

### organs/structures

organs heart, blood vessels, blood

structures layers of heart - pericardium, epicardium, myocardium, endocardium

valves

chambers

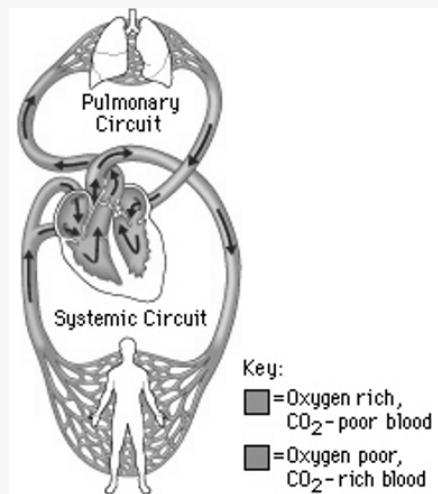
major vessels

major cell types of blood

### thickness of cardiac walls

myocardium of left ventricle is thicker than right - to do with demands of pumping blood away from heart.

### Blood flow



### arteries & veins

have:

three major layers: the tunica interna (featuring the endothelium); tunica media (featuring circular smooth muscle & elastic fibers); and tunica externa (featuring elastic & collagen fibers).

### arteries & veins (cont)

elastic arteries

large arteries with more elastic fibres & less smooth muscle, are able to receive blood under pressure & propel it onward, also called conducting arteries as they conduct blood from the heart to medium sized muscular arteries

muscular arteries

medium-sized arteries with more muscle than elastic fibres in tunica media, capable of greater vasoconstriction & vasodilation to adjust rate of flow - walls are relatively thick, called distributing arteries as they direct blood flow

### aorta divisions

1. ascending aorta
2. arch of aorta
3. thoracic aorta
4. abdominal aorta

### regulation of heart rate

nervous control from cardiovascular centre in medulla: sympathetic impulses increase heart rate & force of contraction, parasympathetic impulses decrease heart rate, baroreceptors (pressure receptors) detect change in BP & send info to cardiovascular centre (located in arch of aorta & carotid sinuses).

heart rate is also affected by hormones:

- adrenaline, noradrenaline, thyroid hormones
- ions Na<sup>+</sup>, K<sup>+</sup>, Ca<sup>2+</sup>
- age, gender, physical fitness & temperature

### cell types

heart	blood vessels	blood
pericardium	endothelium	leukocytes; WBCs

epicardium

myocardium - cardiac monocytes

valves

conducting nerve bundles (SA/AV Nodes)

pericardium

### venules

- small veins collecting blood from capillaries
- tunica media contains only a few smooth muscle cells & scattered fibroblasts - very porous endothelium allows for escape of many phagocytic WBCs
- venules that approach size of veins more closely resemble structure of vein

### arterioles

- small arteries delivering blood to capillaries - tunica media containing few layers of muscle
- metarterioles form branches into capillary bed - to bypass capillary bed, precapillary sphincters close & blood flows out of bed in throughfare channel, vasomotion is intermittent contraction & relaxation of sphincters that allow filling of capillary bed 5-10 times/minute.



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### veins of systemic circulation

- drain blood from entire body & return it to right side of heart
- deep veins parallel the arteries in the region
- superficial veins are found just beneath the skin
- all venous blood drains to either superior or inferior vena cava or coronary sinus

### circulatory routes

#### systemic

left side heart to body & back to heart

#### hepatic portal

capillaries of GI tracts to capillaries in liver

#### pulmonary

right side heart to lungs & back to heart

#### foetal

fetal heart through umbilical cord to placenta & back

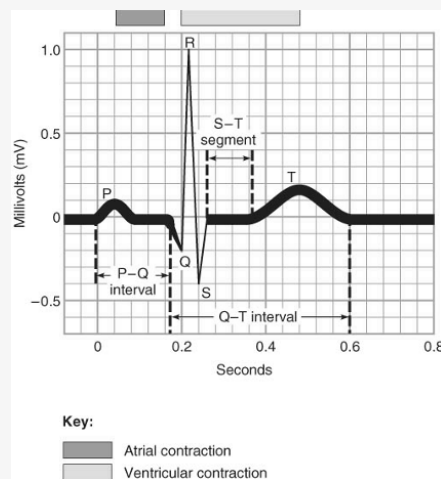
### physiological functions

- |         |   |
|---------|---|
| heart   | pumps over 1 million gallons / year, over 60 000 miles of blood vessels   |
| vessels | retain & circulate blood, help regulate pulse pressure  |
| blood   | erythrocytes - distribute oxygen from & CO <sub>2</sub> to lungs<br>leukocytes - circulating immune cells to combat infection |

### cardiac muscle histology

- branching, intercalated discs with gap junctions, involuntary, striated, single central nucleus per cell.
- desmosomes between myocytes allow depolarisation of adjacent fibers.
- Striations are created by the organisation of myofilaments, actin & myosin

### electrocardiogram - ECG or EKG



ECG - action potentials of all active cells can be detected & recorded

- P wave = atrial depolarization
- P to Q = conduction time from atrial to ventricular excitation
- QRS complex = ventricular depolarization
- T wave = ventricular repolarization
- Q-T = time for ventricular depolarization & repolarisation to occur
- S-T segment = ventricular fibres depolarised (plateau phase of AP)

### electrical conductance

1. SA-Node (in right atrium)
2. AV-Node
3. AV-Node (bundle of His)
4. right & left bundle branches
5. Purkinje fibres

### valves & blood circulation

- valves open & close in response to pressure changes as heart contracts & relaxes.
- dense connective tissue rings surround the valves of the heart, fuse & merge with the interventricular septum.
- support for heart valves, insertion point for cardiac muscle bundles, electrical insulator between atria & ventricles.

### capillaries

found near every cell but more extensive in highly active tissue (muscles, liver, kidneys & brain)  
entire capillary bed fills with blood when tissue is active lacking in epithelia:  
cornea & lens of eye & cartilage  
walls are composed of only one layer of endothelium cells & basement membrane

### layers of heart wall

#### pericardium

dense irregular connective tissue

#### epicardium

visceral layer of serous pericardium

#### myocardium

cardiac muscle layer

#### endocardium

chamber lining & valves, smooth lubricating layer



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