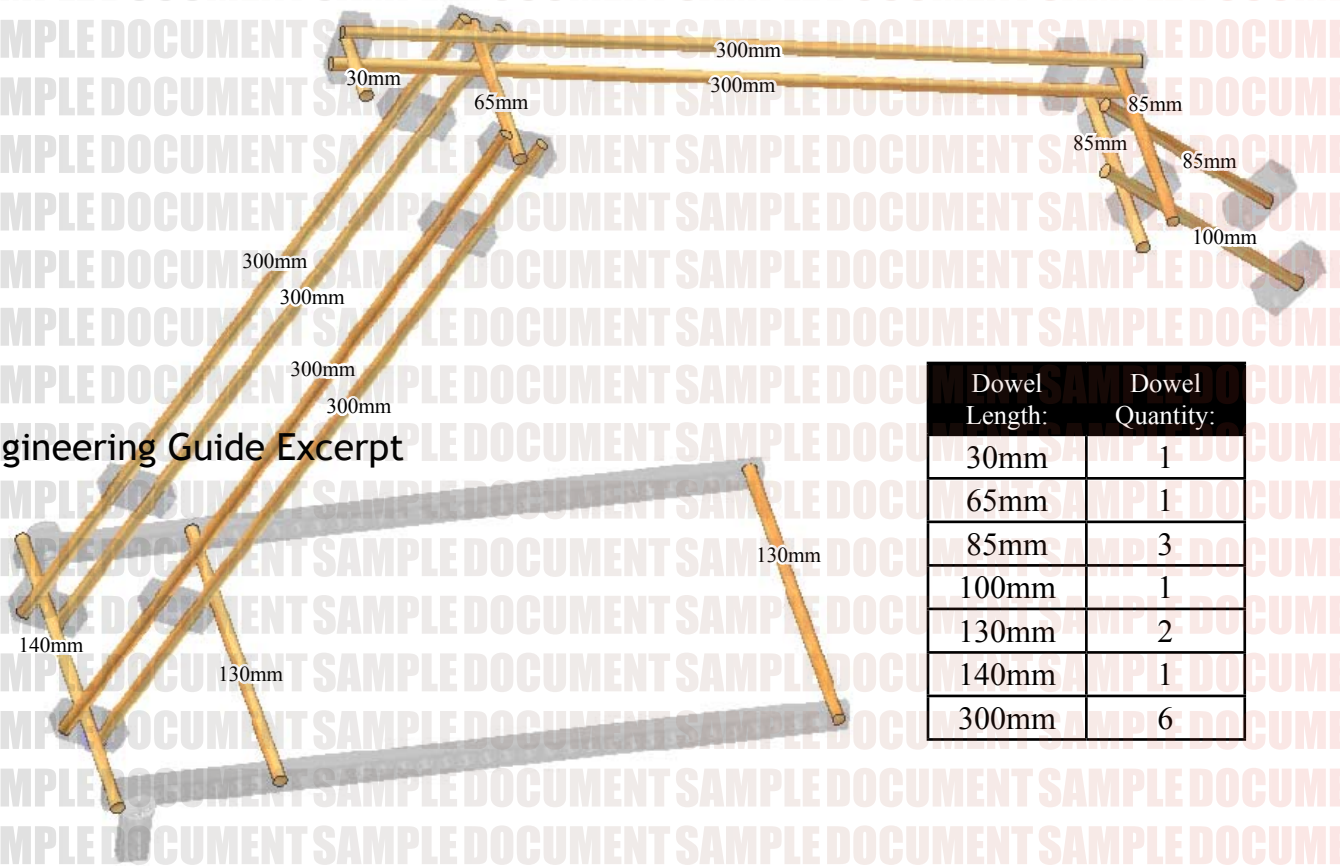
Tighten the screw completely to keep components from rotating.

OR

Leave the screw a ¼ turn from tight to allow components to rotate/pivot.

STEP 1: CUT THE DOWELS

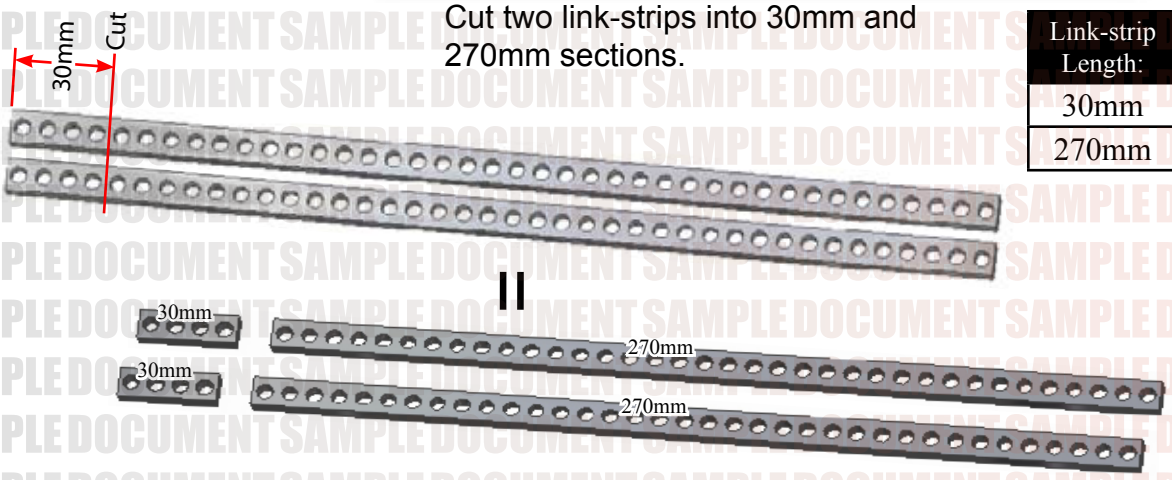
Cut dowels to the given lengths.



Dowel Length:	Dowel Quantity:
30mm	1
65mm	1
85mm	3
100mm	1
130mm	2
140mm	1
300mm	6

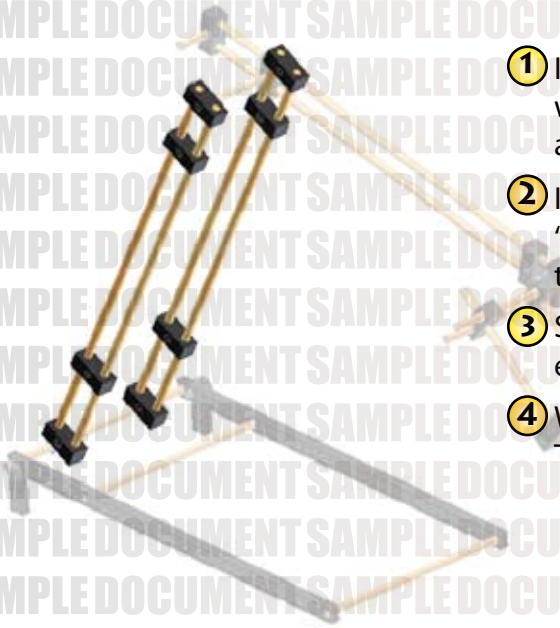
STEP 2: CUT THE LINK-STRIPS

Cut two link-strips into 30mm and 270mm sections.

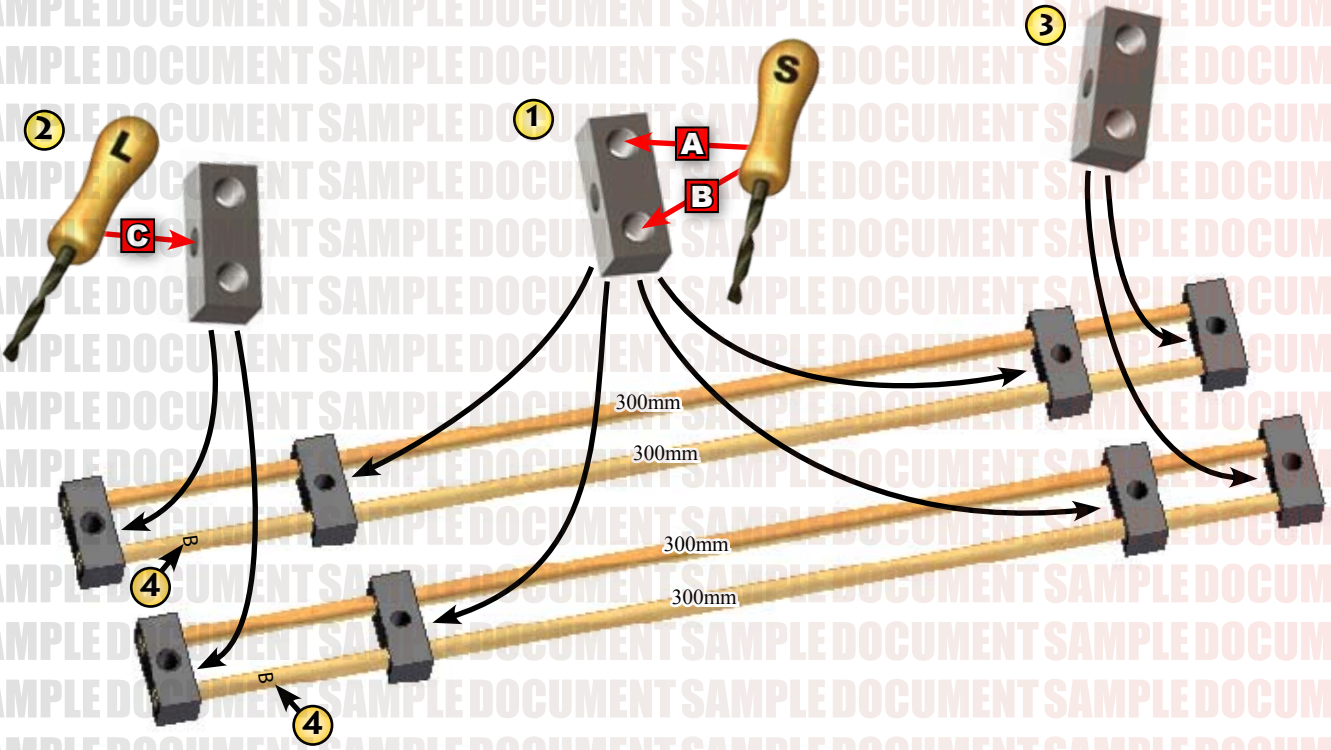


Link-strip Length:	Link-strip Quantity:
30mm	2
270mm	2

Step 3: Assemble The Lower Arm Members

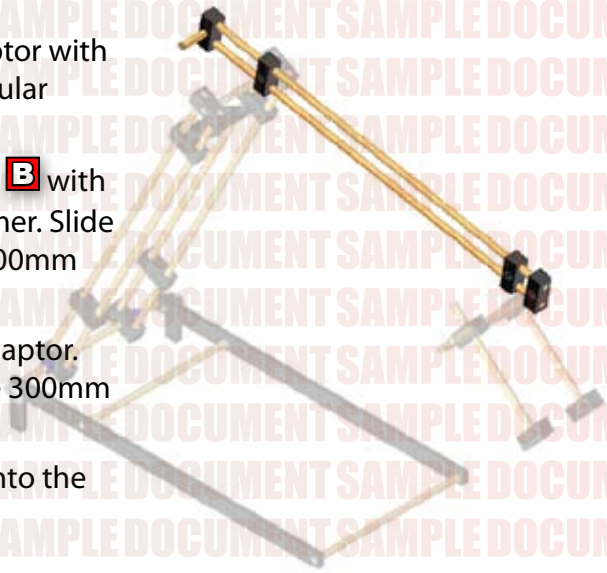


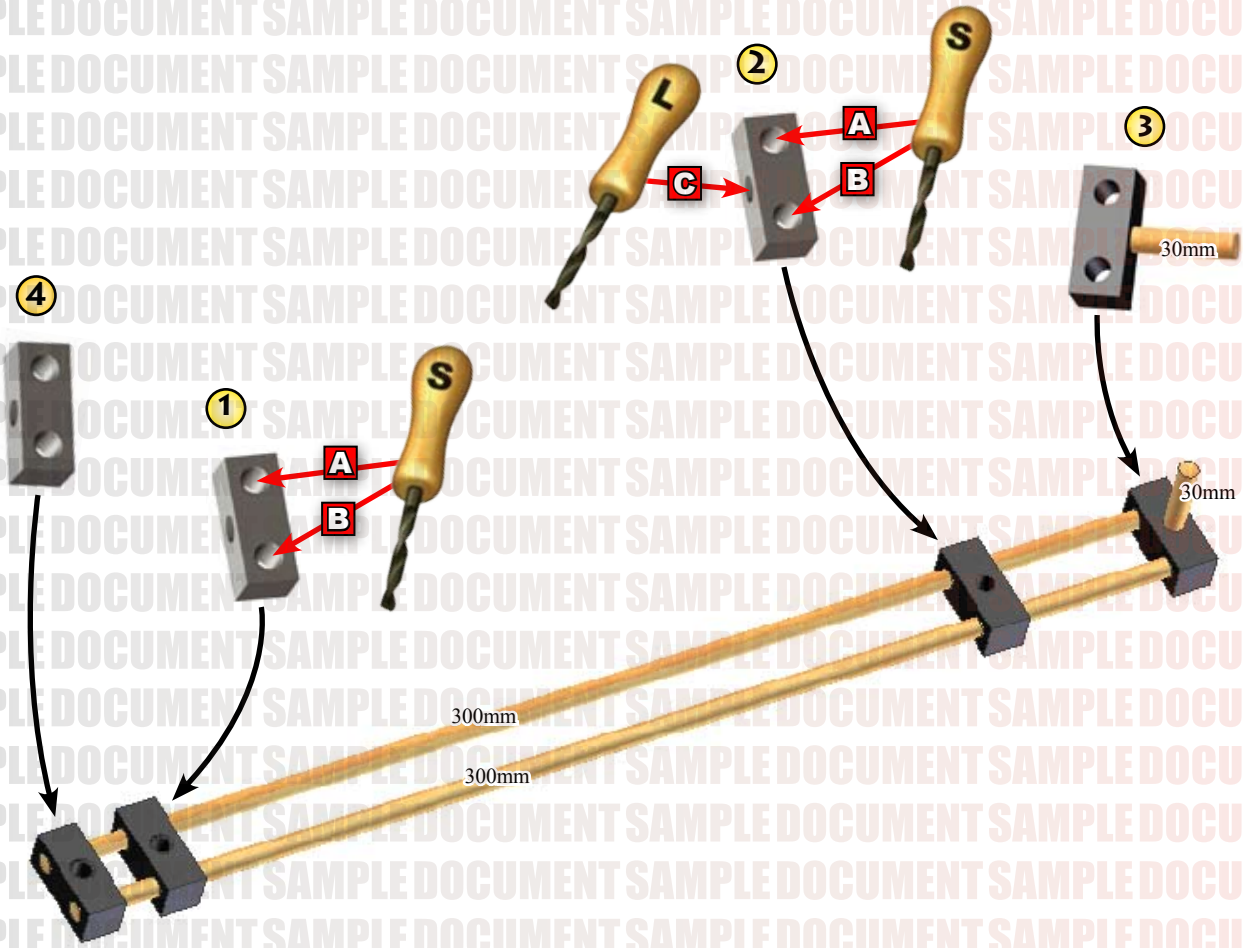
1. In 4 perpendicular adaptors, ream holes **A** and **B** with the "slide" reamer. Slide the reamed perpendicular adaptors onto the 300mm dowels (as shown).
2. In 2 perpendicular adaptors, ream hole **C** with the "loose" reamer. Slide the perpendicular adaptors onto the ends of the 300mm dowels (as shown).
3. Slide 2 non-reamed perpendicular adaptors onto the ends of the 300mm dowels (as shown).
4. Write a "B" next to the perpendicular adaptors from 2. The "B" indicates the bottom of the arm members.



Step 4: Assemble The Upper Arm Member

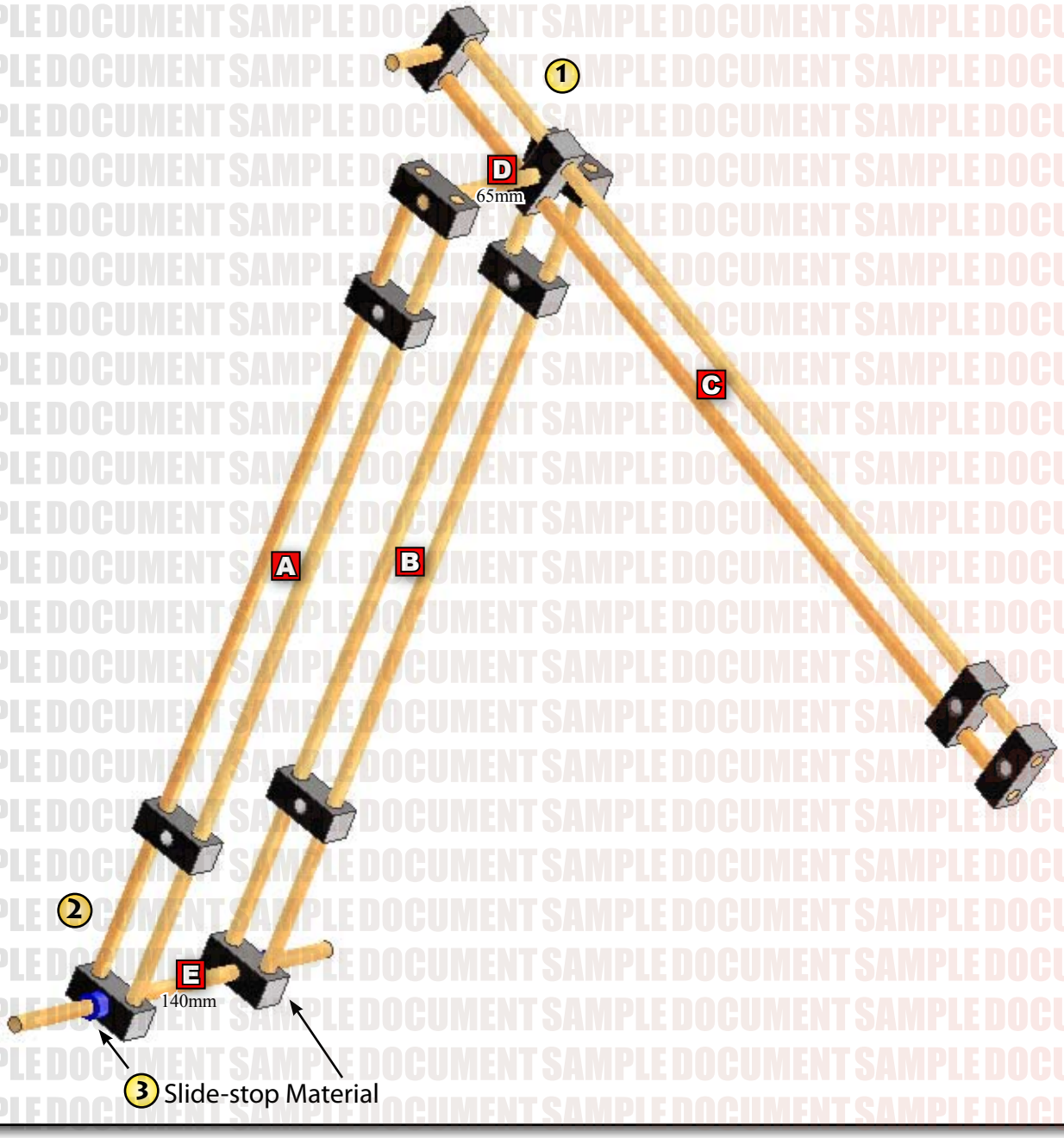
1. Ream holes A and B in a perpendicular adaptor with the "slide" reamer. Slide the reamed perpendicular adaptor onto the 300mm dowels (as shown).
2. In a perpendicular adaptor, ream holes A and B with a "slide" reamer and hole C with a "loose" reamer. Slide the reamed perpendicular adaptor onto the 300mm dowels (as shown).
3. Slide the 30mm dowel into a perpendicular adaptor. Then slide the perpendicular adaptor onto the 300mm end of the dowels (as shown).
4. Slide a non-reamed perpendicular adaptors onto the end of the 300mm dowels (as shown).





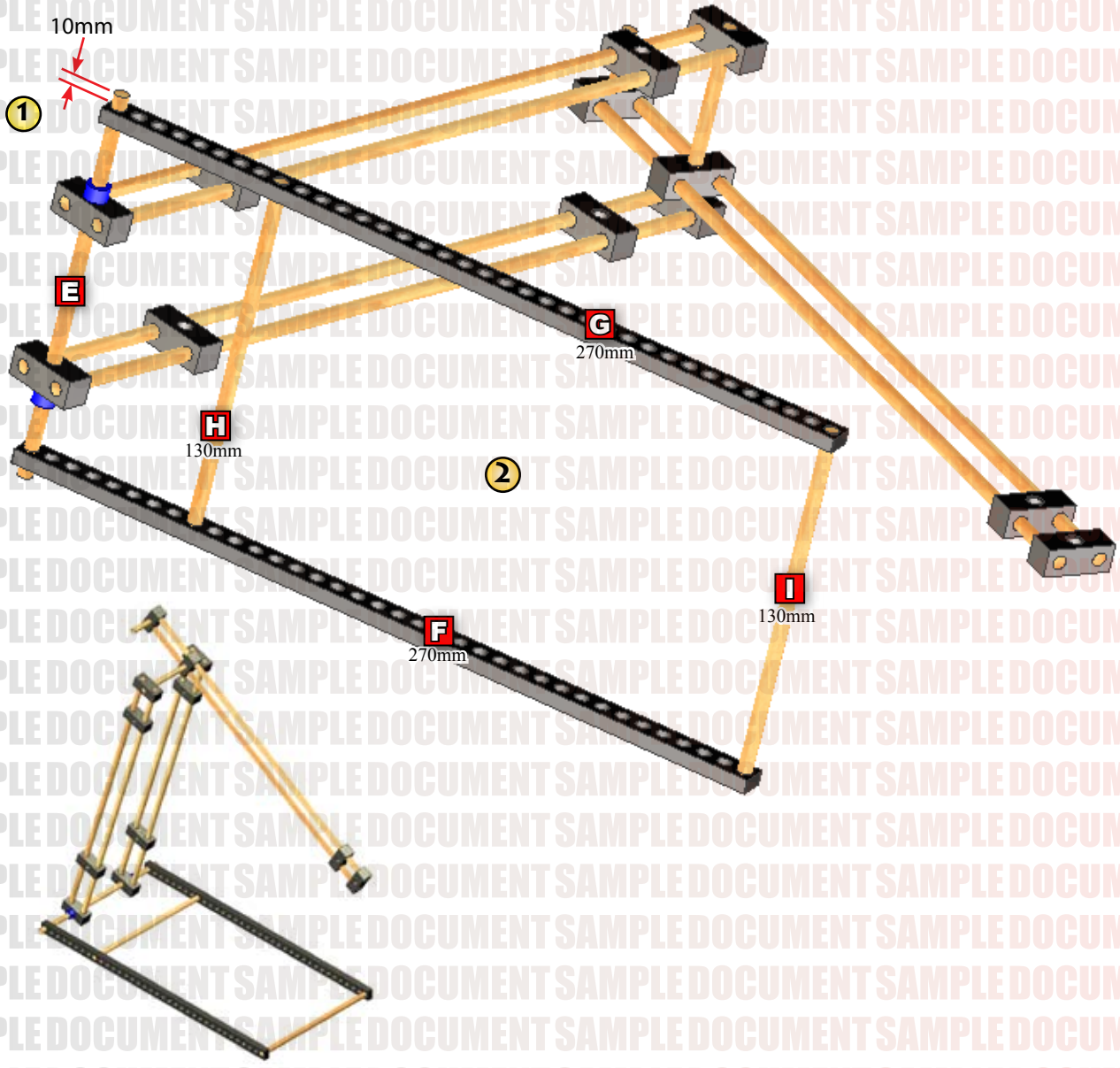
Step 5: Put The Arm Members Together

1. Slide the upper arm (C) onto the 65mm dowel (D). Then slide dowel D into the top of members A and B.
2. Slide the 140mm dowel (E) into the bottom of members A and B. Center dowel E on members A and B, while keeping members A and B 45mm apart.
3. Cut two 6mm sections of slide-stop material and place them outside of members A and B on dowel E. Members A and B should stil be 45mm apart.



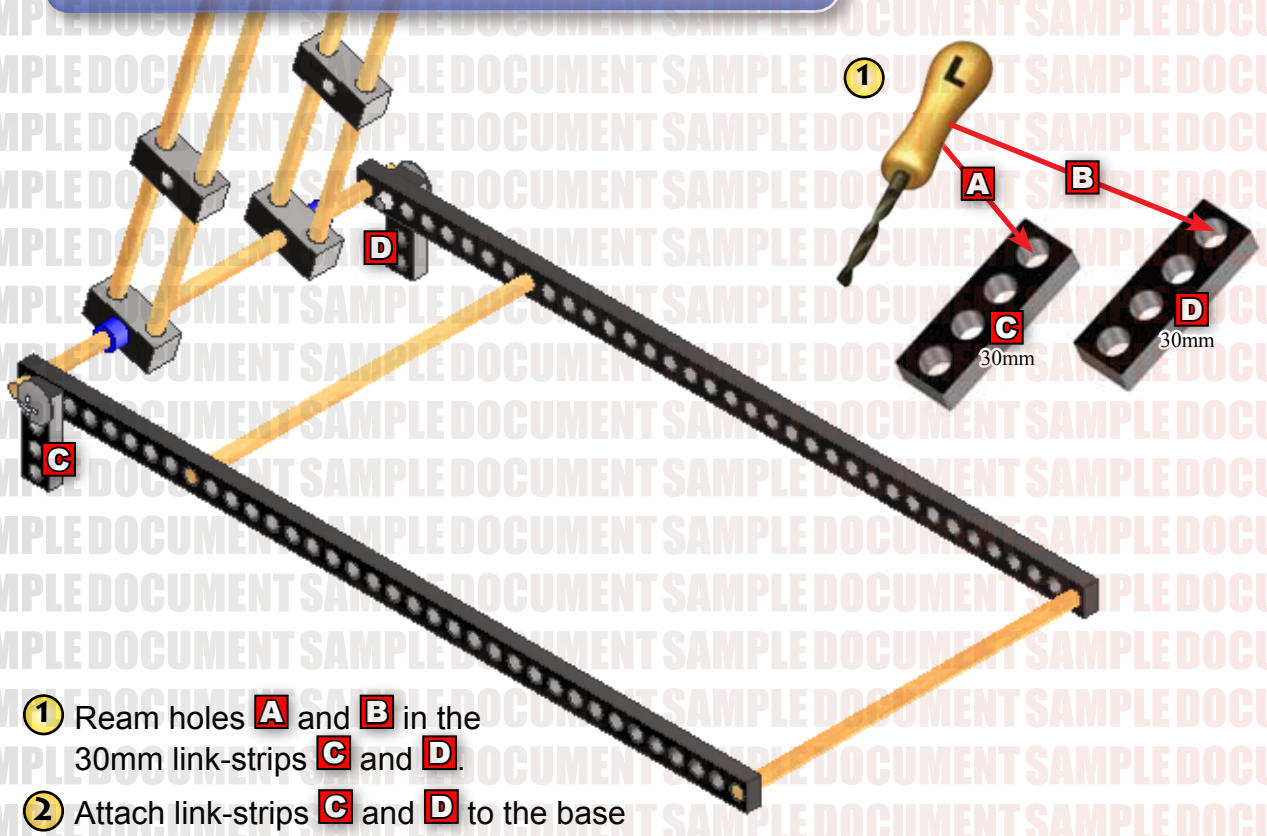
Step 6: Assemble The Base

1. Place link-strips G and F onto dowel E (dowel E from step 5). Dowel E should extend 10mm past link-strips G and F.
2. Place 130mm dowels H and I in between link-strips G and F (as shown).



Step 6, Finished

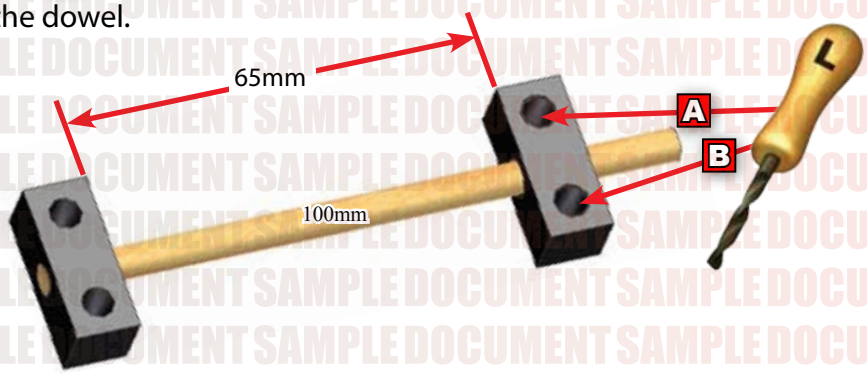
Step 7: Give It Legs



1. Ream holes A and B in the 30mm link-strips C and D.
2. Attach link-strips C and D to the base by screwing them through reamed holes A and B.

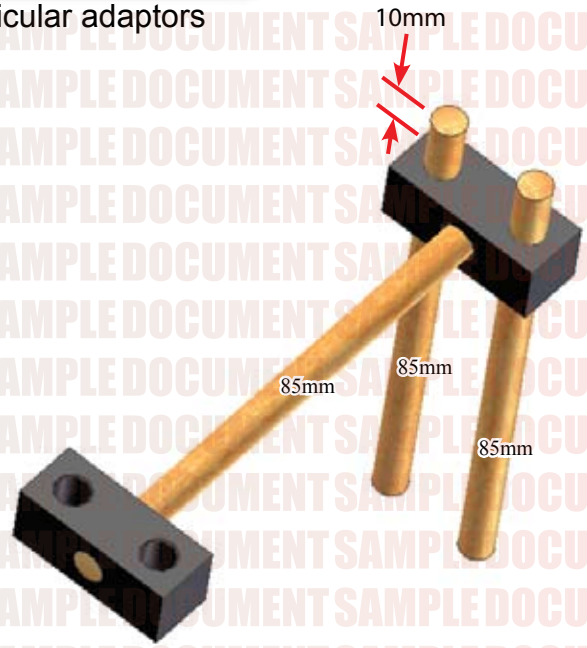
Step 8: Assemble The Gripper Finger

Place 2 perpendicular adaptors, 65mm apart, on the 100mm dowel. (as shown). Ream holes A and B in the perpendicular adaptor which is in from the end of the dowel.



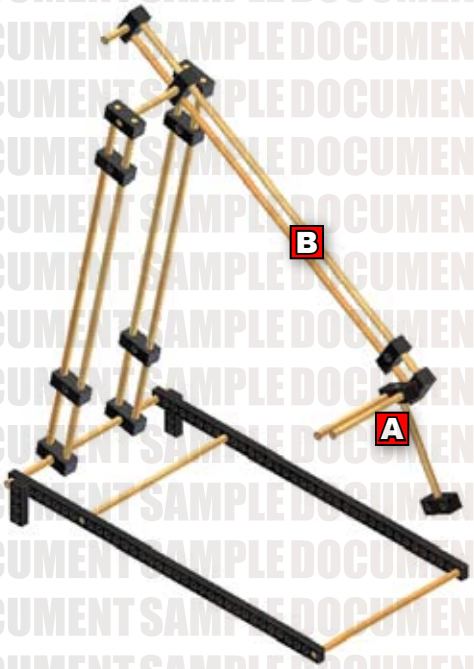
Step 9: Assemble The Gripper Body

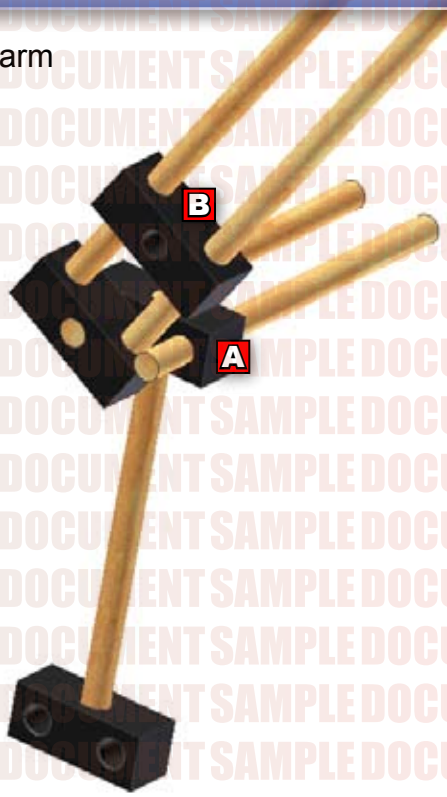
Create the gripper body using two perpendicular adaptors and three 85mm dowels.



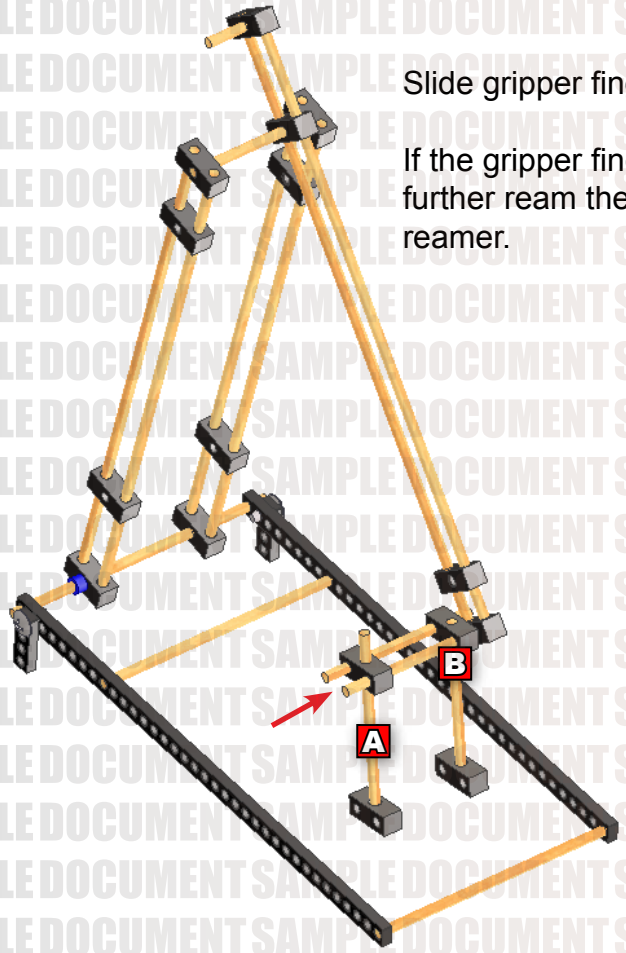
Step 10: Attach Gripper Body To The Upper Arm

Place the gripper body (A) on the end of the upper arm member (B).





Step 11: Finish The Gripper



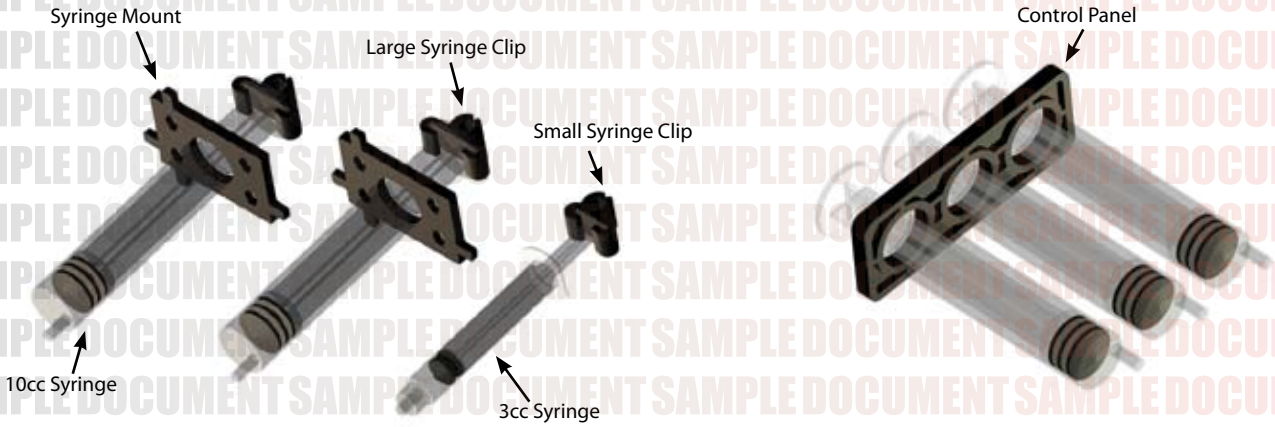
Slide gripper finger A (from step 8) onto gripper body B.

If the gripper finger does not slide freely on the dowels, further ream the holes in the gripper finger with a “loose” reamer.

Congratulations!!! Your Arm Frame Is Finished. Now Let’s Start The Hydraulics.

Caution: Wood dowels can not get wet. If they become wet, they swell and cause joints to stick.

Step 12: Assemble The Hydraulic Cylinders



Step 13: Cut The Hydraulic Lines

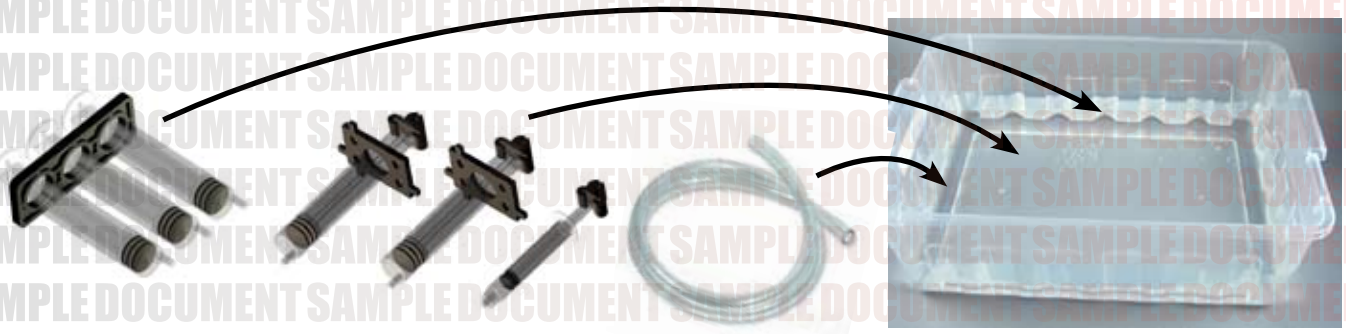
Cut three sections of clear 1/8 I.D. vinyl tubing:

70cm (~27.5")

75cm (~29.5")

110cm (~43.5")

Step 14: Put The Tubing and Cylinders into a Tub of Water

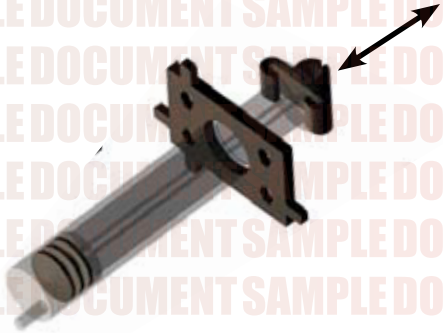


Food coloring can be added to better see the fluid flow through the hydraulic system.

STEP 15: PURGE THE AIR FROM THE CYLINDERS

PERFORM THIS PROCESS UNDER WATER.

Push and pull the plungers to purge all air from the cylinders.



STEP 16: FILL CYLINDERS WITH WATER

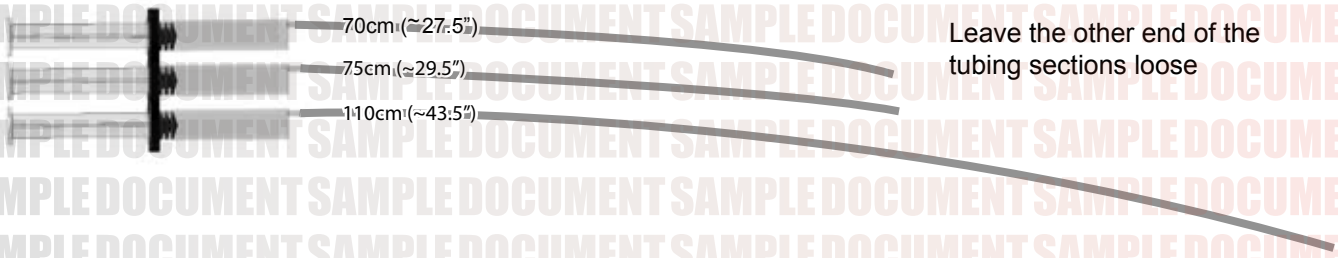
PERFORM THIS PROCESS UNDER WATER.

Pull back the plungers on all the cylinders.

STEP 17: ATTACH TUBING (TO THE CONTROL PANEL)

PERFORM THIS PROCESS UNDER WATER.

Attach tubing sections to the syringes on the control side of the hydraulic system.

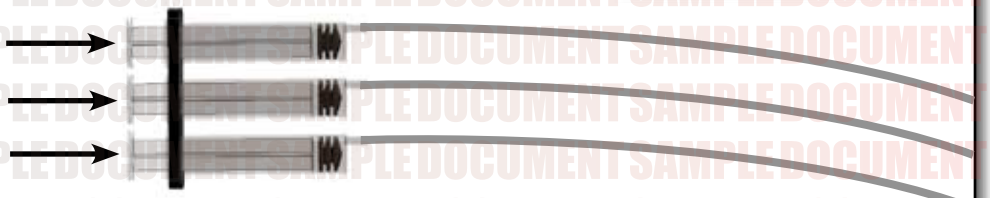


Leave the other end of the tubing sections loose

Step 18: Purge Air From The Tubing

Perform this process under water.

Push in the plungers on the control panel syringes. Leave them pushed in.

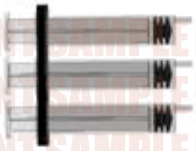


Step 19: Unattached Cylinders Should Be Full of Water.

Perform this process under water.

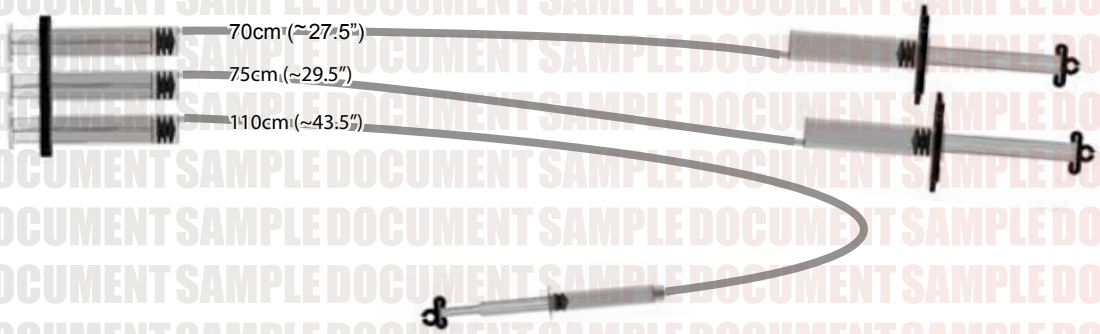
Pull back the plungers and draw water into cylinders that have no tubing connected to them.

Note: Keep the control panel plungers pushed in.

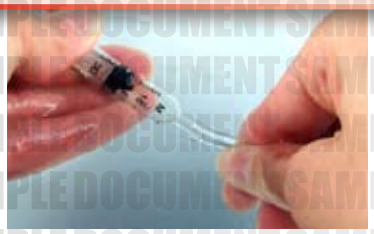


Step 20: Connect The Unattached Cylinders

Perform this process under water.



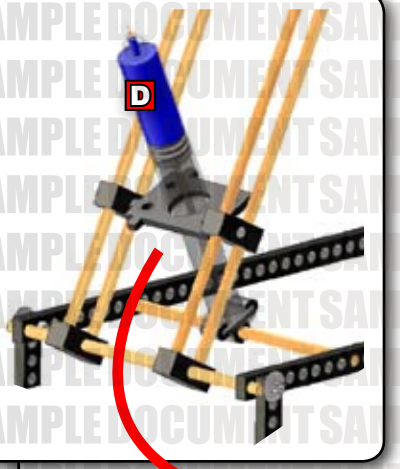
Step 21: One Last Check

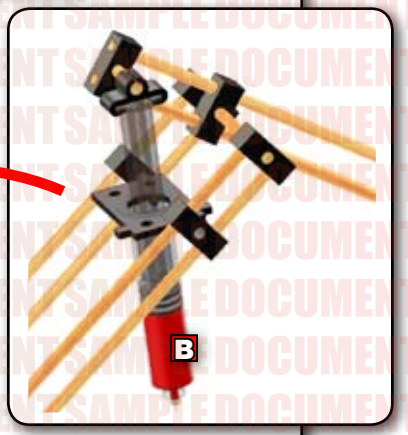


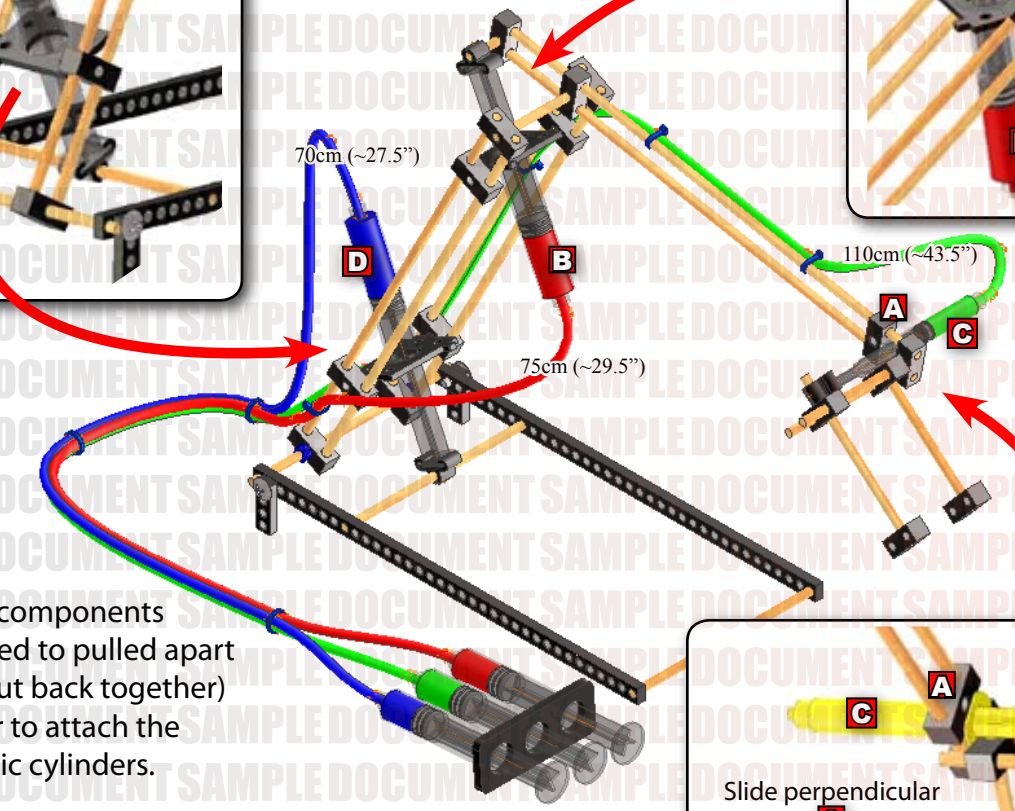
Move the plungers on the hydraulic cylinders. Do they have enough throw (travel)? If not, you may need to place the hydraulic system back under water where you can pull the tubing from a cylinder to add or remove water from the system.

Step 22: Combine the Frame and Hydraulics

Attach the hydraulic cylinders to the frame.

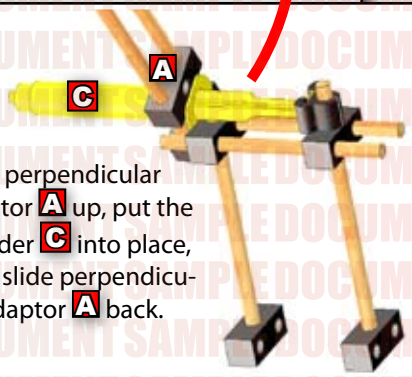






*Some components may need to pulled apart (then put back together) in order to attach the hydraulic cylinders.

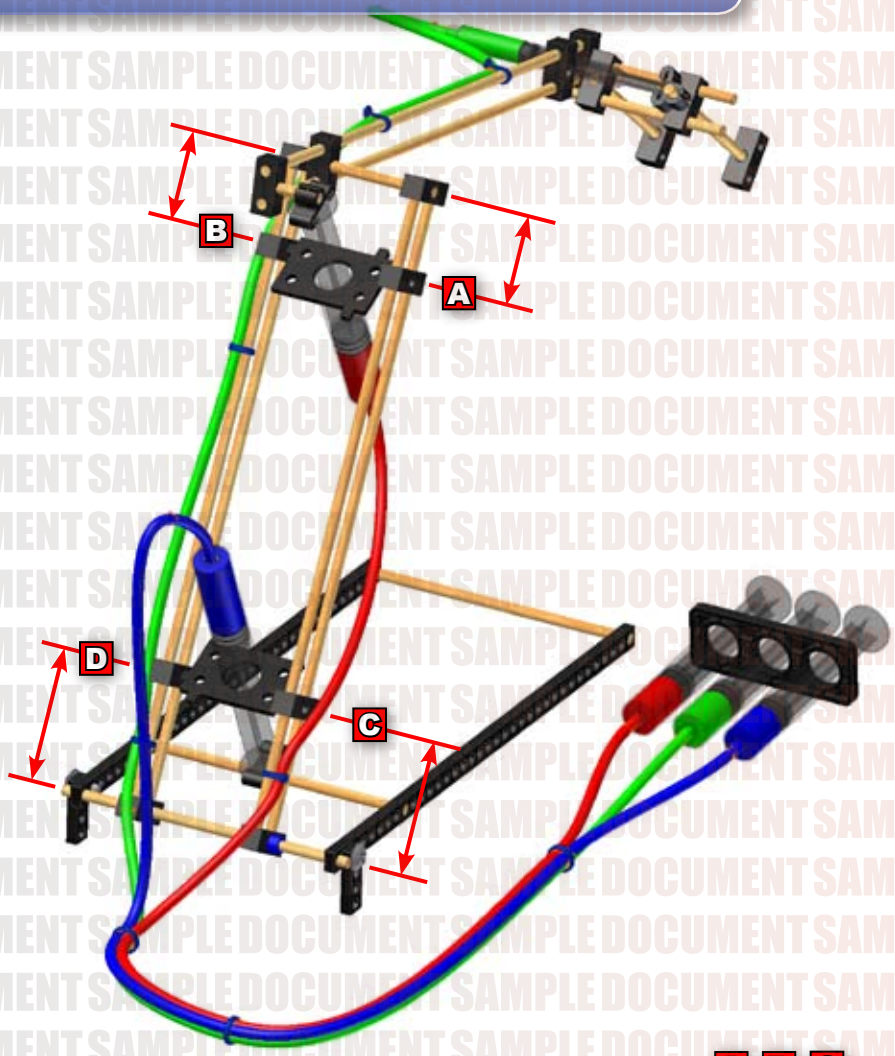
Zip ties can be used to organize the tubing.



Slide perpendicular adaptor A up, put the cylinder C into place, then slide perpendicular adaptor A back.

Syringe "C" is colored yellow for this illustration.

Step 23: Adjust The Arm



Sliding the perpendicular adaptors attached to the syringe mounts (A, B, C and D) changes the travel/mechanical advantage of the arm.

Perpendicular adaptors A and B should always be horizontal with each other. Perpendicular adaptors C and D should always be horizontal with each other.

Congratulations!!! Your Hydraulic Arm is Finished.

