Cardiovascular Lab

Applications

William Harvey's discovery of the circulation of the blood with the heart acting as the pump.

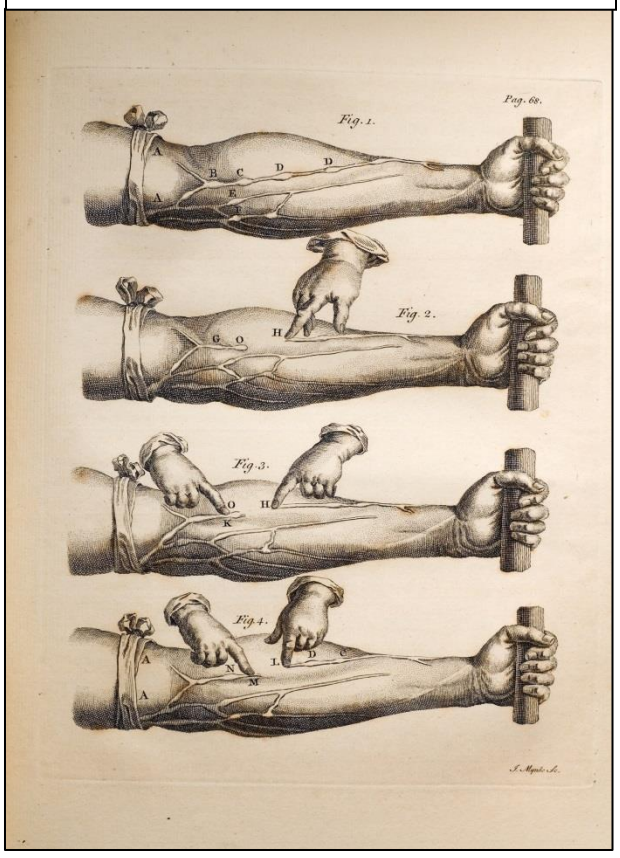
Skills

Identification of blood vessels as arteries, capillaries or veins from the structure of their walls.
Recognition of the chambers and valves of the heart, and the blood vessels connected into it, in dissected hearts or in diagrams of heart structure.

Background:

William Harvey is usually credited with the discovery of the circulation of the blood as he combined earlier discoveries with his own research findings to produce a convincing overall theory for blood flow in the body. He overcame widespread opposition by publishing his results and also by touring Europe to demonstrate experiments that falsified previous theories and provided evidence for his theory. As a result his theory became generally accepted.

Figure 1: William Harvey's experiment on blood flow through veins

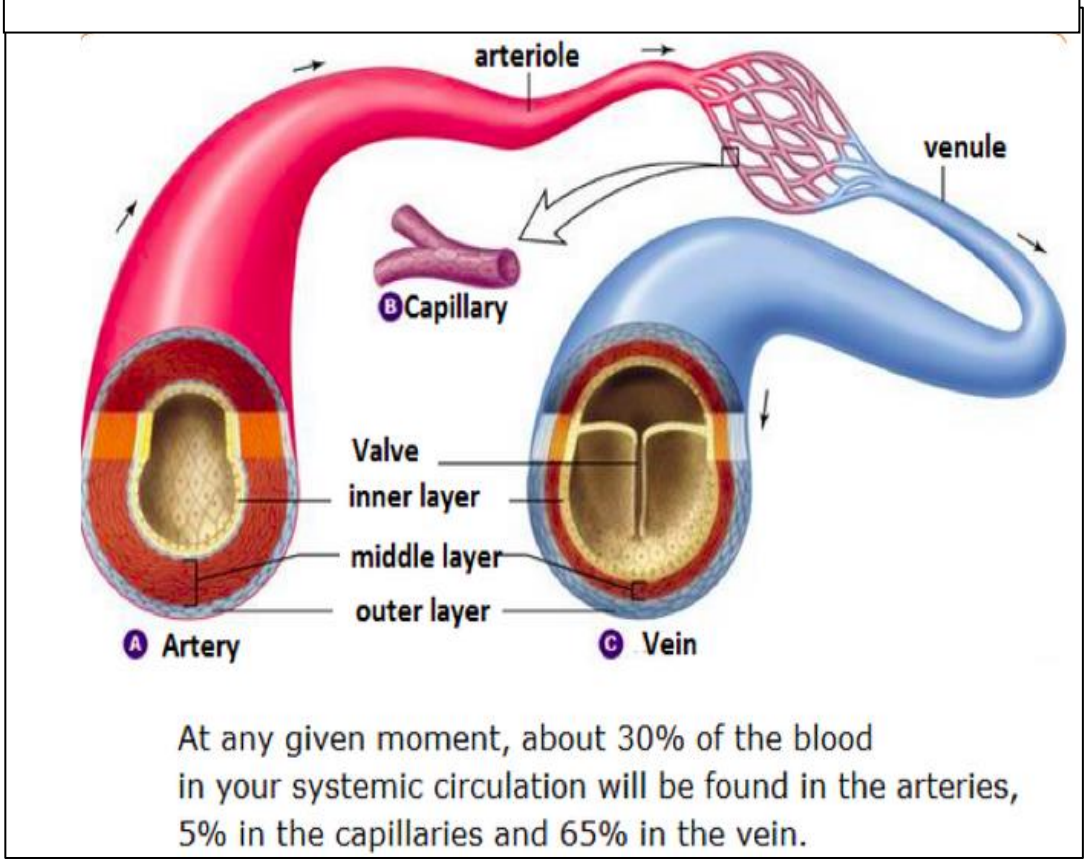


Harvey demonstrated that blood flow through the larger vessels is unidirectional, with valves to prevent backflow. He also showed that the rate of flow through major vessels was far too high for blood to be consumed in the body after being pumped out by the heart, as earlier theories proposed. It must therefore return to the heart and be recycled. Harvey showed that the heart pumps blood out in the arteries and it returns in

veins. He predicted the presence of numerous fine vessels too small to be seen with contemporary equipment that linked arteries to veins in the tissues of the body.

Blood capillaries are too narrow to be seen with the naked eye or with a hand lens. Microscopes had not been invented by the time that Harvey published his theory about the circulation of blood in 1628. It was not until 1660, after his death, that blood was seen flowing from arteries to veins though capillaries as he had predicted. Figure 2 show the flow of blood from arteries through capillaries to veins.

Figure 2: Flow of blood from arteries through capillaries to veins



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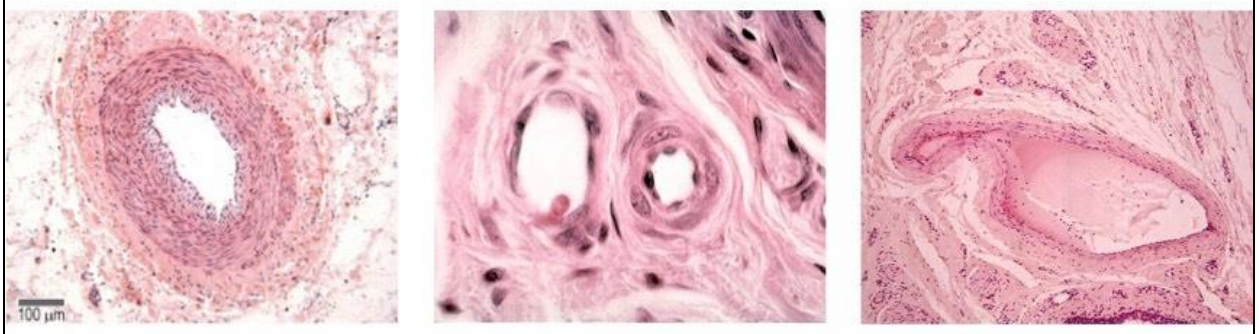
Activity 1

Blood vessels can be identified as arteries, capillaries or veins by looking at their structure. Table 1 below gives differences that may be useful.

Table 1: Characteristics of Arteries, Veins, and Capillaries

	Arteries	Capillaries	Veins
Function	Carry blood **away** from the heart at **high** pressure	-Supply all cells with their **requirements** -Take away **waste** products	**Return** blood to the heart at **low** pressure
Structure of wall	-**Thick**, strong -Contain **muscles**, **elastic** fibres and **fibrous** tissue	**Very thin**, only one cell thick	-**Thin** -Mainly **fibrous** tissue -Contain far **less muscle** and **elastic** tissue than arteries
Lumen	-**Narrow** -Varies with heartbeat (increases as a pulse of blood passes through)	-**Very narrow** -Just wide enough for a red blood cell to pass through	**Wide**
Valves	(-)	(-)	(+) Prevent backflow
How structure fits function	-Strength and elasticity needed to withstand the pulsing of the blood, prevent bursting and maintain pressure wave -Helps to maintain **high blood pressure**, preventing blood flowing backwards	- No need for strong walls, as most of the blood pressure has been lost -Thin walls and narrow lumen bring blood into close contact with body tissue, allowing **diffusion** of materials between capillary and surrounding tissues. -White blood cells can squeeze between cells of the wall	- No need for strong walls, as most of the blood pressure has been lost - Wide lumen offers **less resistance** to blood flow

Figure 3: Cross sectional view of an artery, vein, and capillary



Artery **Capillary*** **Vein**

* The capillary is a significantly smaller structure and thus is shown at a substantially higher magnification than the artery and vein

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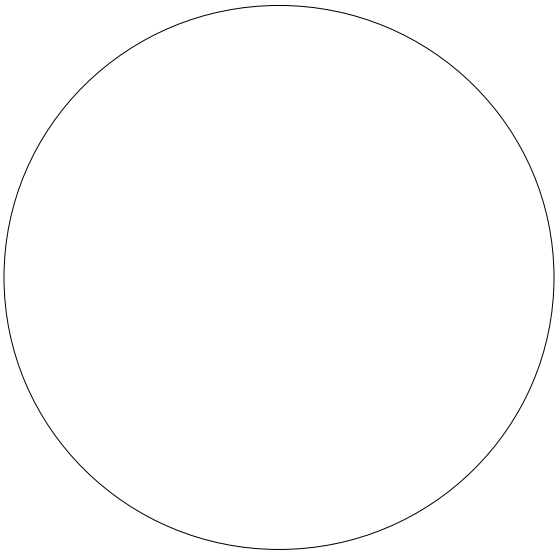
- Identify and sketch an artery, capillary, and vein from a slide.

Artery



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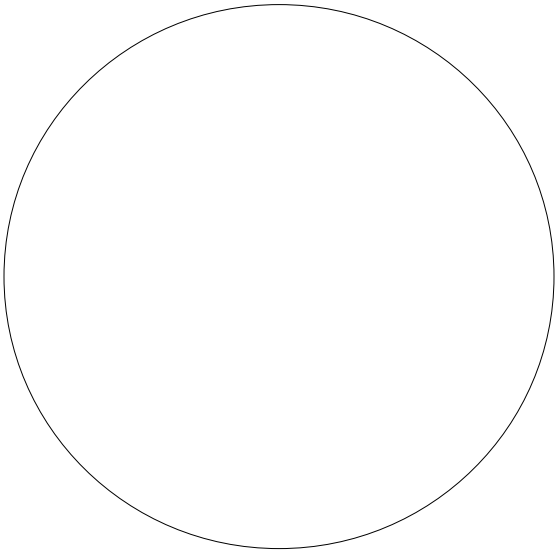
Vein



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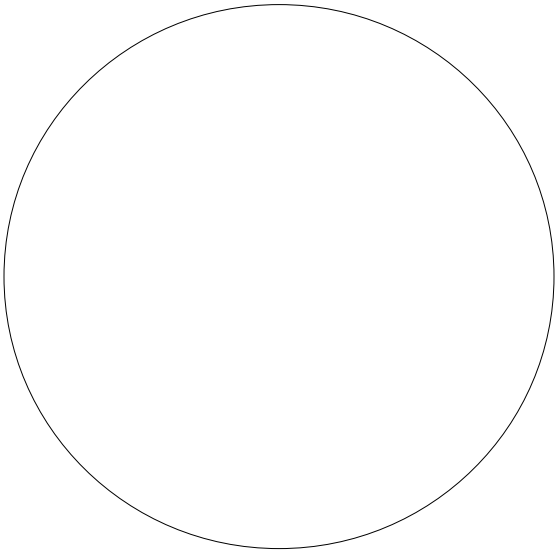
Capillary



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Activity 2

- Diagram and label a model of a heart showing valves, chambers and connected arteries and veins.
- Color code heart with Blue for deoxygenated blood and red for oxygenated blood
- Use arrows to show direction of blood flow.

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Activity 3

- Measuring Blood Pressures

Because arteries are distensible, blood pressure in those that pass near the body surface can be measured relatively easily. A common method is to inflate an arm cuff until it squeezes the tissues (skin, superficial fat as well as the vessels themselves) enough to stop blood flow. The pressure is then released slowly until flow resumes and the operator or instrument can hear the pulse again. The pressures at which blood flow stops and resumes are the systolic and diastolic pressures. They are measured with a pressure monitor. According to the American Heart Association the desired blood pressures for adults of 18 years or older measured in this way are:

Systolic 119-90 mmHg
Diastolic 79-60 mmHg

- Use the sphygmomanometer to record your Blood Pressure =_____

- What factors might influence blood pressure readings?

_____

_____

- Perform an exercise to change your pulse rate.

a) Record your Blood pressure immediately following your exercise._____

b) Record your blood pressure again after 3 minutes of rest._____

c) Graph your pre-exercise, post-exercise, and recovery blood pressure on the graph below. (Use a range bar to show Systolic and Diastolic for each set of Data)

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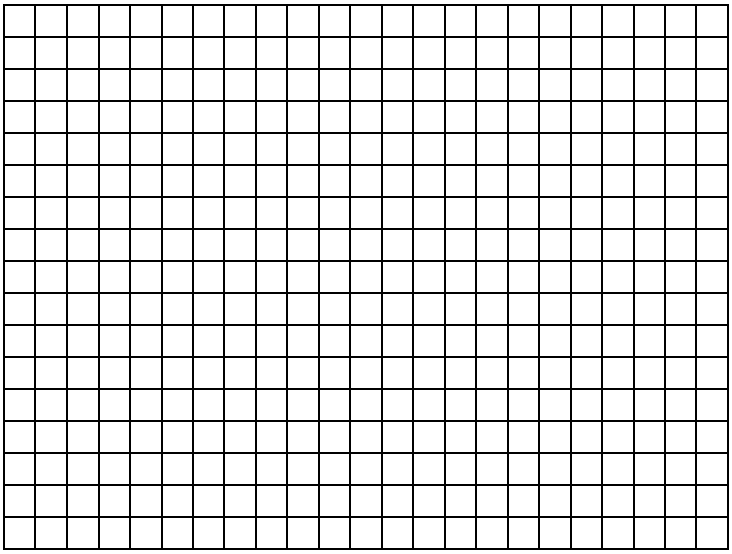
Graph 1 : Pre, Post, and Recovery Blood Pressure



d) Was your blood pressure back to normal after 3 minutes?_____

e) What factors could account for someone's blood pressure not returning to normal after 3 minutes?

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