Unit 1 Biology Revision Pack

This pack contains:
The Biology unit content from the specification
Additional guidance from the exam board
Some activities to help you learn/remember the detail of the content in unit 1 Biology

B1 Cell structure and function

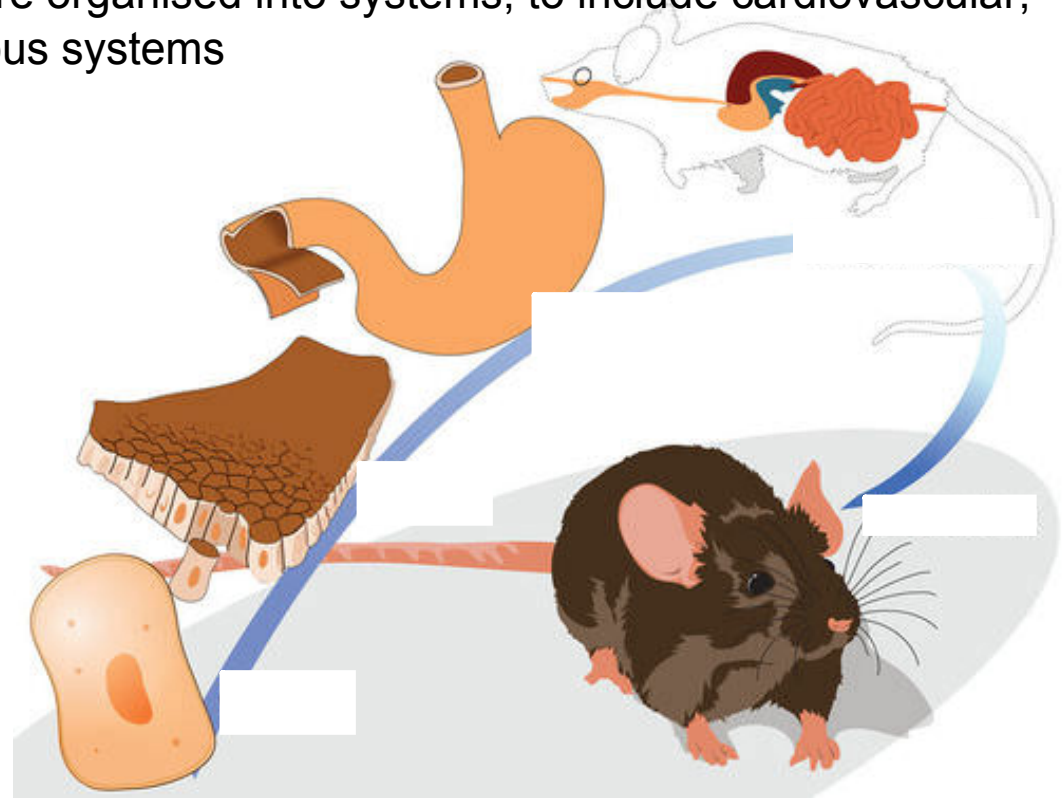
B2 Cell specialisation

B3 Tissue structure and function

B1 Cell structure and function

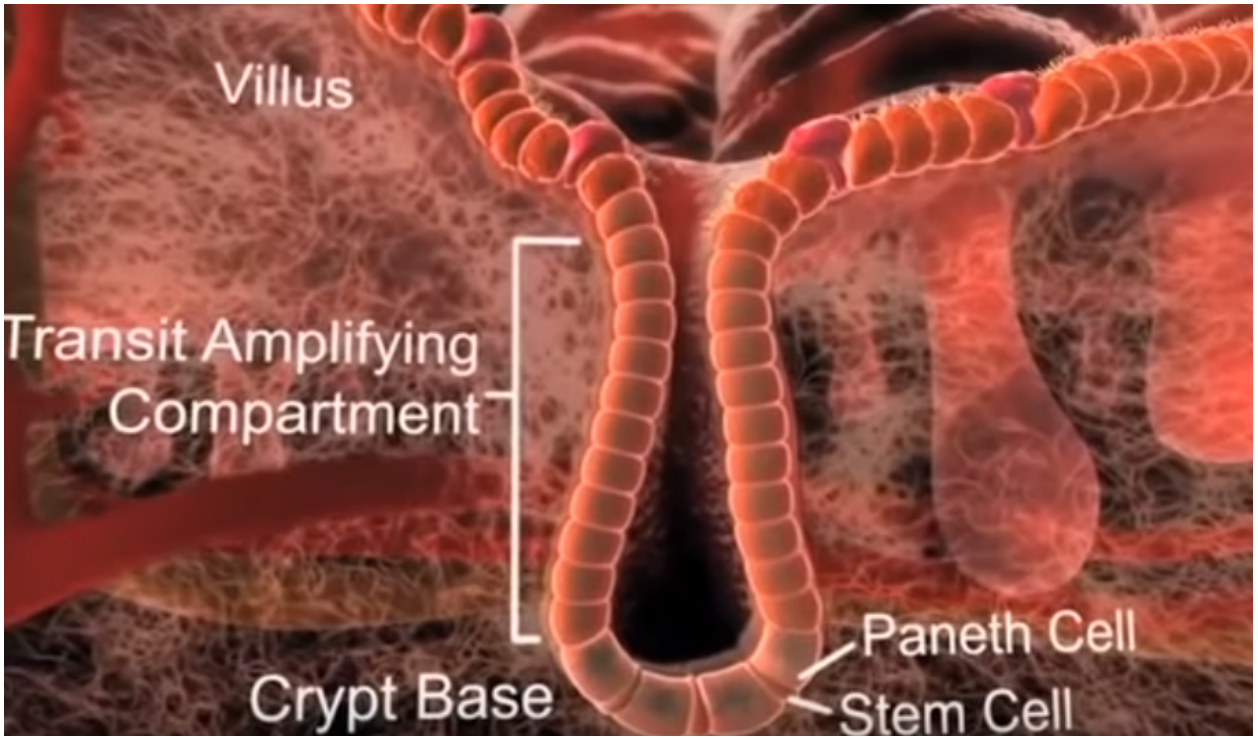
Know that cell theory is a unifying concept stating that cells are a fundamental unit of structure, function and organisation in all living organisms

- know that tissues are collections of similar specialised cells, performing a specific function/set of functions, to include epithelial, skeletal muscle and nervous tissue
- know that organs are collections of tissues performing specific physiological functions
- understand how organs are organised into systems, to include cardiovascular, respiratory, muscular, nervous systems



- understand that differentiation is the process by which cells become specialised for a particular function from stem cells

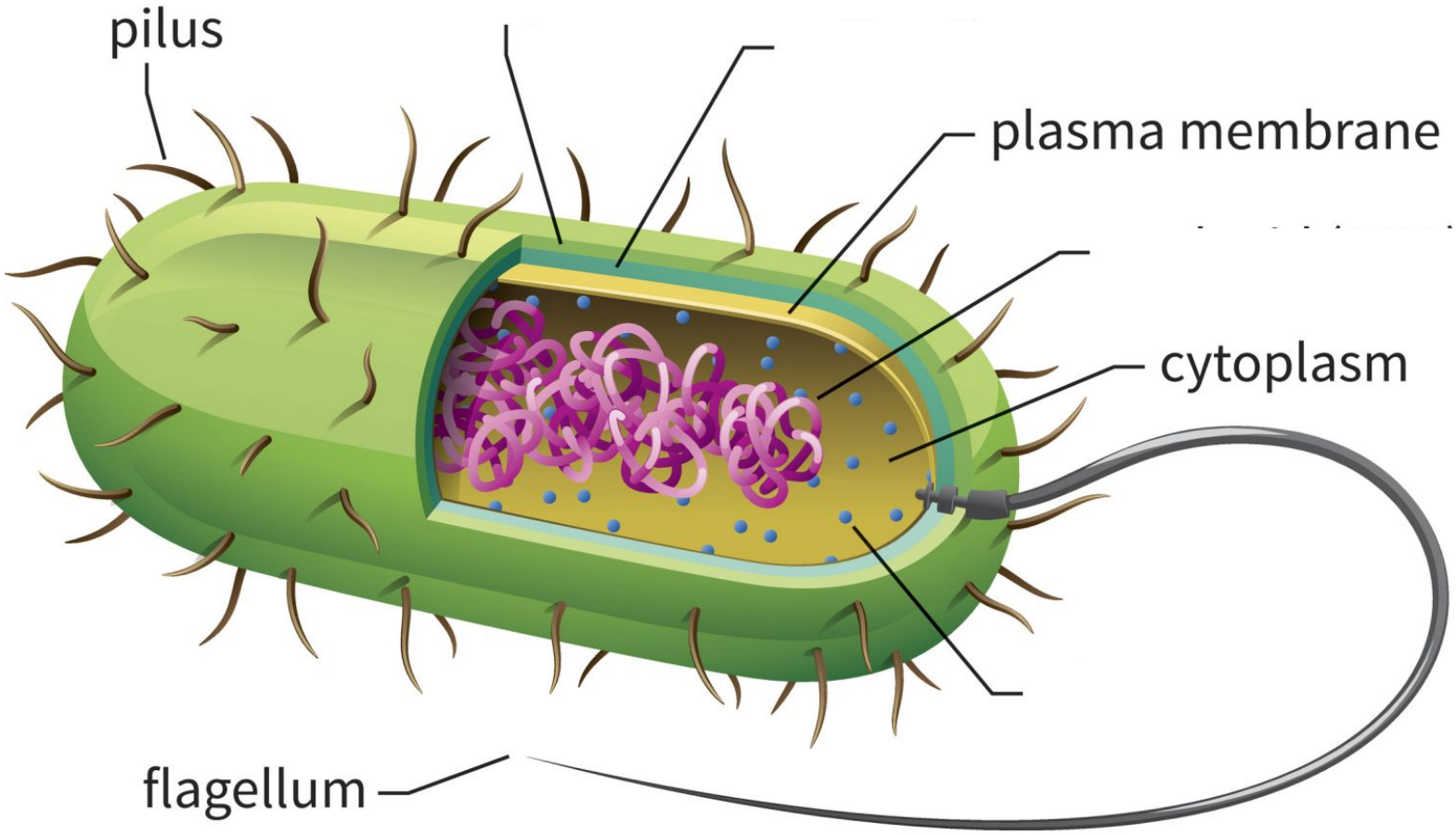
https://www.youtube.com/watch?v=p_otRl61O1s



B1 Cell structure and function

Understand the ultrastructure and function of organelles, to include:

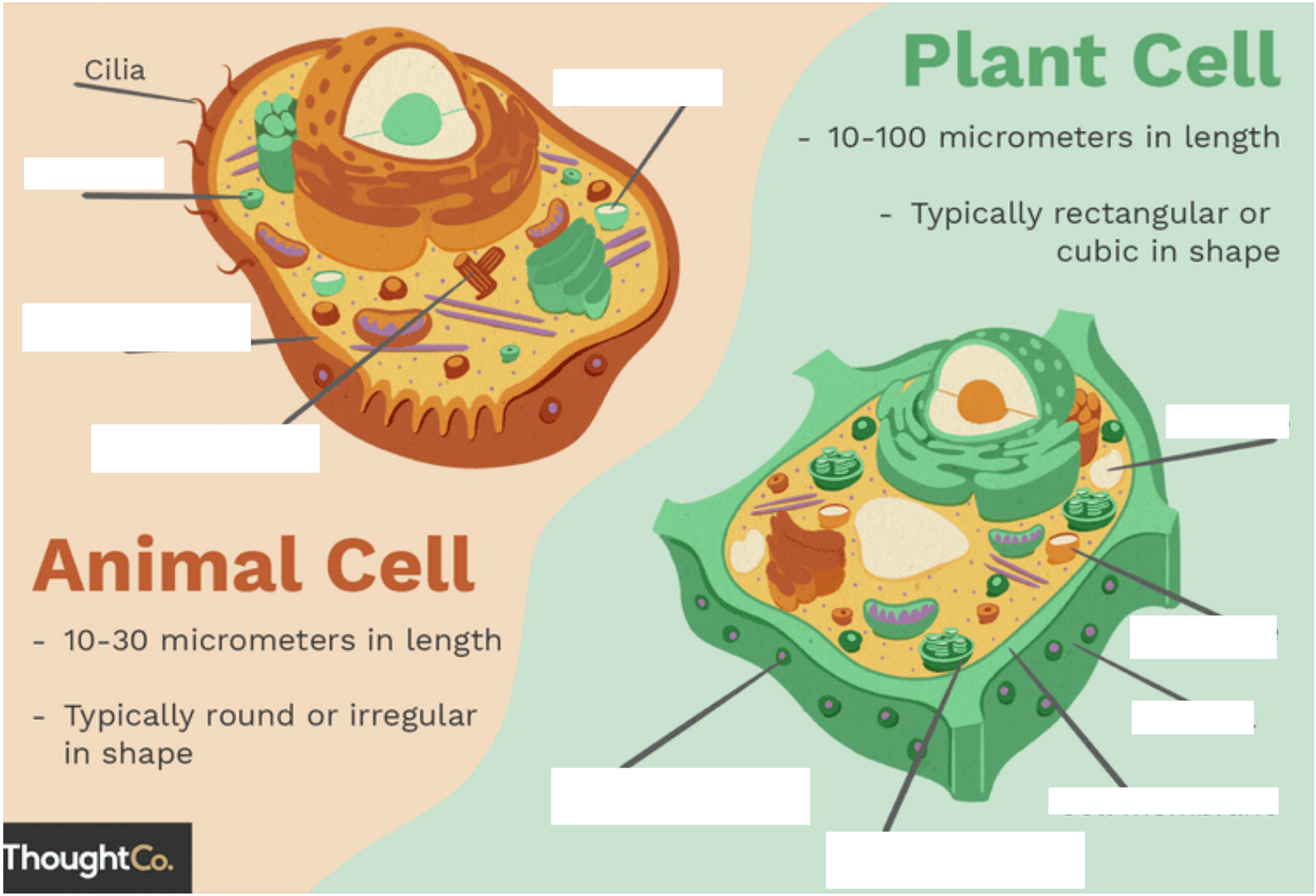
- prokaryote cells (bacterial cell) – nucleoid, plasmids, 70S ribosomes, capsule, cell wall
- eukaryotic cells (plant and animal cells) - plasma membrane, cytoplasm, nucleus, nucleolus, endoplasmic reticulum (smooth and rough), Golgi apparatus, vesicles, lysosomes, 80S ribosomes, mitochondria, centriole
- eukaryotic cells (plant-cell specific) - cell wall, chloroplasts, vacuole, tonoplast, amyloplasts, plasmodesmata, pits

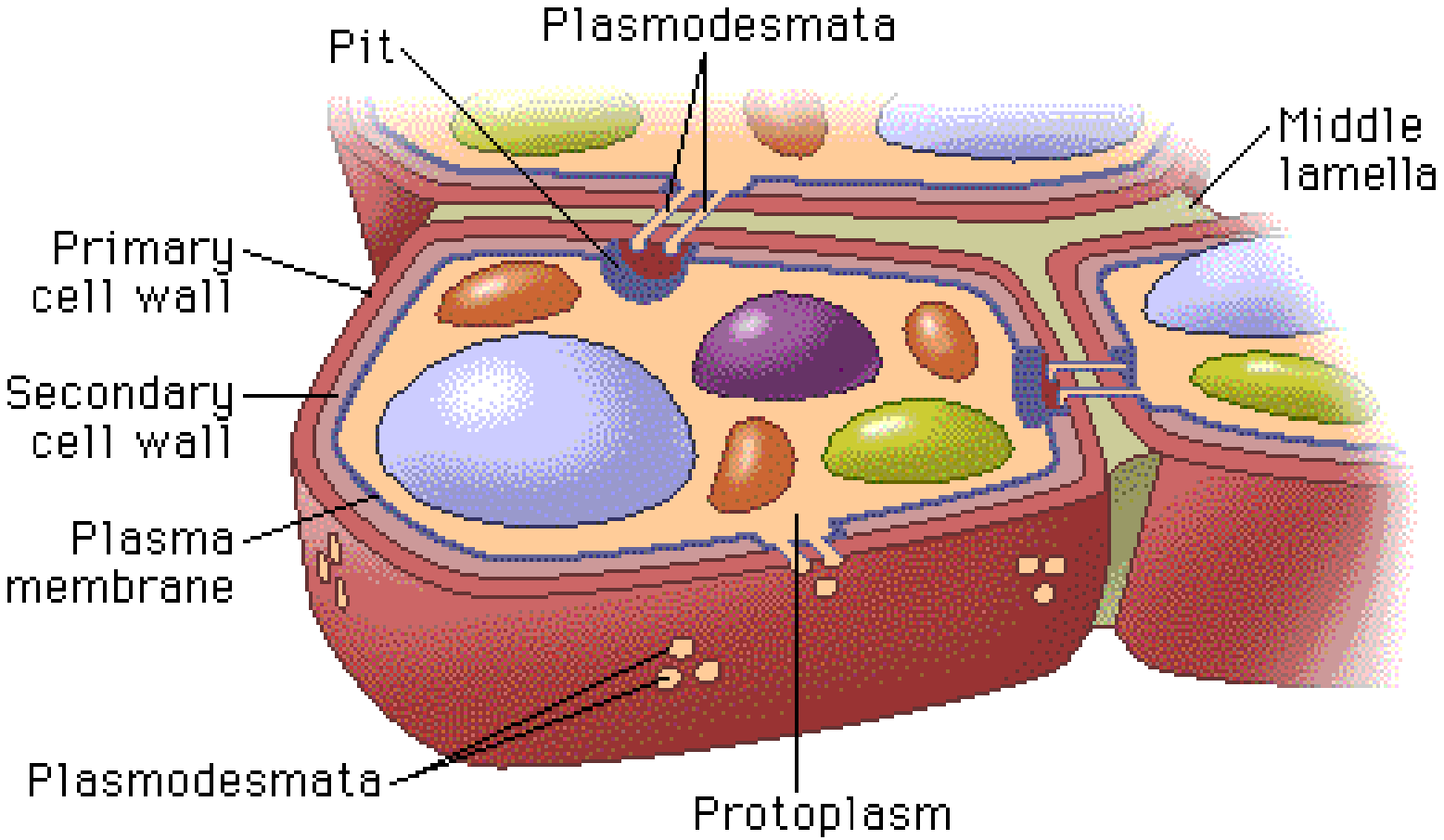


B1 Cell structure and function

Understand the ultrastructure and function of organelles, to include:

- Eukaryotic cells (plant and animal cells) - plasma membrane, cytoplasm, nucleus, nucleolus, endoplasmic reticulum (smooth and rough), Golgi apparatus, vesicles, lysosomes, 80S ribosomes, mitochondria, centriole
- eukaryotic cells (plant-cell specific) - cell wall, chloroplasts, vacuole, tonoplast, amyloplasts, plasmodesmata, pits




Pit
Plasmodesmata
Middle lamella
Primary cell wall
Secondary cell wall
Plasma membrane
Plasmodesmata
Protoplasm

B1 Cell structure and function

- understand the relationship between the ultrastructure and function of cell organelles listed for prokaryotic and eukaryotic (plant and animal) cells.
- Understand the similarities and differences between plant and animal cell structure and function

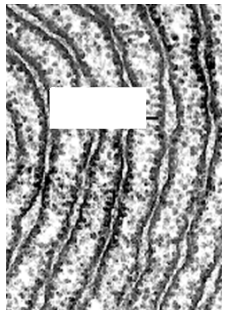
Extension: Can you draw the structure of each of the major structures

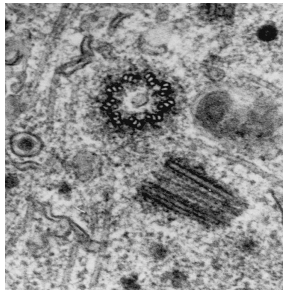
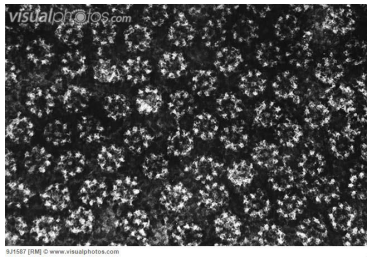
Name	Function	Structure (etc.)
	control centre of cell; contains nucleoplasm which holds nucleolus and chromosomes	double membrane with nuclear pores to control entry/exit of materials; membrane present in Eukaryotes but not in Prokaryotes
	produces ribosomes	not membrane-bound; may be more than one in nucleus
	produce proteins (protein synthesis)	produced in nucleolus; migrate out to cytoplasm where they may be found free-floating or attached to ER (RER)
	receive proteins from ribosomes and transport them throughout cell; modify proteins (add sugar groups, etc.)	series of membrane channels connecting nucleus to cell membrane; studded with ribosomes (RER) or not (SER)
	receive proteins from ER and package them into vesicles (sacs) for export from cell or transport elsewhere in cell; modify proteins	stacks of flattened membranes attached to or near ER
	produce ATP via Matrix rxns and ETS (aerobic cell respiration)	often rod shaped with outer/inner membrane, matrix, cristae
	produce enzymes for degradation of bacteria, worn-out cell components; may fuse with vacuole and pour enzymes into it	membrane-bound
	store water and dissolved food, ions, bacteria, etc.; create turgor pressure in plant cells; receive enzymes from lysosome	membrane-bound
	produce spindle fibres used in mitosis; also produce flagella and cilia (which have microtubules)	rings of microtubules; occur in pairs at right-angles to each other
	supports all intracellular organelles	nucleoplasm is jellylike fluid inside nucleus; cytoplasm is jellylike fluid outside nucleus
	both used for locomotion	flagella is a long taillike structure; cilia are shorter and more numerous (usually); made of microtubules
	support structure for organelles (inner cell skeleton)	made of microtubules and microfilaments
	site of photosynthesis (in plant cells and green algae)	inner and outer membranes; thylakoids (discs) and stroma (jellylike, similar to matrix); contain chlorophyll and other photosynthetic pigments
	controls transport; provides shape/support for cell; site of attachment for hormones/neurotransmitters	fluid mosaic model (see notes)
	general class of organelles which includes chloroplasts (photosynthesis), amyloplasts (store starch), leucoplasts (store fat), etc.	membrane bound sacs

B1 Cell structure and function

- Recognise cell organelles from electron micrographs and the use of light microscopes
- recognise prokaryote and eukaryotic organelles (plant and animal cells, plant specific) from electron micrographs



B1 Cell structure and function

know how to use a light microscope to recognise cells and cell organelles

Write 5 basic rules to follow to be able to focus a sample on a slide easily.

1

2

3

4

5

B1 Cell structure and function

understand the advantages and limitations of using a light microscope

Advantages	Limitations

... material can be viewed ... requiring little expertise

... can be observed

... specimens of around 200nm

Small and portable

B1 Cell structure and function

understand the advantages and limitations of using a light microscope

- Understand how to distinguish between Gram-positive and Gram-negative bacterial cell walls and why each type reacts differently to some antibiotics
- know how to carry out the Gram stain to distinguish between Gram positive and Gram negative bacteria
- understand that Gram positive bacteria have a wall made of a thick layer of peptidoglycan and no outer lipopolysaccharide membrane
- understand that Gram negative bacteria have a wall made of a thin layer of peptidoglycan and an outer lipopolysaccharide membrane
- understand that Gram positive bacteria are susceptible to some antibiotics, such as penicillin, that can damage the peptidoglycan layer

understand that Gram negative bacteria are not susceptible to some antibiotics, such as penicillin, because the peptidoglycan layer is protected by the lipopolysaccharide outer membrane which is not susceptible to some antibiotics

Gram Staining Steps

1. Smear:_____
2. Heat Fix:_____
3. 1st Stain and rinse:_____
4. Iodine:_____
5. Decolourise and rinse:_____
6. 2nd Stain and rinse:_____
7. Observations:_____

B1 Cell structure and function

Calculate magnification and size of cells and organelles from drawings or images

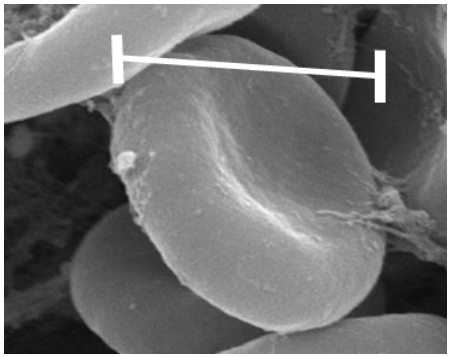
- know how to measure the size of cells and organelles using an eye piece graticule and stage micrometer
- know how to convert mm to µm
- know how to use the formula:

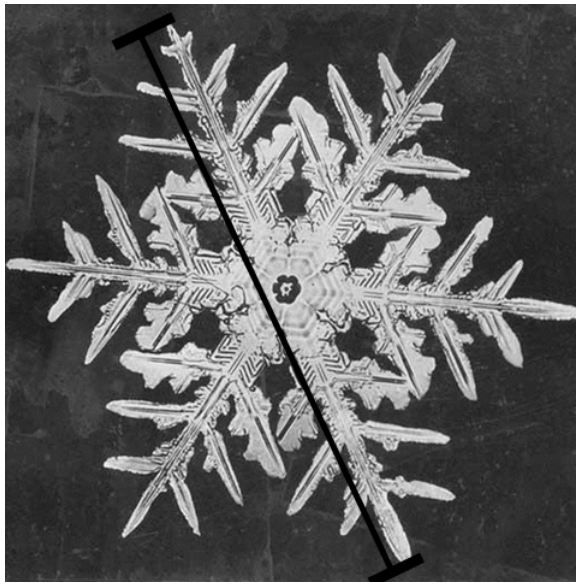
$$\text{magnification} = \frac{\text{measured size}}{\text{actual size}}$$

This is a fly. Its actual eye size is 1,000µm. What is the magnification?

This is a red blood cell. Its actual size is 300µm. What is the magnification?

This is a snowflake. Its actual height is 700µm. What is the magnification?





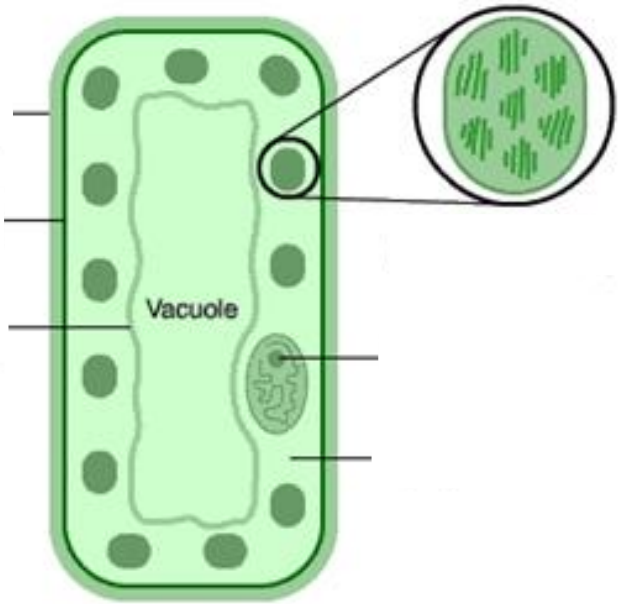
B2 Cell specialisation

Understand cell specialisation in terms of structure and function, to include:

Palisade mesophyll cells in a leaf

- know and understand the structural and functional significance of palisade mesophyll cell features, to include:
  - major site of photosynthesis
  - cylindrical shape
  - arranged at right angles to the upper epidermis
  - cells arranged close together
  - long narrow gaps between palisade cells for air to circulate for gas exchange
  - thin and transparent cellulose cell walls so easy gas diffusion
  - large vacuole
  - chloroplasts near to edge of cell so can absorb more light
  - large number of chloroplasts
- cytoskeleton can move chloroplasts around/up/down in cell to maintain photosynthesis in low light and protect chloroplasts in intense light

Can you explain how each of the bullet points above improve the cells ability to carry out its function?



B2 Cell specialisation

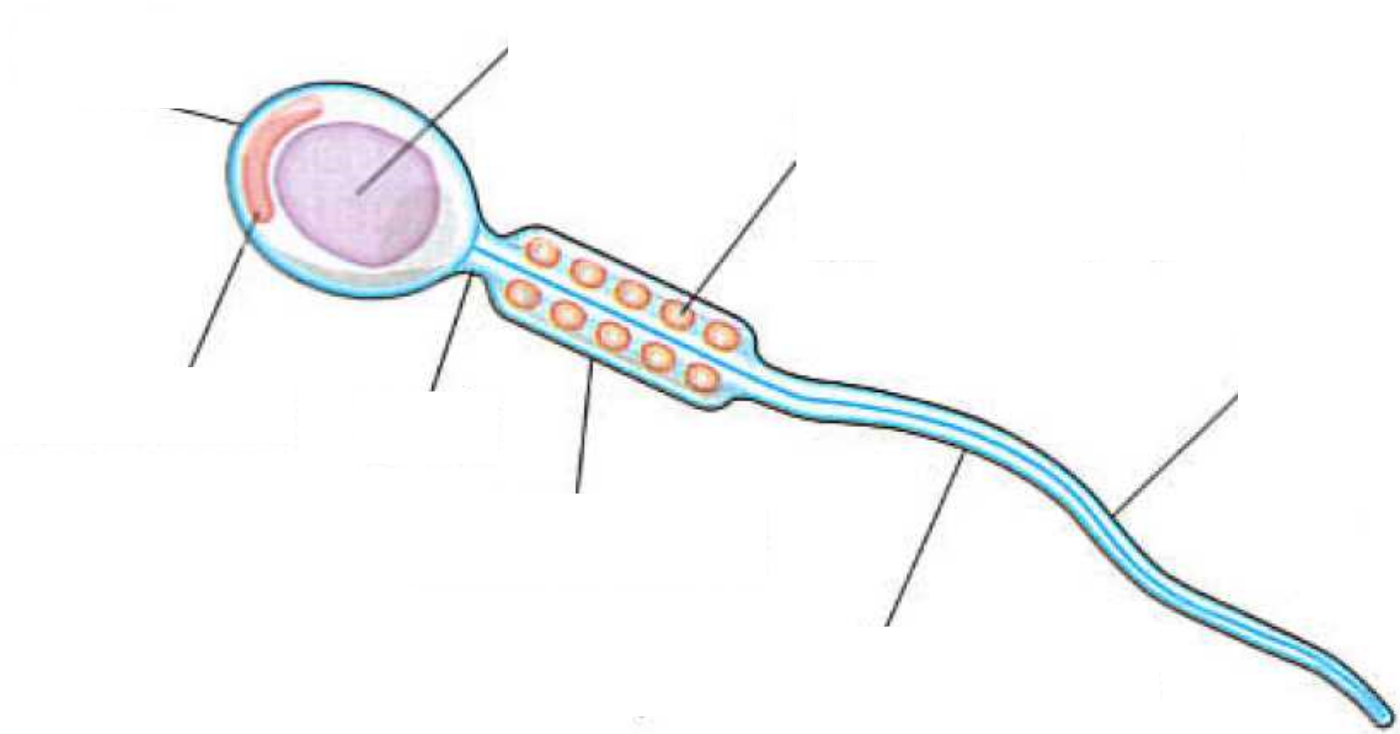
Understand cell specialisation in terms of structure and function, to include:

Sperm and egg cells in reproduction

- know and understand the structural and functional significance of sperm and egg cell features, to include:

Sperm cell

- nucleus contains 23 chromosomes (haploid nucleus)
- head – acrosome
- acrosome - enzyme to digest a path through the outer membrane (zona pellucida) of egg (ovum)
- mid-section contains large numbers of mitochondria - aerobic respiration
- tail – motility



B2 Cell specialisation

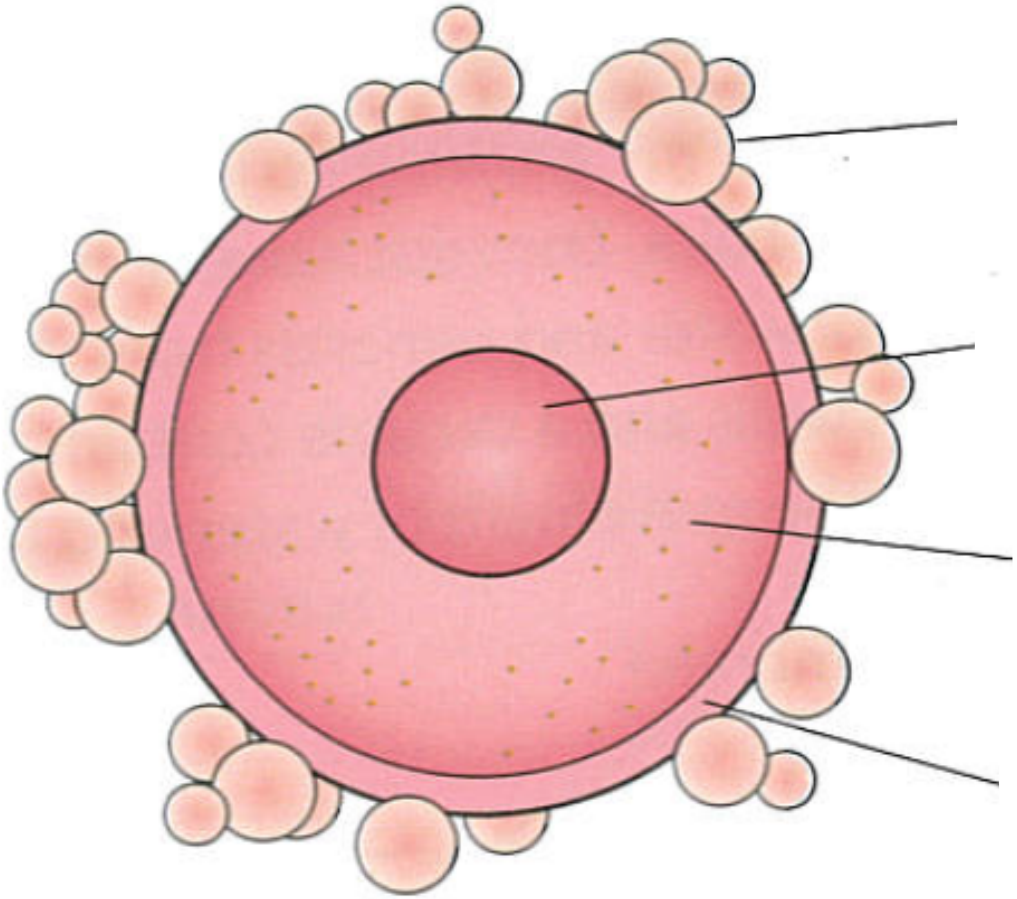
Understand cell specialisation in terms of structure and function, to include:
Sperm and egg cells in reproduction

- know and understand the structural and functional significance of sperm and egg cell features, to include:

Egg cell

- nucleus contains 23 chromosomes (haploid nucleus)
- large cytoplasm, organelles and energy store
- outer membrane (zona pellucida)

corona radiata – outer protective layer, supplies protein to the fertilised egg cell

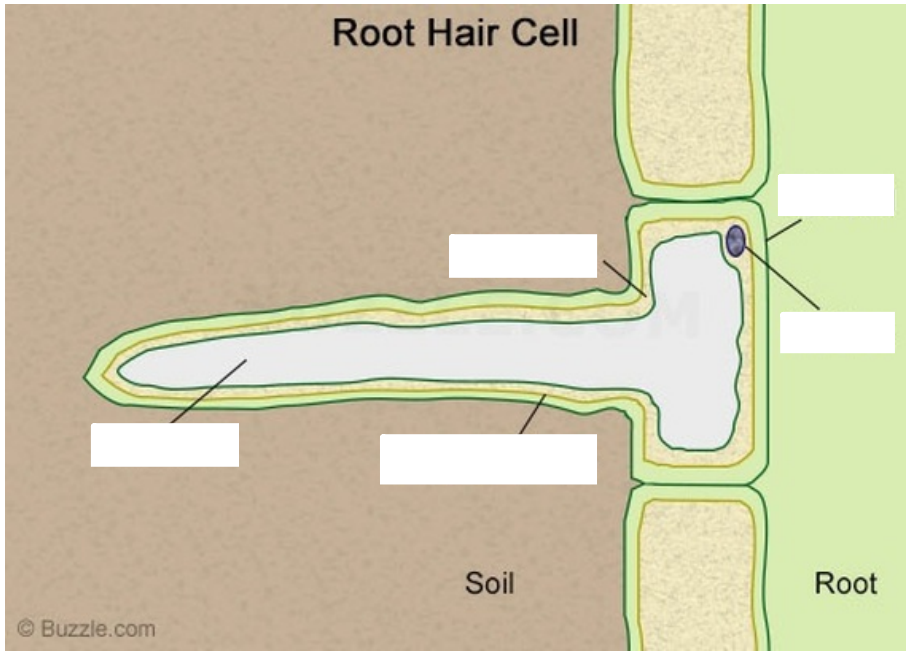


B2 Cell specialisation

Understand cell specialisation in terms of structure and function, to include:
Root hair cells in plants

- know and understand the structural and functional significance of root hair cell features, to include:
  - large surface area increases the rate of absorption of water and ions
  - cell membrane channels and carrier proteins to enable ions to cross membrane
  - cell membrane partially permeable to water
  - mitochondria to provide energy (ATP) for active transport of ions

short distance across cell wall increases rate of diffusion



B2 Cell specialisation

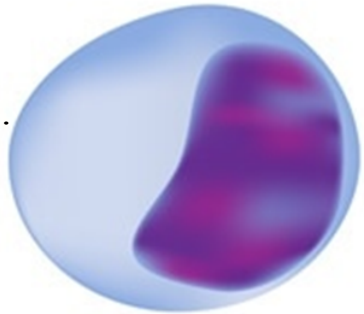
Understand cell specialisation in terms of structure and function, to include:
White blood cells

- know and understand the structural and functional significance of white blood cell features, to include involvement in immunity, allergy and rejection of transplants

lymphocytes

- T and B cells
- large nucleus
- immunological memory
- T cells send signals to B cells
- B cells produce antibodies
- B cell proliferation - some of which make antibodies and some become memory cells
- T cells destroy infected/cancerous cells

B cells produce antibodies
Cytotoxic T Cells(CD8 cells) Destroys host cells that harbour anything foreign. ...
Helper T Cells(CD4 cells) Modulate activities of OTHER immune cells.
Supressor T Cells. Turn off an immune response.
Memory T Cells.



Lymphocyte

B2 Cell specialisation

Understand cell specialisation in terms of structure and function, to include:
White blood cells

- know and understand the structural and functional significance of white blood cell features, to include involvement in immunity, allergy and rejection of transplants

Neutrophils

- the commonest type of white blood cell
- nucleus has several lobes
- flexible, mobile – can squeeze between cells in the capillary wall
- migrate to areas of infection

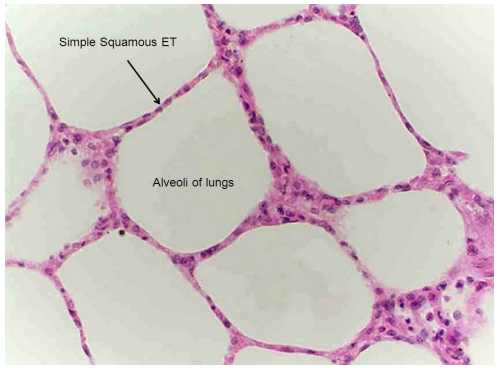
phagocytic – engulf and destroy pathogens

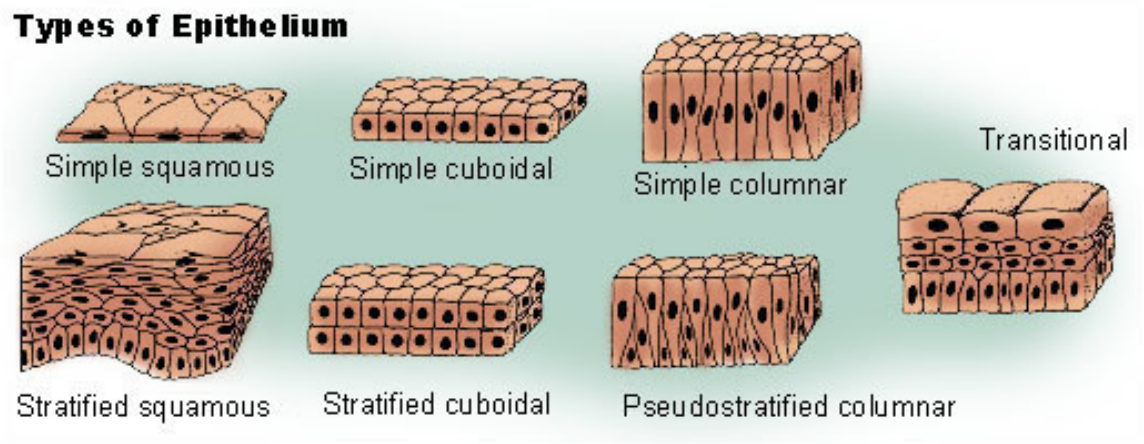
Neutrophil

B3 Tissue structure and function

Understand the structure and function of epithelial tissue, to include:
Squamous as illustrated by the role of alveolar epithelium in gas exchange to include the effect of chronic obstructive pulmonary disease (COPD) in smokers

- know and understand the structural and functional significance of squamous tissue features, to include:
  - simple squamous epithelium makes up the walls of the alveoli
  - alveoli are sites where oxygen and carbon dioxide are exchanged
  - oxygen from air to the blood in the capillaries around the alveoli
  - carbon dioxide as a waste product from blood into air in the capillaries around the alveoli
- chronic_obstructive pulmonary disease (COPD), to include: emphysema and chronic bronchitis





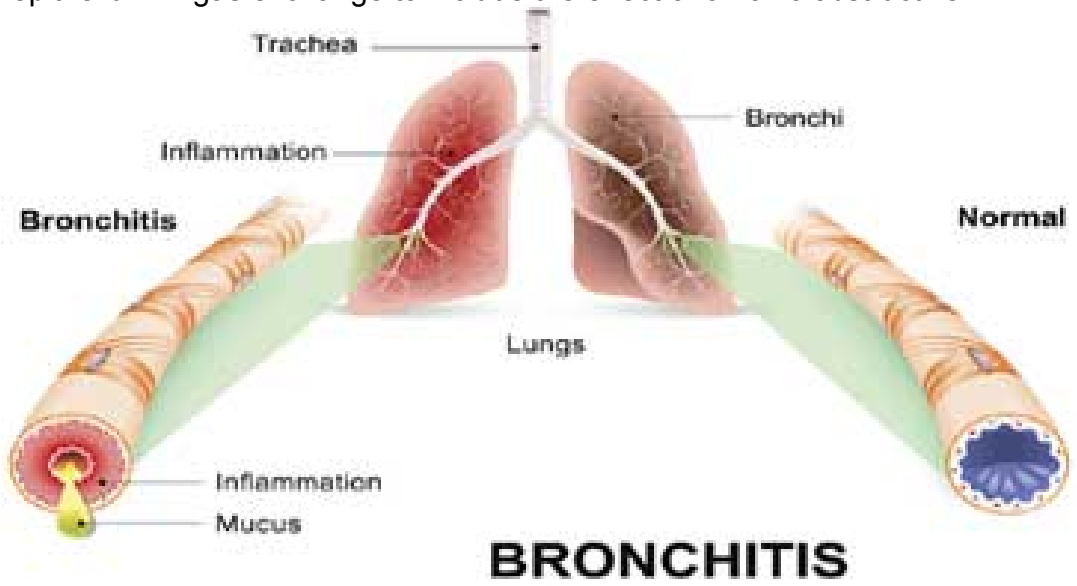
B3 Tissue structure and function

Understand the structure and function of epithelial tissue, to include:

Squamous as illustrated by the role of alveolar epithelium in gas exchange to include the effect of chronic obstructive pulmonary disease (COPD) in smokers

<u>chronic bronchitis</u>

- inflammation of airways in lungs
- squamous epithelium thickens
- excessive secretion of mucus - cough
- blocked airways – difficulty breathing

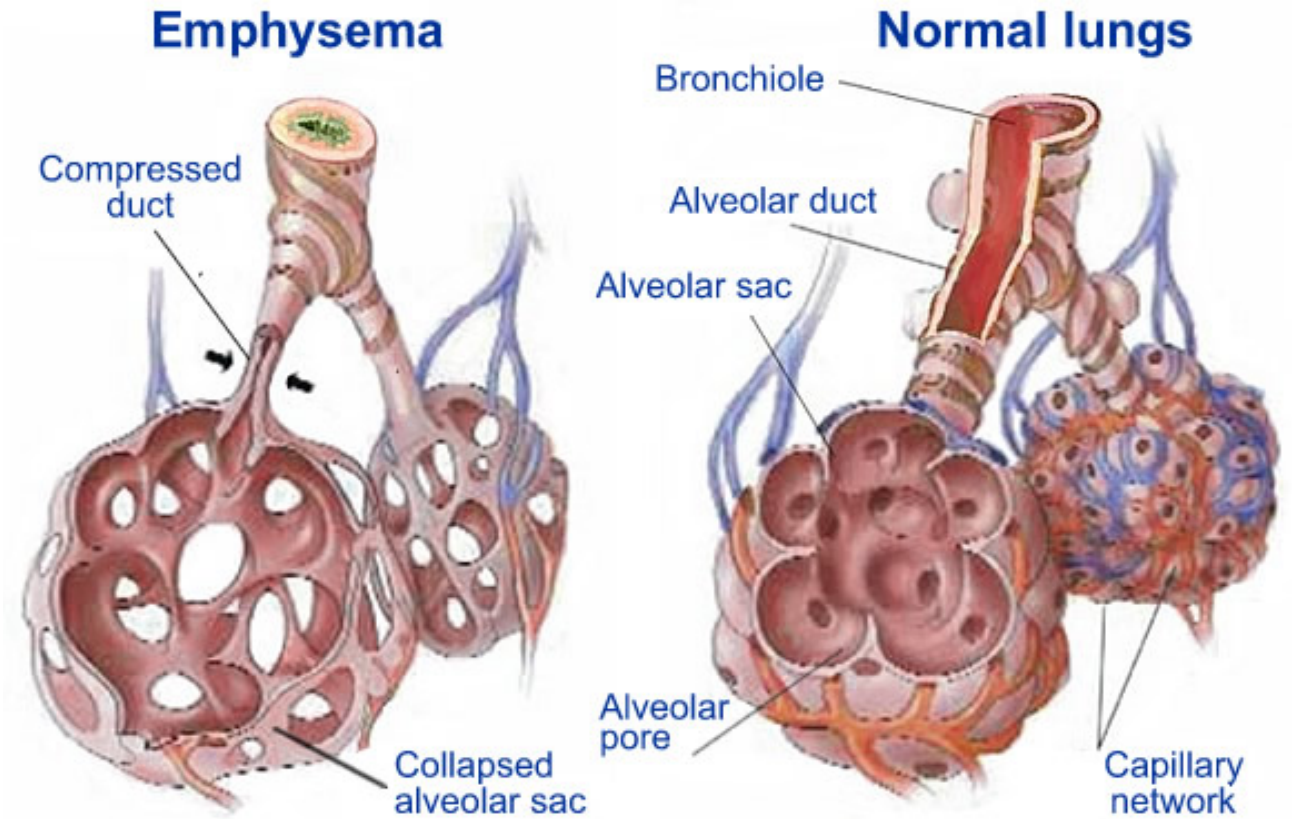


B3 Tissue structure and function

Understand the structure and function of epithelial tissue, to include:
Squamous as illustrated by the role of alveolar epithelium in gas exchange to include the effect of chronic obstructive pulmonary disease (COPD) in smokers
emphysema

- smoking is the main cause
- damage to the air sacs in the lungs
- destruction of the alveoli walls /membranes
- abnormally large air spaces in the lungs
- decreased surface area for gas exchange
- destruction of elastin means alveoli do not recoil – difficulty exhaling

causes respiratory problems and difficulty breathing and reduction of gaseous exchange



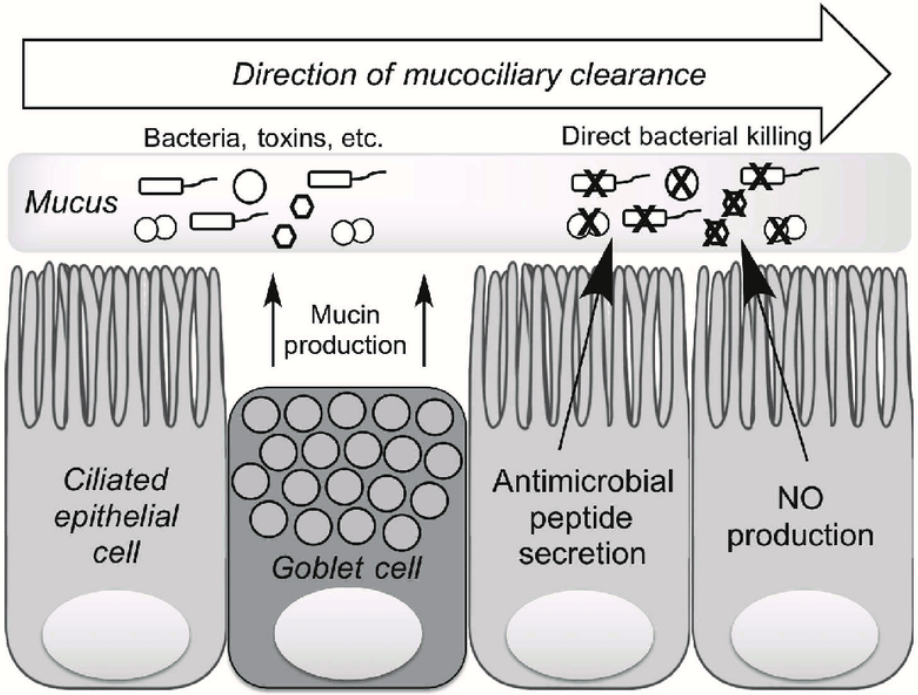
B3 Tissue structure and function

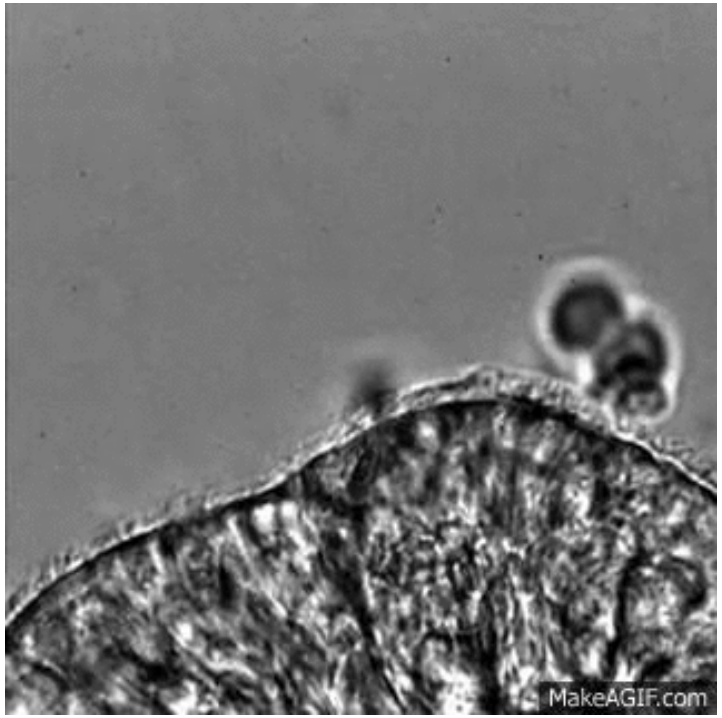
Understand the structure and function of epithelial tissue, to include:

Columnar as illustrated by goblet cells and ciliated cells in the lungs to include their role in protecting lungs from pathogens

- know and understand the structural and functional significance of columnar epithelium and goblet cells features, to include:
  - single layer of cells lining the trachea
  - cilia cover free surfaces of cells
  - epithelium contains goblet cells
  - goblet cells secrete mucus
  - cilia produce rapid wave-like motions

cilia move mucus and trapped foreign bodies (e.g. pathogens) up and out of the respiratory system

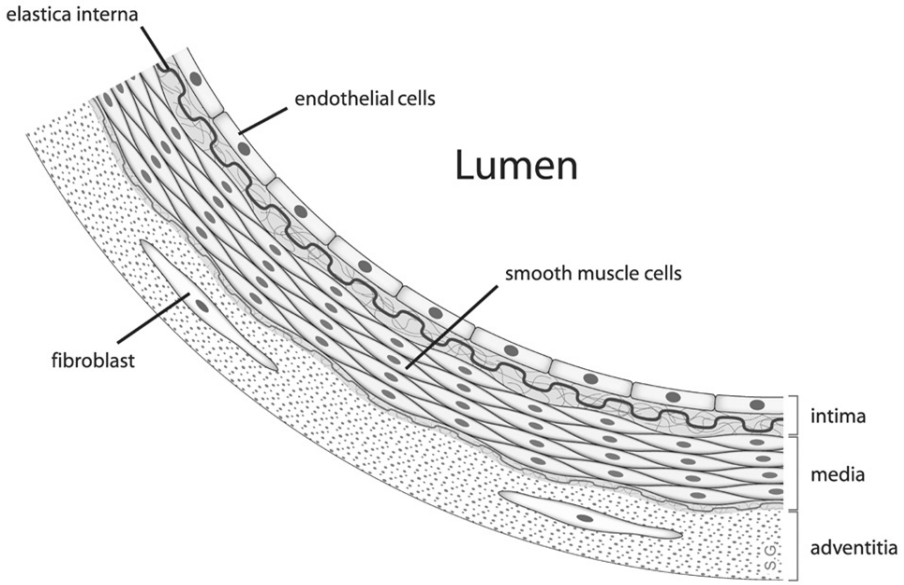




B3 Tissue structure and function

Understand the structure and function of endothelial tissue, as illustrated by blood vessels in the cardiovascular system, including the risk factors that damage endothelial cells and affect the development of atherosclerosis

- know and understand the structural and functional significance of endothelial tissue features, to include:
  - epithelium and endothelium are both types of lining tissue
  - epithelium covers outer surfaces
  - endothelium covers inner surfaces
  - single layer of squamous endothelium lines the inner surfaces of arteries, veins and capillaries



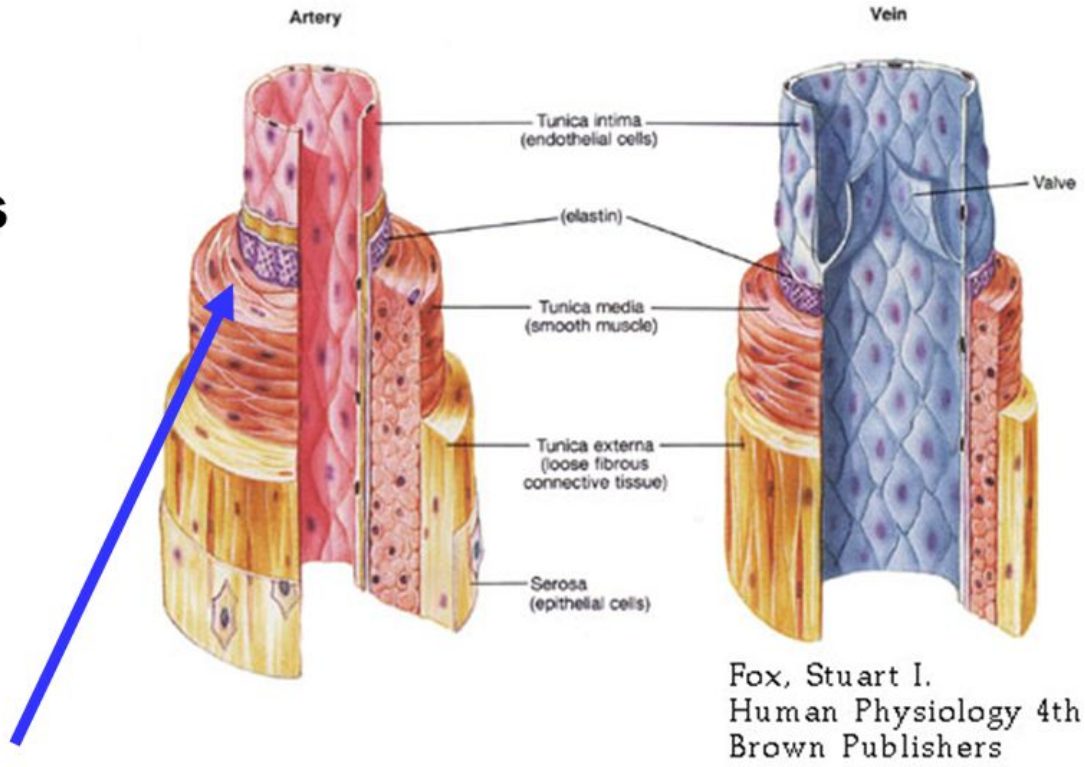
B3 Tissue structure and function

Understand the structure and function of endothelial tissue, as illustrated by blood vessels in the cardiovascular system, including the risk factors that damage endothelial cells and affect the development of atherosclerosis

arteries and veins

- endothelium reduces friction and allows for smooth flow of blood
- damaged endothelial cells release substances that cause blood vessels to constrict
- regulates blood flow and pressure

Arteries vs. Veins



Fox, Stuart I.
Human Physiology 4th
Brown Publishers

Arteries have muscular walls that squeeze the blood along

Veins have little muscle to squeeze blood along, and rely on our skeletal muscles to do so.

https://www.youtube.com/watch?v=R6QTiBfzULE

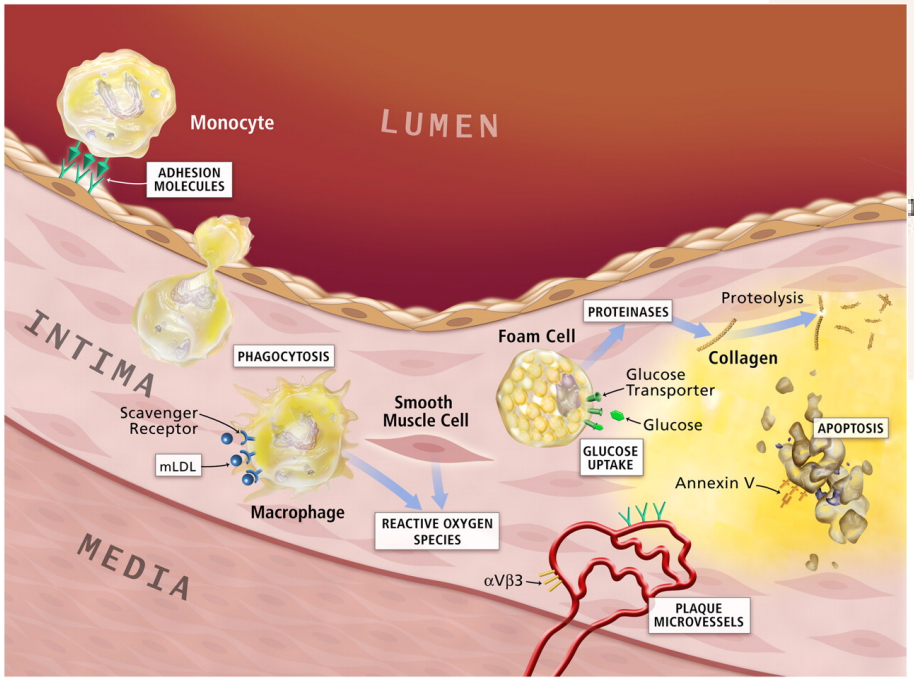
B3 Tissue structure and function

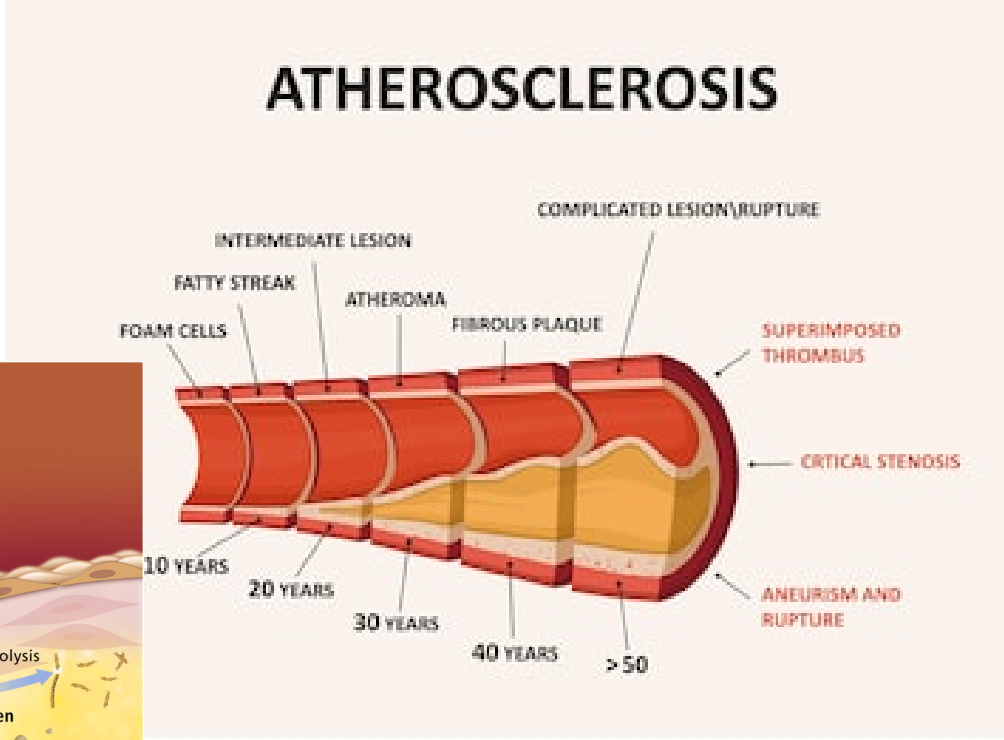
Understand the structure and function of endothelial tissue, as illustrated by blood vessels in the cardiovascular system, including the risk factors that damage endothelial cells and affect the development of atherosclerosis

atherosclerosis

- risks: smoking, diet and high blood pressure
- effect of white blood cells (foam cells)
- plaque in artery walls
- reduction of lumen diameter
- rupture of protective membrane over plaque

formation of blood clot (thrombus)





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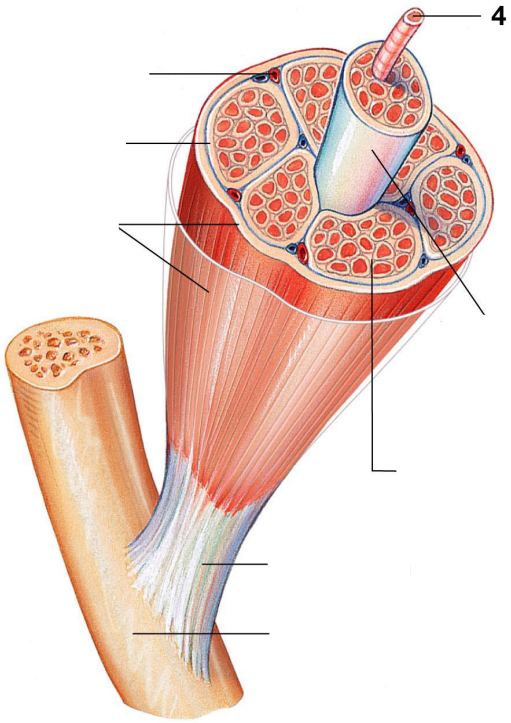
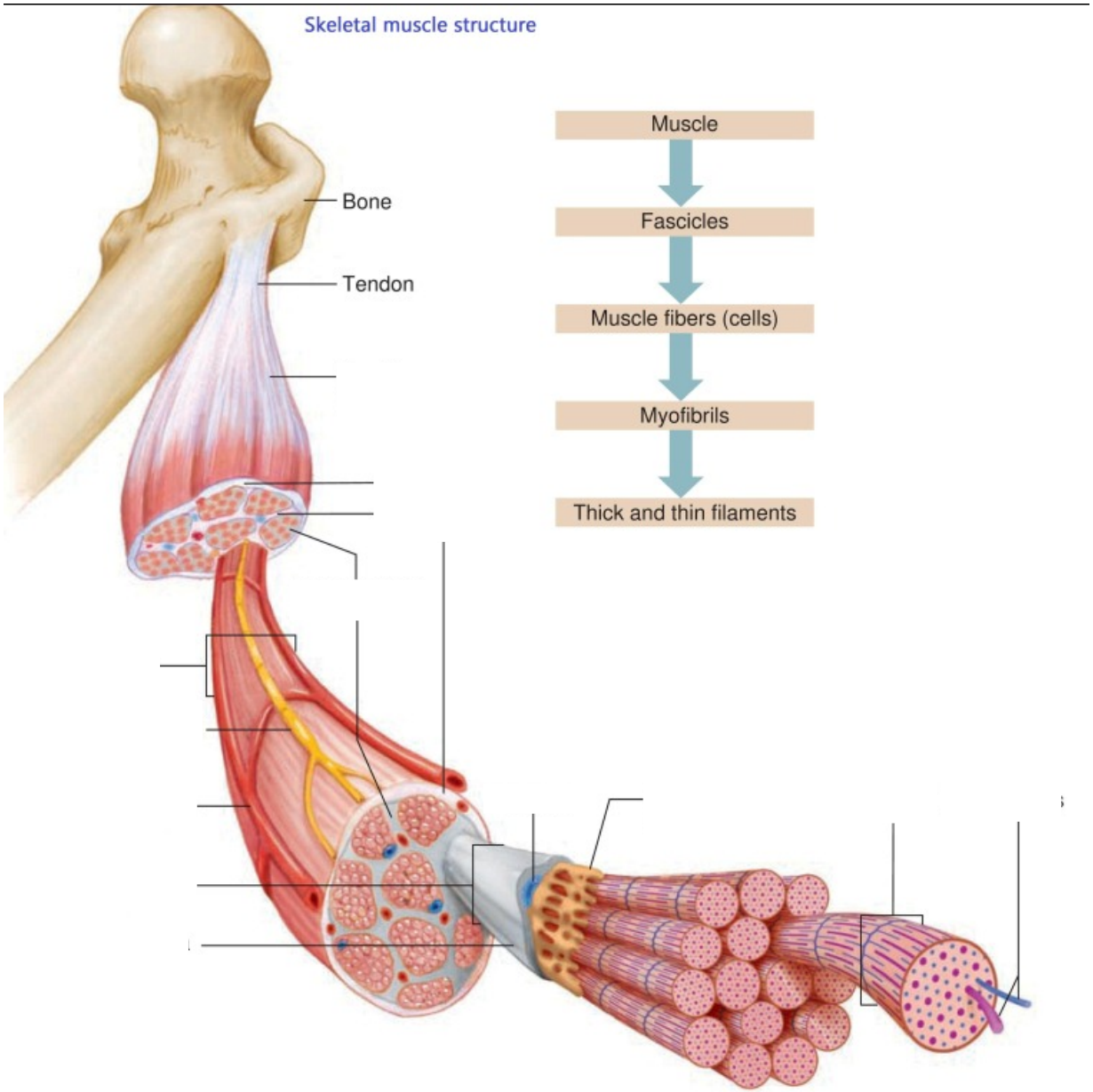
B3 Tissue structure and function

Understand the structure and function of muscular tissue, to include:

the microscopic structure of a skeletal muscle fibre

- know and understand the microscopic structural and functional significance of skeletal muscular tissue features, to include:
  - muscle fibres
  - multi nucleated
  - striated appearance
  - myofibrils
  - sarcomere
  - sarcolemma
  - sarcoplasmic reticulum
  - mitochondria
  - neuromuscular junctions
  - T tubules
  - sliding filament theory - actin and myosin, troponin, tropomyosin, calcium ions, ATP



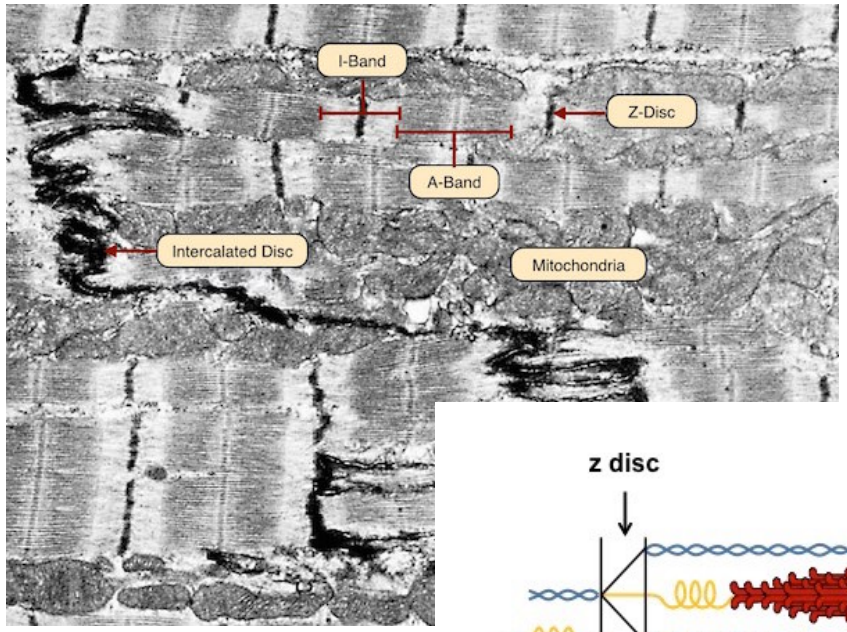

Skeletal muscle structure
Bone
Tendon
Muscle
Fascicles
Muscle fibers (cells)
Myofibrils
Thick and thin filaments

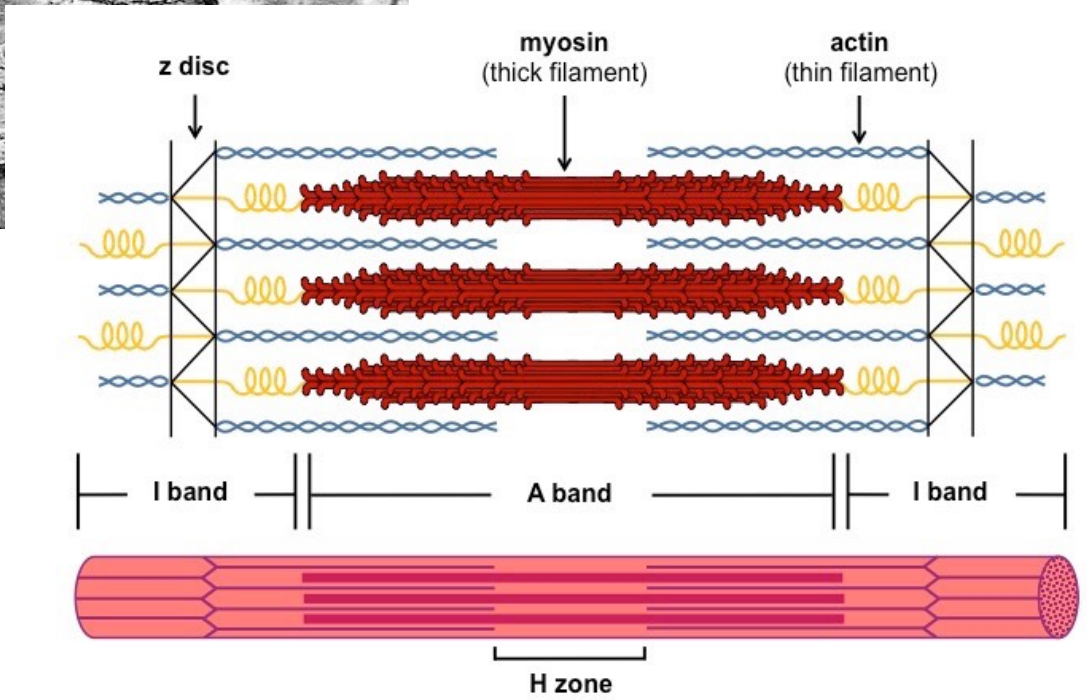
Sliding Filament Theory https://www.youtube.com/watch?v=ousflrOzQHc

1. _____
2. _____
3. _____
4. _____
5. _____

B3 Tissue structure and function

Understand the structure and function of muscular tissue, to include:
the microscopic structure of a skeletal muscle fibre
recognise the microscopic structure of skeletal muscle fibre from diagrams and photomicrographs





B3 Tissue structure and function

structural and physiological differences between fast- and slow-twitch muscle fibres and their relevance in sport

- understand the structural and physiological differences between fast- and slow-twitch muscle fibres and their relevance in sport, to include:
  - rate of contraction
  - rate of fatigue
  - suitability for activity
  - mitochondria
  - glycogen
  - sarcoplasmic reticulum
  - respiratory enzymes
  - myoglobin
  - appearance

blood supply

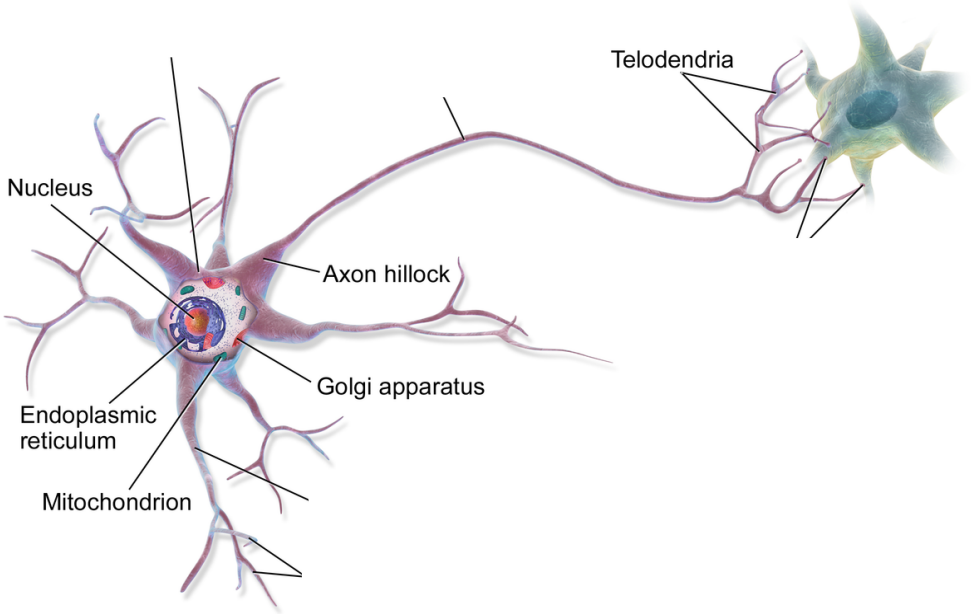
	Fast twitch (type II)	Slow Twitch (type I)
contraction velocity		
relaxation velocity		
capillarization		
myoglobin content		
mitochondrial content		
aerobic energy production		
anaerobic energy production		
fatigue		
suited for		
generation of speed and power		

B3 Tissue structure and function

Understand the structure and function of nervous tissue, to include:
non-myelinated and myelinated neurones

- know the structure of myelinated motor neurone
- know that action potentials are conducted along non-myelinated and myelinated axons

know that the speed of conduction of nerve impulses in non-myelinated is slower than in myelinated neurones



B3 Tissue structure and function

the conduction of a nerve impulse (action potential) along an axon, including changes in membrane permeability to sodium and potassium ions and the role of the myelination in saltatory conduction

- know and understand the conduction of a nerve impulse (action potential) along an axon, including changes in membrane permeability to sodium and potassium ions and the role of the myelination in saltatory conduction, to include:
  - resting membrane potential (c -70mV)
  - concentration gradients for K^+ and Na^+
  - conduction/ propagation
  - changes in membrane permeability to Na^+ which leads to depolarisation and the generation of an action potential
  - threshold potential and the all-or-nothing principle
  - voltage-gated ion channels
  - repolarisation owing to K^+ diffusion out of cell
  - hyperpolarisation
  - refractory period

factors affecting the speed of conductance such as myelination and saltatory conduction between nodes of Ranvier

Can you explain all the bullet points above?

B3 Tissue structure and function

interpretation of graphical displays of a nerve impulse and electrocardiogram (ECG) recordings

- be able to interpret graphical displays of a nerve impulse and electrocardiogram (ECG) recordings, to include:
  - threshold, depolarisation, repolarisation and hyperpolarisation, refractory period, and resting state phases of a nerve impulse

identify the PQRST points on ECG recording

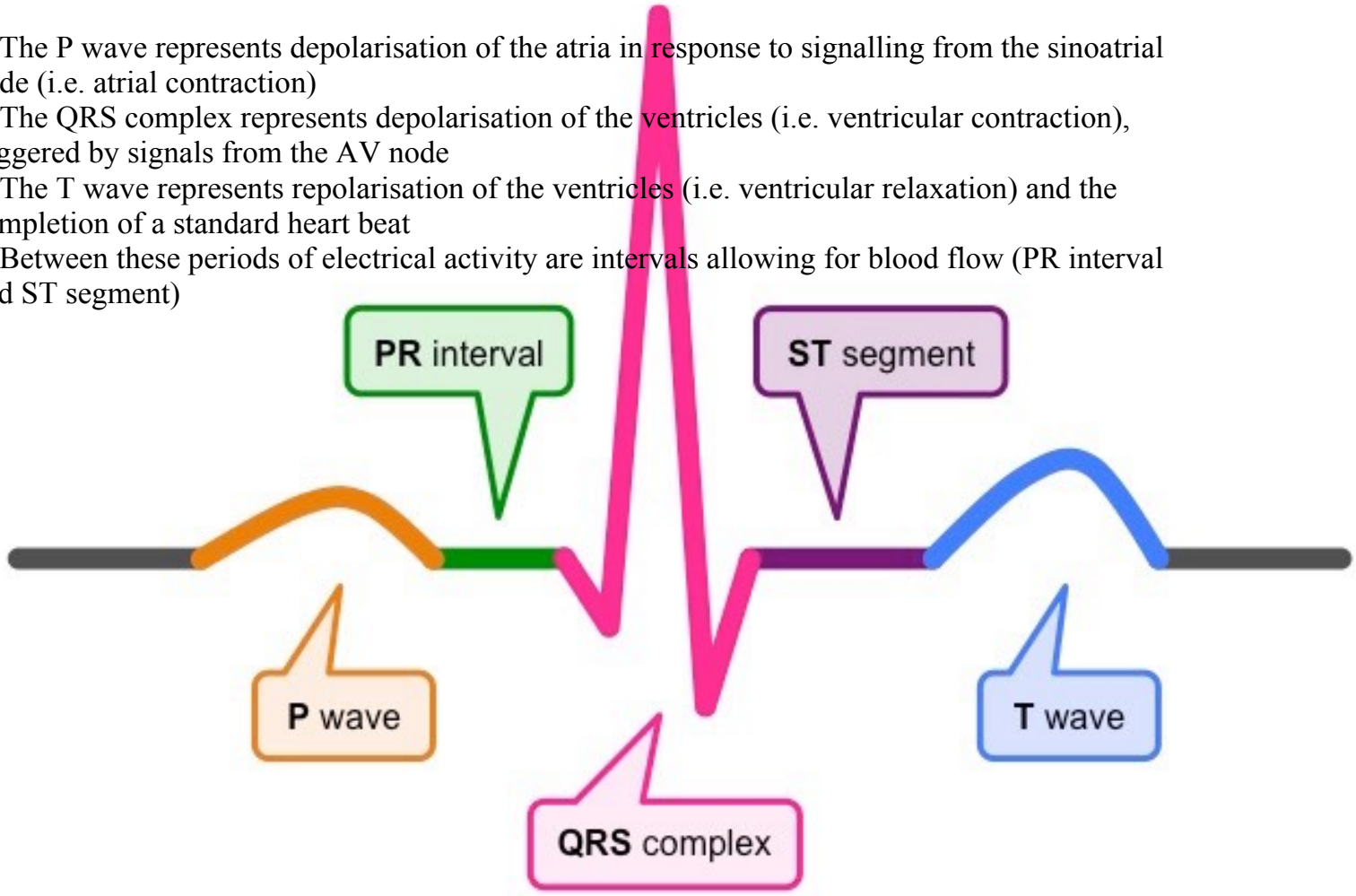
Each normal heart beat should follow the same sequence of electrical events:

The P wave represents depolarisation of the atria in response to signalling from the sinoatrial node (i.e. atrial contraction)

The QRS complex represents depolarisation of the ventricles (i.e. ventricular contraction), triggered by signals from the AV node

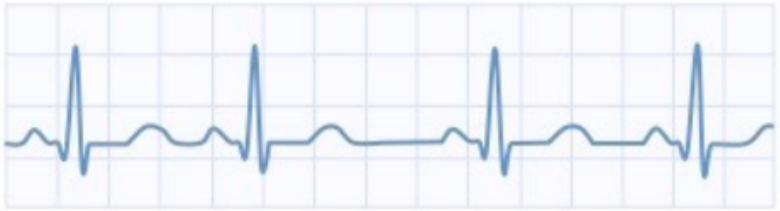
The T wave represents repolarisation of the ventricles (i.e. ventricular relaxation) and the completion of a standard heart beat

Between these periods of electrical activity are intervals allowing for blood flow (PR interval and ST segment)



Cardiac Rhythm Diagnoses

Complexes normal, evenly spaced. Rate 60–100 bpm

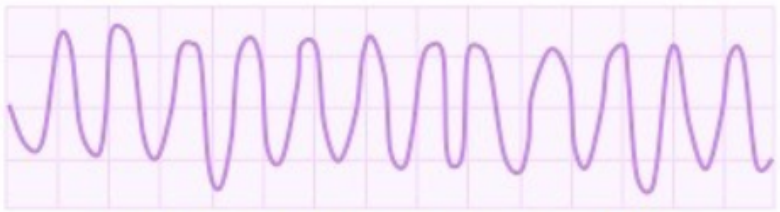


All complexes normal, rhythm irregular

Complexes normal, evenly spaced. Rate < 60 bpm

Complexes normal, evenly spaced. Rate > 100 bpm

Baseline irregular. Ventricular response irregular



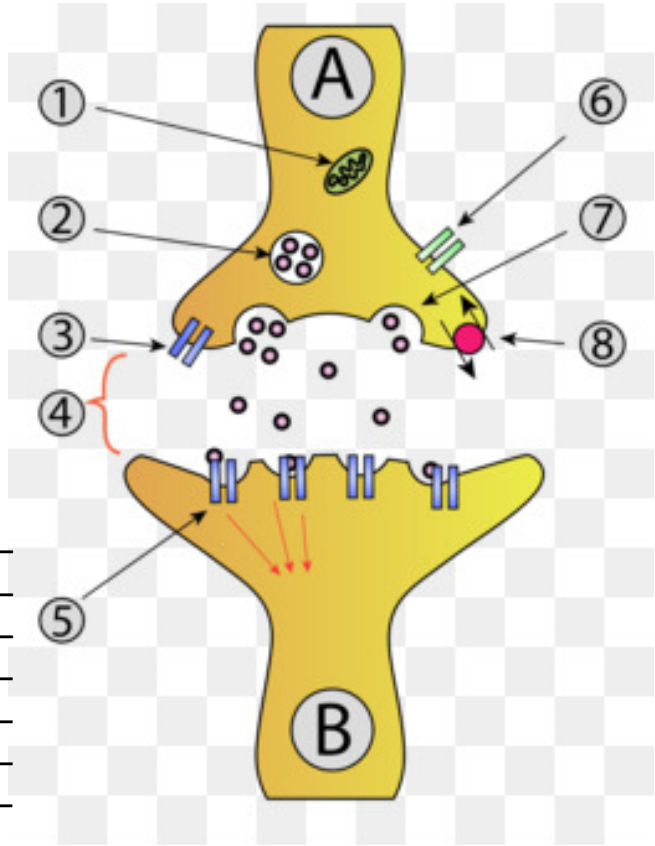
Rapid, wide irregular ventricular complexes

B3 Tissue structure and function

synaptic structure and the role of neurotransmitters, including acetylcholine

- understand synaptic structure and the role of neurotransmitters, including acetylcholine, to include:
  - presynaptic knob/membrane
  - postsynaptic neurone/membrane
  - synaptic cleft
  - exocytosis of neurotransmitter, role of calcium ions
  - diffusion of neurotransmitter across the synaptic cleft
  - receptors on post synaptic membrane
  - depolarisation of post synaptic membrane, triggers action potential
  - breakdown, reuptake and recycling of neurotransmitters
  - acetylcholine at the neuromuscular junction
  - acetylcholine receptors on the muscles

propagation of action potential



Can you label all the parts of the synapse and write a story to describe what happens during synaptic transmission?

B3 Tissue structure and function

how imbalances in certain, naturally occurring brain chemicals can contribute to ill health, including dopamine in Parkinson's disease and serotonin in depression

- understand:
  - how varying concentrations of dopamine and serotonin contribute to ill health
  - the effect of the imbalances of dopamine in Parkinson's disease the effect of the imbalances of serotonin in depression

B3 Tissue structure and function

the effects of drugs on synaptic transmission, including the use of L-Dopa in the treatment of Parkinson's disease

- know the types of neurotransmitters
  - inhibitory – decrease the likelihood of an action potential
  - excitatory - increase the likelihood of an action potential
- understand antagonist and agonist effects of drugs on synaptic transmission, including:
  - L-Dopa as precursor of dopamine, raises levels of dopamine, reduces muscle tremor and other motor problems
  - antagonist – blocks action of transmitter on its receptors (e.g. atropine or curare)

agonist – mimics action of transmitter on its receptors (e.g. nicotine or muscarine)