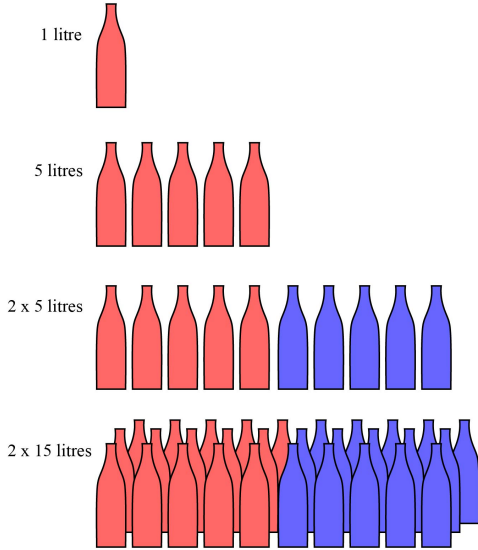


B.4.4. Cardiac Output

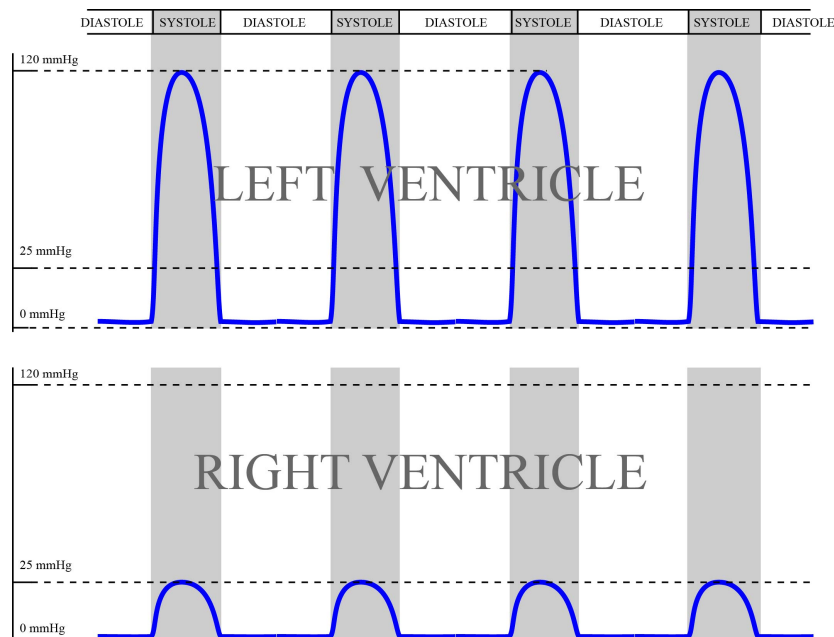
A. Cardiac Output:

1. The function of the heart is to pump blood out of the ventricle. This amount of blood is called the cardiac output .	2. Cardiac output is defined as the amount of blood that is pumped out of the left (or the right) ventricle in one minute.
3. This cardiac output (=CO) can be easily calculated by multiplying two values; the frequency of the heart (=F) and the stroke volume (=SV): Frequency*Stroke Volume = Cardiac Output.	4. The frequency of the heart is the number of times the heart beats every minute. At rest, when the body is not exercising, it is about 60-80 beats/minute.
5. The stroke volume is the amount of blood that is pumped out of a ventricle with every beat. This is, again at rest, about 70 ml.	6. Suppose that the heart beats at 70 beats/min and that the stroke volume is 70 ml; then the cardiac output is: $70 \text{ b/min} * 70 \text{ ml} = 4900 \text{ ml}$ (or approximately 5 litres/min).
7. Eh! Wait a minute! FIVE LITRES per MINUTE?? Yes, this is absolutely true; at rest, a normal heart in a normal size adult beats about 5 litres/min.	 1 litre 5 litres 2 x 5 litres 2 x 15 litres
8. Just think about it ; here is a 1-litre bottle of water. Multiply this with 5, then, this is the amount of blood that one ventricle pumps every minute. And then, there is a second ventricle, which also pumps the same amount of blood, so, the two hearts together pump 10 LITRES every minute!!!	
9. And this was at rest. When the body exercises, it will need more blood and the heart provides for this. Then, the heart has to beat faster (the frequency increases) and the force of contraction increases (to be discussed later). Increase in contraction force will increase the stroke volume .	

10. Therefore, as both the frequency and the stroke volume increase (in both ventricles!), this will easily increase the cardiac output (in each ventricle) to, for example, 15 litres/min.	11. Just to give you an idea of how much all this really is; go to kitchen and open the tap wide open. Try to fill a bucket (typically 10 litre) in one minute!
--	--

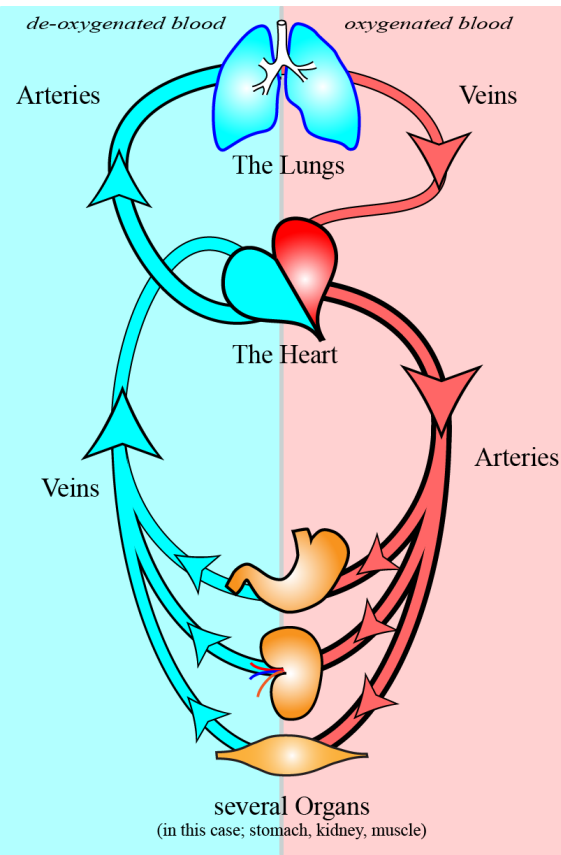
B. Major difference between the right heart and the left heart:

1. The behaviour of the heart and the flow of blood during systole and diastole is very similar in the right and the left heart.	2. The valves work near simultaneously in closing and opening; both AV-valves close and open simultaneously and so do the SL-valves.
3. The amount of blood that is pumped out (= the stroke volume, i.e., SV) is also very similar in each ventricle.	4. The big difference between the right heart and the left heart is the blood pressure in the two ventricles.



5. As shown in the diagram, during systole, the pressure in the left ventricle increases from 0 to 120 mmHg.	6. But in the right ventricle, the increase is much less, and reaches a maximum of “only” 25 mmHg.
7. This difference is caused by the fact that the wall of the left ventricle is much thicker than that of the right ventricle.	8. Therefore, the left ventricular contraction is much stronger and the pressure achieved much higher ; i.e., 120 mmHg instead of 25 mmHg.

C. Why is the blood pressure in the left ventricle so much higher than in the right ventricle?

1. Remember the two circulations in our body? The pulmonary and the systemic circulation?	
2. So, the right heart collects (de-oxygenated) blood from all the organs in the body and pumps it to the lungs for oxygenation. And the lungs are literally next-door to the heart, both inside the chest. Small difference in height.	
3. But the left heart collects the oxygenated blood from the lungs and pumps it to ALL the organs in the body.	
4. All the organs, from the brain in your head all the way to the muscles in your legs and muscles.	
5. So, much bigger distances and, when you stand up on your feet, much bigger difference in height, and thus in pressure.	
6. That's why the blood pressure in the systemic circulation has to be much higher than in the pulmonary circulation, approx. 120/80 mmHg.	