a WOW Lab BLUEPRINT

Cardiac Pop Pump

Prep Instructions

The following items will be required for the prep of this activity:

- 4 pop bottles (2 L)
- thick transparent plastic tubing (1/2 in. O.D. x 5/16 in. I.D.)
- thin transparent plastic tubing (7/16 in. O.D. x 5/16 in. I.D.)
- thick rubber tubing (3/4 in. O.D. x 1/2 in. I.D.)
- thin rubber tubing (5/8 in. O.D. x 3/8 in. I.D.)
- craft knife
- permanent marker
- old screwdriver
- cutting board
- red and blue balloons
- duct tape
- 1/4 in. straight tubing connector
- petroleum jelly
- clamp stand
- 4 clamps
- scrap paper or sticky notes
- fume hood
- 2 jumbo car sponges
- tape measure or ruler
- scissors
- red and blue electrical tape (optional)

Step 1

Using a craft knife, cut a 3 ft. length of 1/2 in. (thick) plastic tubing. This piece of tubing represents the aorta (**Figure 1**).

Figure 1

Step 2

Cut a 3 ft. length of thin tubing to represent the vena cava and a 7 ft. length of thin tubing to represent the pulmonary artery and pulmonary vein (**Figure 2**).

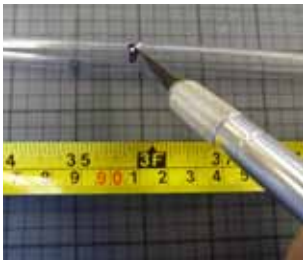

Figure 2

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Step 3

Cut a piece of thick rubber tubing an inch in length. Insert the thick plastic tubing halfway into the piece of thick rubber tubing (**Figure 3**).

Figure 3

Step 4

Cut a piece of thin rubber tubing an inch in length. Insert the 7 ft. thin plastic tubing halfway into the piece of rubber tubing.

Step 5

Assign each pop bottle to one of the four chambers of the heart. To simplify the set-up, temporarily label the pop bottles as right ventricle, left ventricle, right atrium and left atrium using scrap paper or sticky notes.

Figure 4

Step 6

Take the pop bottle that has been assigned to the left ventricle and place the end of the thick plastic tubing covered in rubber on the bottle where the sloped part becomes straight (**Figure 4**). Trace around the tubing with a thin permanent marker.

Step 7

Repeat Step 6 using the end of the thin tubing covered in rubber and the bottle representing the right ventricle.

Step 8

Take the pop bottle that has been assigned to the left atrium. Place the thin plastic tubing near the base of the bottle as shown in **figure 5** and trace around it. Repeat with the bottle assigned to the right atrium.

Figure 5

Step 9

Under a fume hood, heat up the screwdriver tip using a Bunsen burner. Hold it in the flame for at least one minute to ensure the tip is hot enough to easily make a precise hole in the bottle. Alternatively, use a soldering iron to make the holes (see *Alternative Method for Melting the Holes* on page 6 of this document).

Step 10

Use the heated screwdriver to melt away the plastic within the permanent marker line drawn on one of the bottles (**Figure 6**). Ensure that the plastic outside the permanent marker line is not melted away, or else the tubing will not have a tight fitting and leakages will occur.

Figure 6

Step 11

Repeat Step 10 for the other three pop bottles.

Step 12

Insert a deflated red balloon into the pop bottle representing the left ventricle.

Step 13

Blow up the balloon to tennis ball size through the hole and tie it off (**Figure 7**). When the ventricle fills up with fluid, the balloon (representing an atrioventricular valve) will float, preventing backflow into the atrium.

Figure 7

Figure 8

Step 14

Repeat Steps 12 and 13 with a blue balloon in the pop bottle representing the right ventricle.

Step 15

Hold the rims of the bottles representing the right ventricle and right atrium together tightly while another person connects the bottlenecks with duct tape (**Figure 8**). Wrap the duct tape around several times to ensure a tight seal.

Step 16

Repeat Step 15 for the other two pop bottles (left atrium and left ventricle).

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Step 17

Coloured electrical tape can be used to distinguish between blood vessels carrying oxygenated and deoxygenated blood. Wrap red electrical tape at one inch intervals along the entire length of the thick tubing and along the half of the 7 ft. thin tubing without the rubber. Wrap blue electrical tape along the entire length of the the 3 ft. thin tubing and the other half of the 7 ft. thin tubing (**Figure 9**).

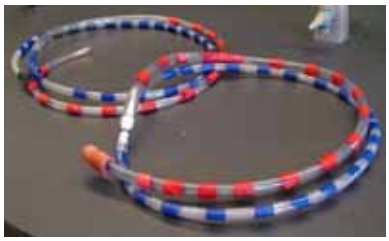

Figure 9

Step 18

Connect the two 3 ft. tubes with the tubing connector.

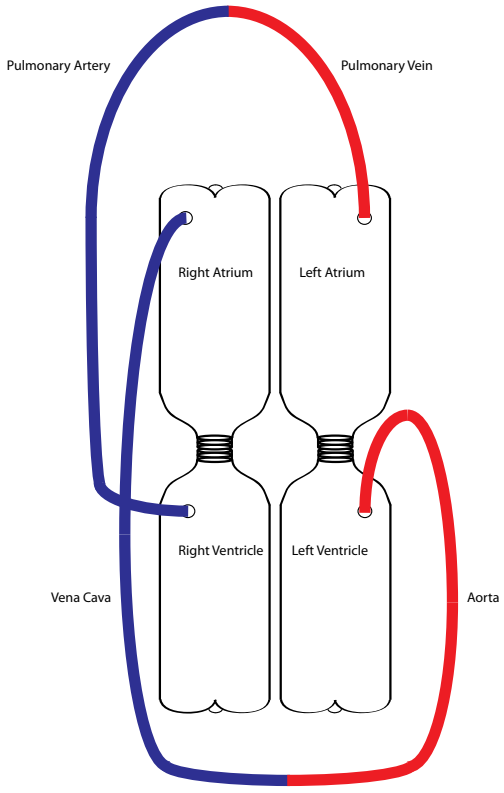

Figure 11

Step 19

Using a clamp stand, securely attach both sets of pop bottles at the point where the two bottles are connected by duct tape to ensure the structure is stable (**Figure 10**).

Figure 10

Step 20

Insert the end of the thick tubing with the rubber into the hole made in the left ventricle. Twisting may make it easier to put the tubing in place. Insert the end of the 7 ft. thin tubing without the rubber into the hole in the left atrium.

Step 21

Insert the free end of the 3 ft. thin tubing into the right atrium and insert the free end of the 7 ft. thin tubing into the bottle representing the right ventricle. Ensure that the tubing does not interfere with the balloons or else backflow may occur when the ventricle is squeezed. All the blood vessels should now be connected as shown in **figure 11**.

Step 22

To prevent leakage, rub petroleum jelly around the junctions between the rubber tubing and the pop bottles (**Figure 12**).

Figure 12

Step 23

Clamp the 7 ft. tubing to the stands. Duct tape the two sponges vertically on the tubing above the pop bottles to represent the lungs (**Figure 13**). Remove the scrap paper or sticky notes before allowing the class to see the model.

Step 24

Position the model on a table at the front of the class so that the left ventricle is on the right-hand side, as viewed from the students' perspective.

Figure 13

Alternative Method for Making the Holes

A soldering iron can be used to melt holes in the pop bottles in place of a heated screwdriver. Forming the holes will take less time with a soldering iron, but the melted plastic may ruin the tips. Therefore, use old tips if available.

The following items will be required for the prep of this part of the activity:

- soldering iron
- 4 pop bottles (2 L)

Step 1

Under a fume hood, put an old tip on the soldering iron and turn it on. Set the temperature to around 200 °C and wait for a few minutes for it to heat up.

Step 2

Use the soldering iron to melt precise holes in the bottles within the permanent marker lines (**Figure 14**).

Figure 14