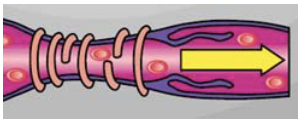
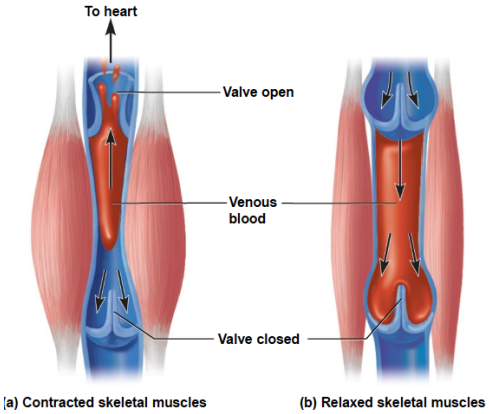
Venous return: Volume of blood flowing back to the heart and is influenced by:

Venous pressure gradient (1)

Blood returns back to the heart through the change in pressure between the veins and the right atrium. This is further determined by venous volume and compliance of the blood vessels. Sympathetically-mediated venous contraction stiffens veins walls (↓ compliance ↑ venous pressure). If blood is in high pressure, this can increase the pressure gradient which increase blood flow and blood flows from high pressure to low pressure.



Skeletal muscle pump (2)



- Constrict leg veins e.g. stretch up
- Increase pressure in veins
- Create a pressure gradient
- Flow back to heart from legs.
- Note: this is not an actual pump but works through contraction of skeletal muscle.

Respiratory pump (3)

- Breathe in
- Decrease in pressure thorax
- Increase in pressure in abdomen
- Creates a pressure gradient
- Expanded during exercise - frequent breathing

Cardiac cycle

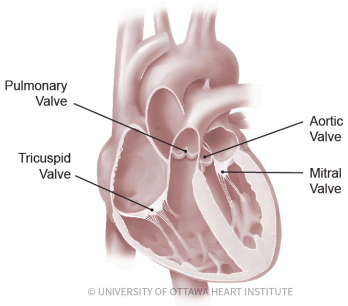
To pump blood effectively, the heart contracts and relaxes. This is termed the cardiac cycle (the beginning of heartbeat to next heartbeat).

- Ventricular systole = period of ventricular contraction (and blood ejection)
- Ventricular diastole = period between contraction (ventricular relaxation and blood filling)

Note: rate of excitation = rate of pacemaker cells in SA node.

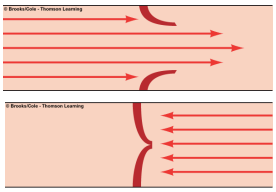
Cardiac cycle is controlled by two important factors.

1. Valves that regulates directional flow of blood through the heart
2. Conducting system which coordinates the spread of excitation through the heart

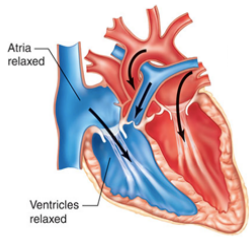
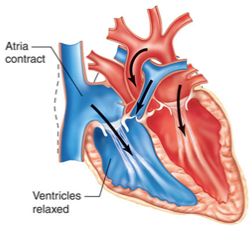
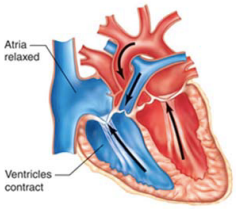
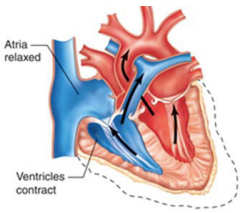
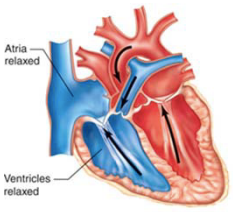


Heart/cardiac valves

- Aortic and Pulmonary Valves: semilunar shapes, blood flow from ventricles → arteries and prevent backflow (arteries →| ventricles)
- Atrioventricular Valves:
  - mitral/bicuspid shapes, located between left atrium and ventricle
  - tricuspid shapes located between right atrium and ventricle)
  - Flow from atria → ventricles and prevent backflow (ventricles →| atria)
- Papillary muscles can control valves but apart from that they are passive structures – they respond to changes in pressure



Phases of cardiac cycle

Phase 1A **Passive filling of ventricles**	**Phase 1B** **Atrial contraction**	**Phase 2** **Isovolumetric ventricular contraction**	**Phase 3** **Ventricular ejection**	**Phase 4** **Isovolumetric ventricular relaxation**
				
Passive filling of ventricles	SAN fires action potentials and atria contracts	Ventricle is now “sealed” → isovolumetric contraction and ventricular pressure rises sharply	Aortic valve opens once ventricular pressure is more than aortic. As ventricles empty, ventricular pressure falls and ventricles relax.	A valve shuts once ventricular pressure is less than aortic → ventricle sealed. Isovolumetric relaxation. When ventricular pressure falls, AV valve opens → phase 1
80% blood flow atria → ventricle	20% blood flow atria → ventricle	No blood flow	Blood flow ventricle → aorta	No blood flow
		AV valve close (LUB)		A+P close (DUB)
ECG silent	P wave	QRS complex	T wave	ECG silent

Renal system

(1) Function of the kidney and urine formation

Four functions of the kidney (and how symptoms of renal disease relate to these functions)

Functional description	What is involved	Symptom of renal disease	Relation
Regulation of water, electrolyte balance and osmolarity	Na, Cl, K, Ca, PO4, Mg Arterial blood pressure	Renal hypertension, Oedema, Thirst and Hyperkalaemia (K)	Hypertension - lots of fluid - increase arterial BP Thirst – if lot H2O lost
Regulation of the acid base balance	H ions	Metabolic acidosis	Build-up of H ions
Excretion of waste products and foreign material	Nitrogen (urea, NH3) Drugs, pesticides and food additives	Urine reflex?	Urine not excreted so can come back up
Endocrinal functions	Renin (angiotensin II) Erythroprotein (RBC production) Vit D3 (Ca homeostasis)	Anaemia – tiredness Osteoporosis	Low RBC count Calcium unregulated
Glucogenesis	Converting AA to glucose	Malnutrition	

Anatomical features of the nephron

Kidney is made of individual functional units called nephrons. The nephron is made up of: A filtration component (renal corpuscle) and Renal tubules. The renal corpuscle consists of a bundle of capillary loops = glomerulus and a fluid filled Bowman's capsule.