Trainer 1: LUNG & HEART SIMULATOR

Simulates arteries supplying blood from heart to the lungs

Prepared by:

SMAP CENTER

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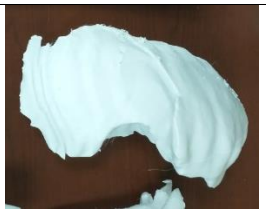
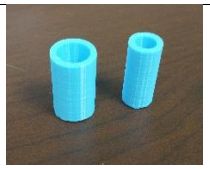
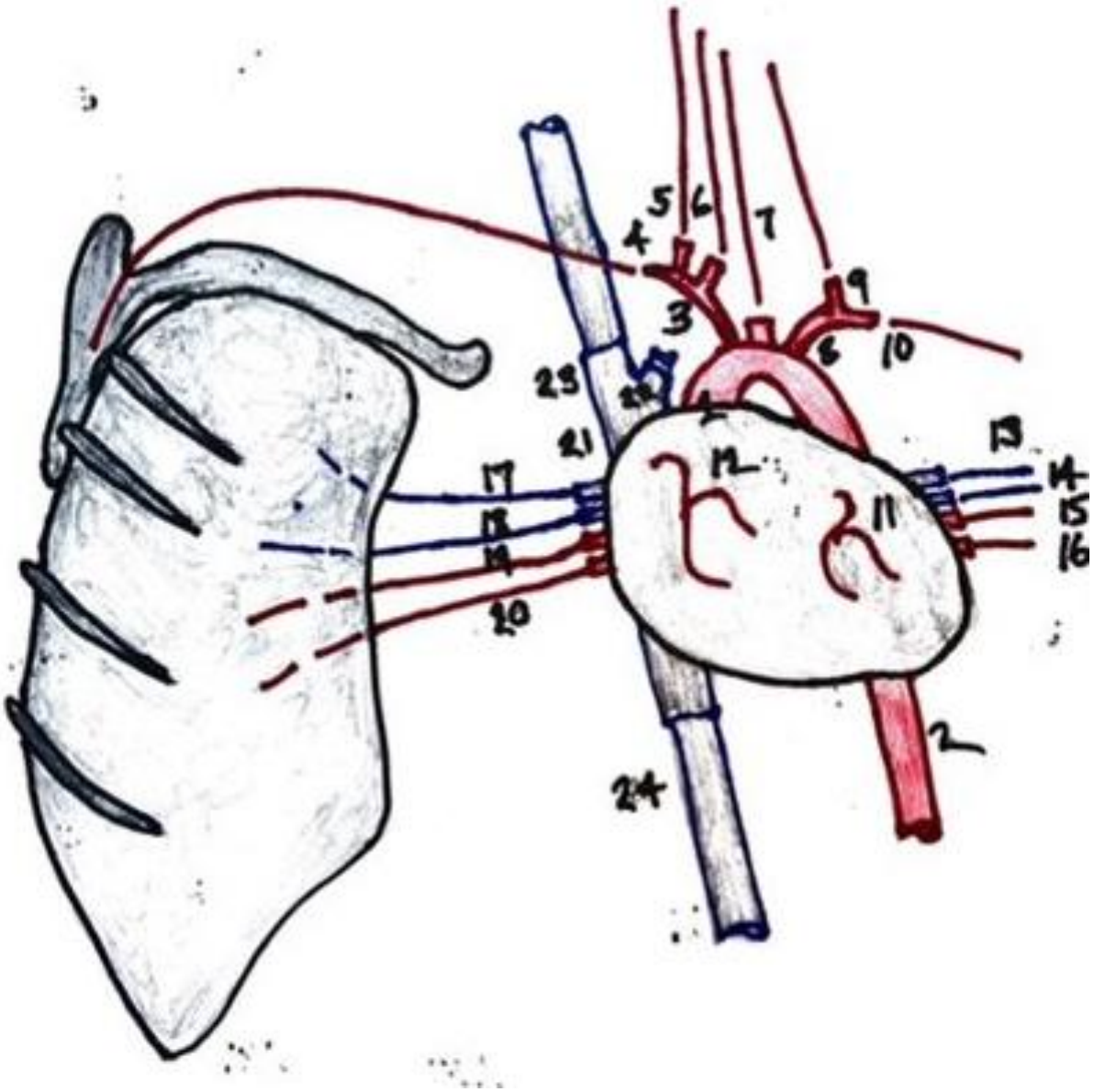
MATERIALS AND TOOLS:

Plywood Base 12x14x0.75 inches	
Super glue (with cyanoacrylate)	
Silicone cord	
Scissors or hobby knife	

3D MODELS: Download from MEDNET (https://www.uahmednet.org) and print
***The following models were separated and/or significantly modified from original designs not licensed by SMAP. More details at the end of this manual.*

Model Name	Quantity	Picture
“Right ribs set 1”	1	
“Lung L”	1	
“Heart_NEW”	1	
“Clavicle L”	1	
“Brachiocephalic trunk”	1	
“Left subclavian trunk”	1	
“Support block” & “Support block 0.5” (from right to left)	1 (of each)	
“8-mm sleeve” and “5-mm sleeve” (from left to right)	2 (of each)	

SCHEMATIC OF ARTERIES



The descriptions of the numbers are given in the table below.

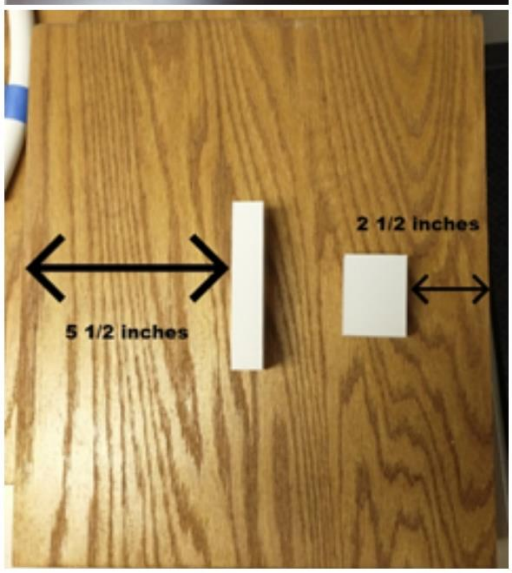
Table 1: Each artery and their diameters

Number	Artery	Diameter (mm)
1	Ascending aorta	-
2	Descending aorta	14
3	Brachiocephalic trunk	8
4	Right subclavian trunk	5
5	Right vertebral	4
6	Right common carotid	7
7	Left common carotid	7
8	Left subclavian trunk	8
9	Left vertebral	4
10	Left brachial	5
11	Left coronary	-
12	Right coronary	-
13	Left pulmonary	8
14	Left pulmonary (small)	5
15	Left superior pulmonary vein	5
16	Left inferior pulmonary vein	6
17	Right pulmonary	8
18	Right pulmonary (smaller)	5
19	Right superior pulmonary vein	5
20	Right inferior pulmonary vein	5
21	Superior vena cava	8
22	Left brachiocephalic vein	7
23	Right brachiocephalic vein	8
24	Inferior vena cava	16

ASSEMBLY

Setting up the board:

You're ready to begin! Make sure that the board you are roughly has the correct dimensions (12x14x0.75 inches)

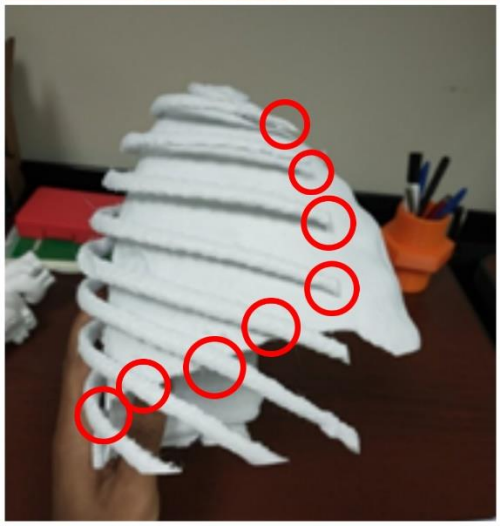


Lay the "support block" on its thin side and the "support block 0.5" on its wider side as show in the second image.

Before permanently attaching the blocks to the board with the DURO superglue, make sure that both blocks are distanced as shown in the second image.

Apply the glue when ready. DURO superglue dries quickly, but wait at least 10 seconds before any contact.

Joining the rib cage and lung:



Next part to is to glue the rib cage to lung.

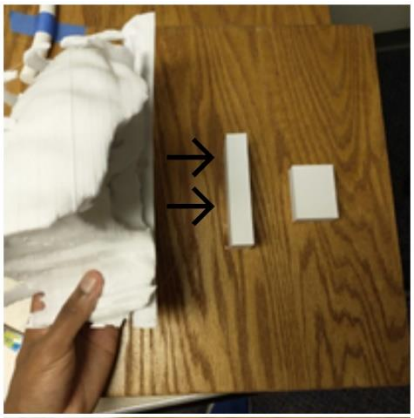
First, fit the lung nicely within the rib cage. If necessary, get another person to hold the rib cage and lung in place while you do the gluing.

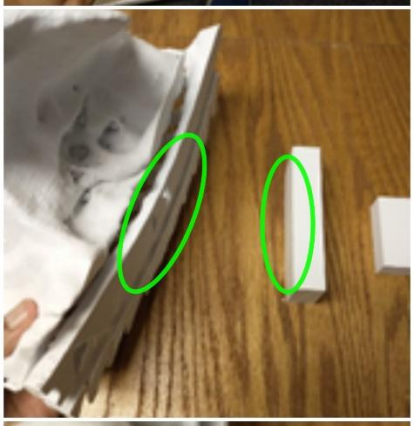
Take one tube of glue and apply a glob or two between each rib and the lung. The recommended areas are circled in red.

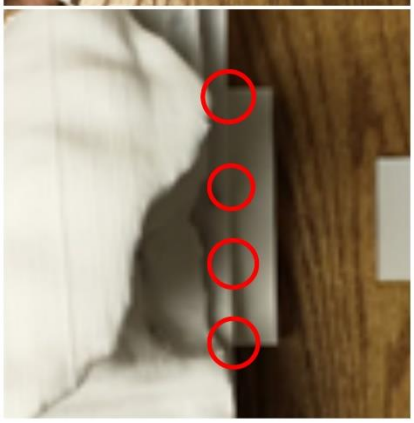
Remember to wait at least 10 seconds for the glue to dry before any kind of contact.

If you think you need to add glue to other areas, feel free, but remember to be conservative with the amount.

Joining lung/rib cage to board:







Position the newly assembled lung/rib cage in respect to the long block in the first image.

VERY IMPORTANT, it is recommended that you not apply any glue until you've mated the side of the rib cage with the long block.

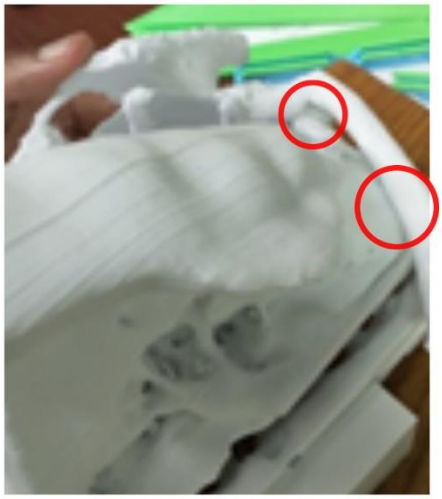
These are circled in green.

Once you've done that, apply drops of glue in the area between the rib cage and block.

The recommended areas are circled in red.

If you like, you can also apply glue between the rib cage and board AFTERWARDS.

Putting in the collarbone:

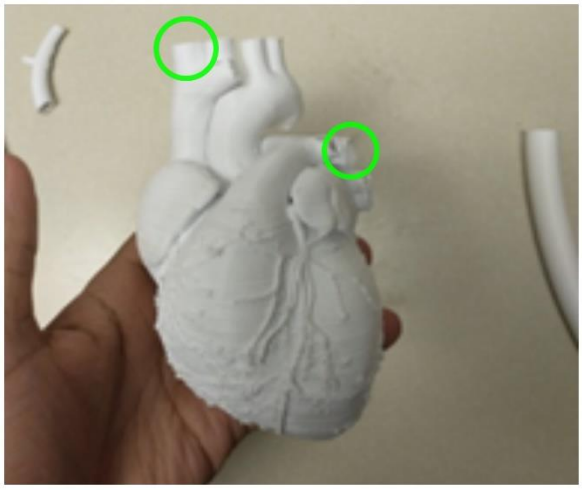


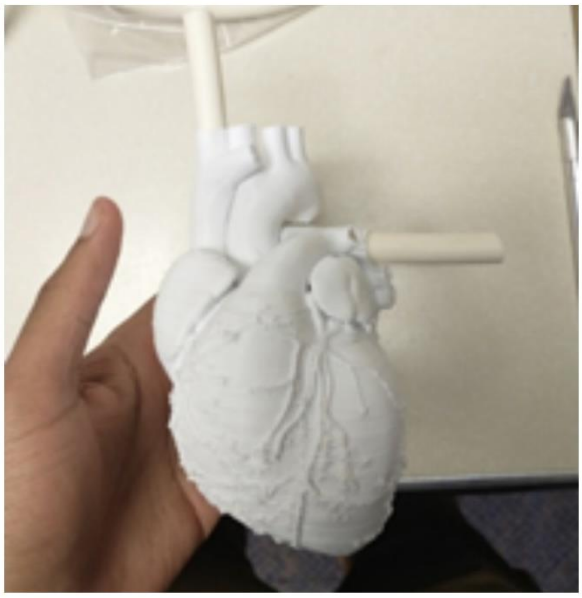
This portion will likely need two people.

Arrange the collarbone, also known as the clavicle next to the rib cage, as shown in the first image.

Apply glue between the rib cage and clavicle. The recommeded areas are circled in red.

Assembling the heart:





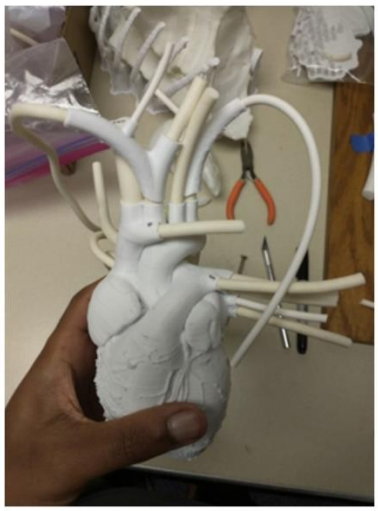
Cut a 40-mm long piece and a 55-mm long piece of the 10-mm-diameter red cord.

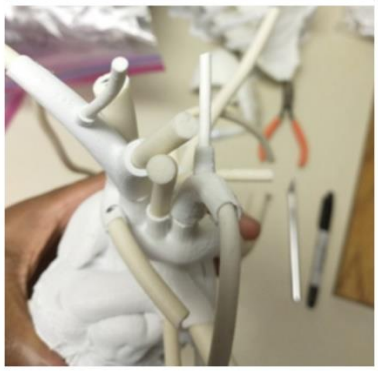
The 40-mm piece, representing the right brachiocephalic vein, goes at the top (circled in green).

The 55-mm piece, representing the left pulmonary, goes into the side (also circled in green).

Now, for the rest of the arteries…

Assembling the heart (part 2):





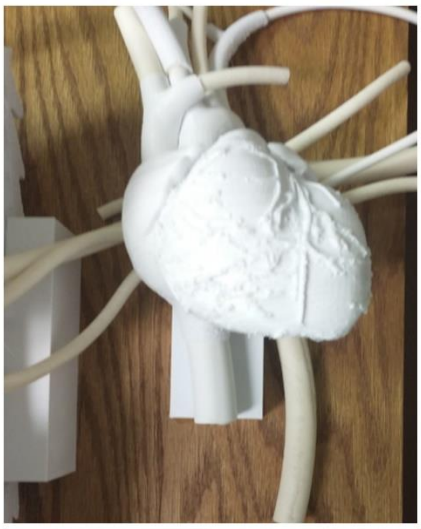
Before continuing with this section, make sure that you have the brachiocephalic trunk and left subclavian trunk printed and nearby, since they'll join the assembly during this section.

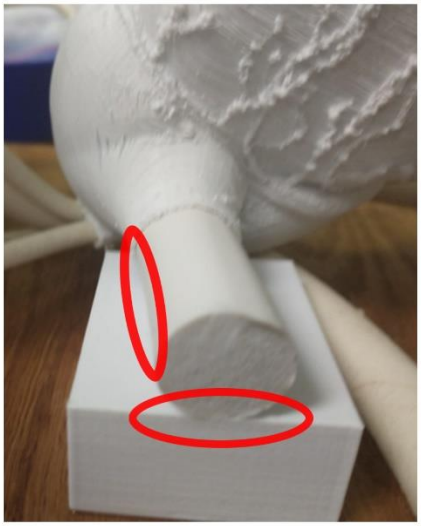
CHALLENGE: For the remaining heart arteries, I want you deduce refer to the table that's in the beginning of this manual

Some tips:

1) **Refer to the schematic (at the beginning of this manual) and its table to determine the appropriate diameters.**
2) **Look at the image of a complete trainer to guess the appropriate lengths.**
3) **There's another pretty obvious one on this very page!**

Gluing heart to board:





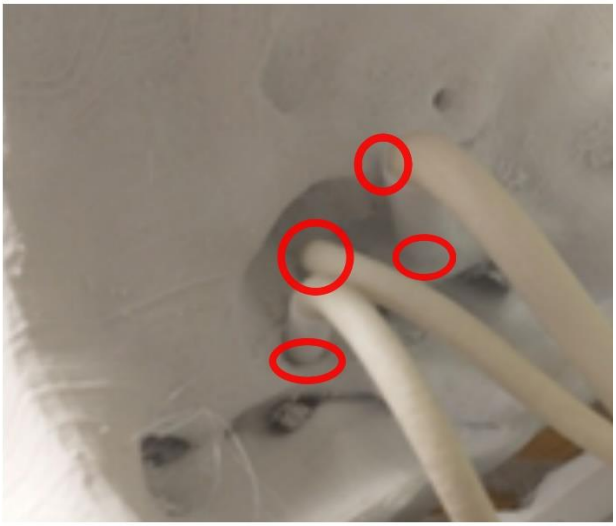
Place the now completed heart onto the small block like in the first picture.

Before applying glue, be sure that the cords are pointing in the correct direction and are not stuck underneath the heart.

When ready, apply glue to the areas circled in red.

If there are other areas between the block and the cord that you believe need to be glued down, feel free.

Making connections between the heart and lung:



Like the heart artery assembly, this section will allow you to "freestyle".

Attach and glue two "5-mm sleeve" onto the right superior pulmonary vein & right inferior pulmonary vein and a single "8-mm sleeve" onto the right pulmonary respectively.

These cords can be glued anywhere within the area circled in green.

Make sure the two 5-mm cords lie further "down" than the 8-mm cord, as shown in the two images.

The recommended areas to glue are circled in red

Congratulations, you now have a complete simulator!

Significant alterations were made to the following models to generate the models cited in this manual. In accordance with the Creative Commons Attribution 3.0 Unported (CC BY 3.0) license provided by the authors of these models, provided below are the authors' credits and links to their original material.

Model Name	Author	Link
"Test2 – stl file processed 1.0.0"	Ahmad Fares	https://www.embodi3d.com/files/file/40147-test-2-stl-file-processed/
"3D printable human heart"	embodi3d	https://www.embodi3d.com/files/file/35-3d-printable-human-heart/
"lungmax.stl 1.0.0"	Selami	https://www.embodi3d.com/files/file/33842-lungmaxstl/

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