Organelle	Pupil	Organelle	Pupil
Nucleus	KO'N	Microtubules + centrioles	LF
Endoplasmic reticulum	ED	Plant cell wall	OC
Ribosomes	KL	Chloroplasts	RK
Golgi apparatus	BC	Large vacuole	KR
Lysosomes	JF	Plasmodesmata	JE
Mitochondria	KS	Vesicles	KR
Cell surface membrane*	NN	Prokaryotes and eukaryotes	AD

*Need a summary just – not covered yet!

NUCLEUS

A nucleolus synthesis ribosomal RNA (rRNA) makes ribosomes, which are the component essential in process of protein synthesis.

The nucleus often contains one or more nucleoli, under the microscope this appears even darker than densely packed heterochromatin and is more discrete in structure that the more diffuse heterochromatin, often concentrated close to the nuclear membrane.

Chromatin

When cells are not dividing the chromosomes are not visible but are more diffusely organised in a form called chromatin.

In parts of the nucleus, the chromatin is more densely packed (heterochromatin), appearing dark when viewed by electron microscope.

In other parts, it is less densely packed (euchromatin), and therefore appears lighter when viewed.

It is the largest and most obvious organelle in most cells.

Nucleus contains DNA in chromosomes

Control centre of the cell, as the DNA in chromosomes codes for the synthesis of proteins in cytoplasm.

The chromosomes in nucleus are isolated so that the DNA are safe from damage.

The DNA code for protein synthesis needs to be taken from the safety of the nucleus to the cytoplasm. This is achieved by the presence of nuclear pores in the nuclear envelope (membrane).

The nuclear envelope is a double membrane with very narrow space between each membrane.

ENDOPLASMIC RETICULUM

Location→

- ER is a membrane that extends throughout the cytoplasm.
- IT is often very near the nucleus, meaning that the mRNA doesn't have to travel too far.
- **RER** is more common in cells whose function it is to secrete proteins.
- **SER** is more common in cells that release oils.

Structure→

Rough ER:

- RER is flattened and looks like sheets of membranes.
- It has ribosomes encrusted along the outside of the membranes.

Smooth ER:

- Smooth ER has a more tubular appearance.
- It doesn't have ribosomes.

The double membranes of the ER form sacs called cisternae.

Function→

RER:

- The RER has ribosomes attached to it.
- Ribosomes contain rRNA and are the site of protein synthesis.
- The RER provides the scaffolding for the ribosomes to make the primary proteins.
- Once synthesised, the proteins are either stored in the cisternal space or pinched off the RER in vesicles to be sent to the Golgi Apparatus for modification.

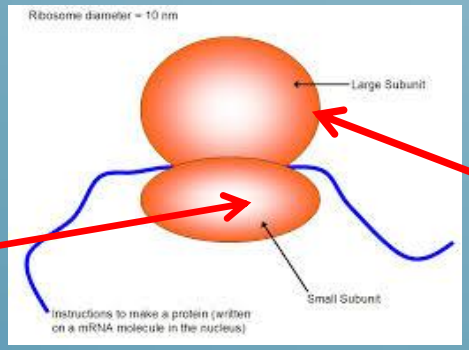
SER:

- The SER is responsible for lipid synthesis and metabolism.
- Steroid and lipid storage also occurs here.
- Proteins synthesised in the RER can also travel in the cisternae to be pinched off the SER as vesicles.

Ribosomes

- Ribosomes are small bodies of proteins
- Up to 30nm
- Each ribosome is formed of a large and a small subunit
- Visible as black dots in electron micrographs
- Frequently occur in groups called *polyribosomes* which create 'hot spots' for protein synthesis

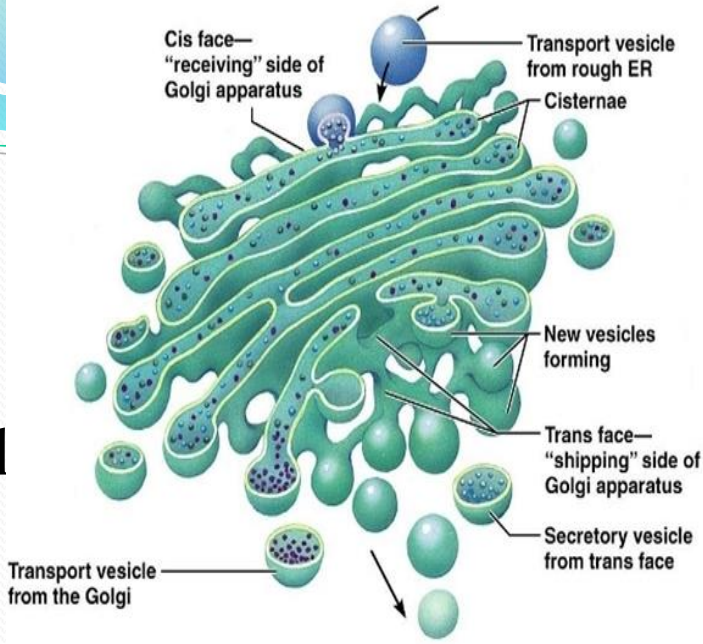
- Found either free in the cytoplasm or attached to the outer surface of the endoplasmic reticulum(RER)
- The mRNA in the nucleus leaves and travels to the ribosomes where the message is read and translated to protein
- Proteins made in the ribosomes accumulate in the RER and then the ER operates as a distribution network for proteins



Small subunit

Large subunit

GOLGI APPARATUS



- The Golgi is made up of a number of Cisternae and found in the cytoplasm of cell
- The Golgi's main function is to gather primary proteins to modify them to making molecules that are more complex,

e.g glycoprotein.

- When a newly synthesised protein is released from the ER, it travels through the cytoplasm in a transport vesicle. When the vesicle reaches the Golgi it fuses with the (convex) forming face.
- In the main body of the Golgi the protein becomes modified and packaged into a secretory vesicle to be pinched off from the maturing face of the Golgi and exocytosed into the cytoplasm. From there, the vesicle moves to the cell membrane and the protein is released out of the cell.

LYSOSOMES

Location?
Cytoplasm

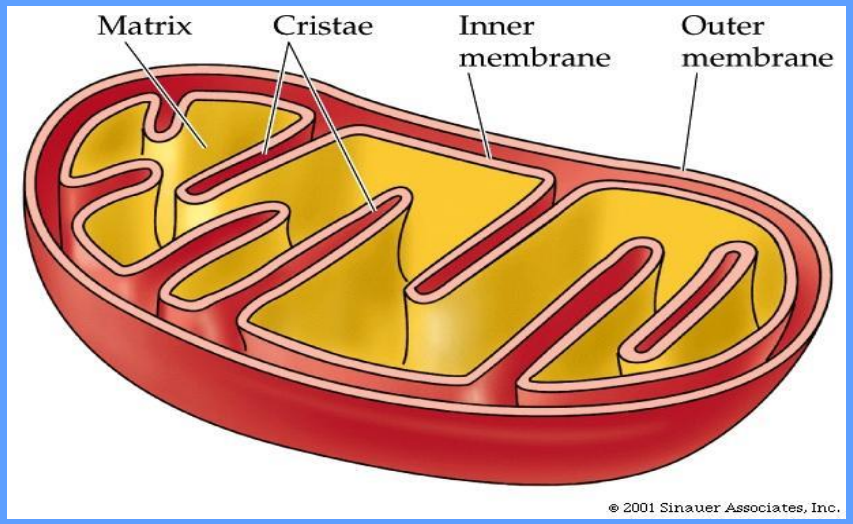
Structures?
Thick lipoprotein membrane
Hydrolytic Enzymes

Other Information?
- A thick membrane is necessary to insulate the enzymes from the rest of the cell because they would digest it
- Organic debris is removed by AUTOLYSIS

Functions?
- Fusion with other vesicles that contain organic debris (e.g. worn out cell organelles) to release digestive enzymes. Here they form secondary lysosomes.
- Important role in phagocytes, they digest engulfed bacteria in a phagosome
- Protect cell by destroying foreign bacteria/virus
- Destroying an old/ damaged cell by bursting

Links to other organelles?
- Lysosomes are formed by the Golgi apparatus
- Lysosomes have the ability to digest ANY organelle

MITOCHONDRIA are present in almost all types of ***ANIMAL CELLS.*** Located in the ***CYTOPLASM*** of the cell.



They are common in cells that have high energy requirements, such as ***MUSCLE CELLS.***

Mitochondria are enclosed within a double membrane, separated by and ***INTER-MEMBRANE*** *space.*

The inner membrane is ***FOLDED*** to from ***CRITSAE.*** That extends into the matrix.

This infolding gives the inner mitochondrial membrane a ***GREATER SURFACE AREA-*** *therefore increasing the number of enzymes (involved in aerobic respiration) that can be embedded within the membrane.*

It is the site of ***ATP SYNTHESIS*** during ***AEROBIC RESPIRATION.***

The mitochondrion is the of the cell.

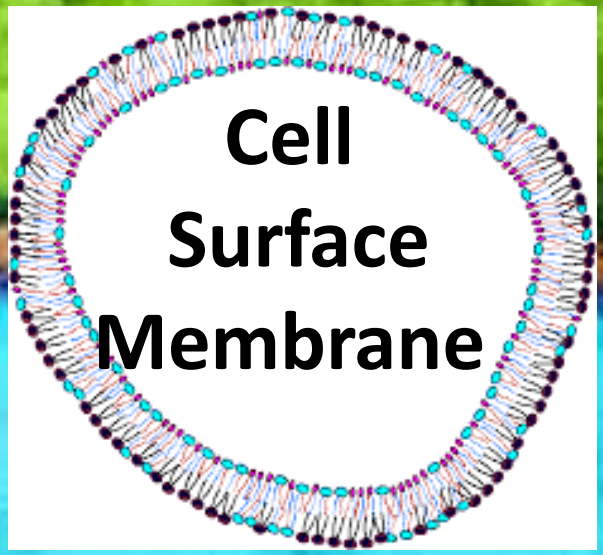
POWERHOUSE

It consists of two basic components: a phospholipid bilayer and protein

It is a partially permeable membrane

Protein molecules can be attached peripherally to the bilayer (extrinsic) or integrally embedded into one of the layers (intrinsic)

Cell Surface Membrane



Protein molecules are scattered throughout the membrane

Animal cell membranes also contain cholesterol molecules that lie between the phospholipid tails

The glycoalyx extends from the outer phospholipid layer of the membrane, it contains polysaccharides that are bound to either glycoproteins or glycolipids

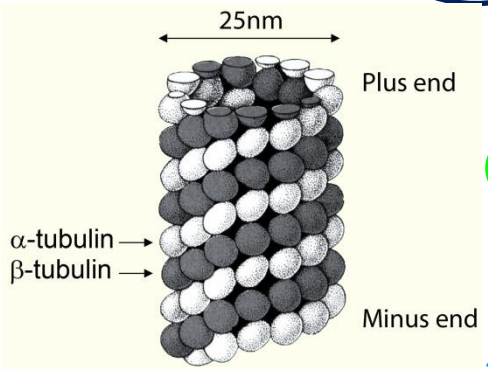
Microtubules and Centrioles.

Microtubules: Hollow cylinders formed from a protein called Tubulin.

Length: Up to 10μm

Concentrated in specific areas for specific functions.

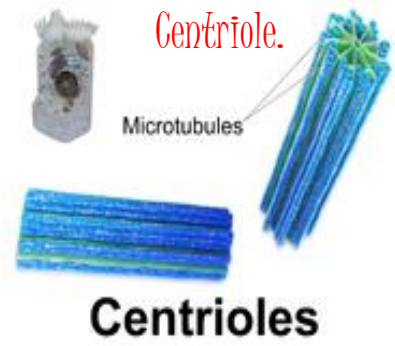
Microtubule.



Found: Within Centrioles as 9 triplets in a circular formation, throughout the Cytoplasm.

Diameter: 25nm

Form part of cytoskeleton



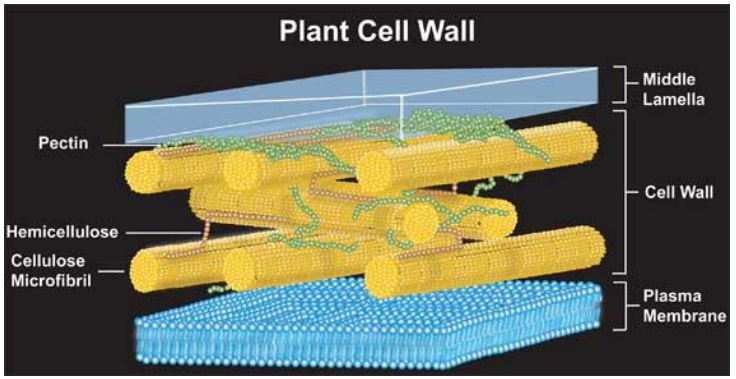
Form spindle fibres during cell division.

Allow movement of cell organelles.

Centrioles: Animal and Fungal cells.

Cell Wall

- Location: lies immediately outside the cell-surface membrane
- Structure: main component of plant cell walls is the polysaccharide cellulose, which is laid down in microfibrils. These microfibrils consist of many cellulose molecules cross linked to each other. The primary cell wall is made up of many microfibrils orientated in different and random directions. The secondary cell wall is formed when the cell reaches full size. The microfibrils here are orientated in the same direction and additional layers are orientated in the same direction- lattice type arrangement. Cell walls or adjacent cells are linked by the middle lamella, largely made up of polysaccharides called pectin. Calcium pectate forms a gel holding neighbouring cells together.
- Function: PROVIDE SUPPORT-restrict outward expansion of cell content (protoplast) as the cell takes in water, providing the supporting force against turgor pressure. FULLY PERMEABLE.
- Links: plasmodesmata



Chloroplasts

Location

- Leaves of plants in photosynthesising cells e.g mesophyll cells, also guard cells & palisade layer

Structure

- Large organelle: 10μm - 25μm in diameter
- Bounded by double membrane, outer & inner (protects inner parts of chloroplast)
- Within the stroma (where sugars are synthesised) is a system of membranes (thylakoids) which can be are arranged in stacks (grana, singluar = granum)
- Thylakoids have chlorophyll molecules (capture light energy from the Sun) on their surface, & are most densely concentrated in the grana
- Between the grana, membranes are less concentrated (inter-grana)
- Stacks of sacs are connected by stroma lamellae (skeleton of chloroplasts - keeps sacs safe distance from each other & ensures max. efficiency in capturing light energy)

Function

- Site of photosynthesis: aids process of food production which is crucial for plant survival
- Chlorophyll causes green colouration of leaves & uses sunlight energy to make sugars/starch grains/lipid droplets through process of photosynthesis
- Photosynthesis equation: light + CO_2 + H_2O -> glucose (stored as ATP energy) + O_2
- Mitochondria work in the opposite direction to chloroplasts, use O_2 in process of releasing chemical energy from sugars and produce CO_2 + H_2O

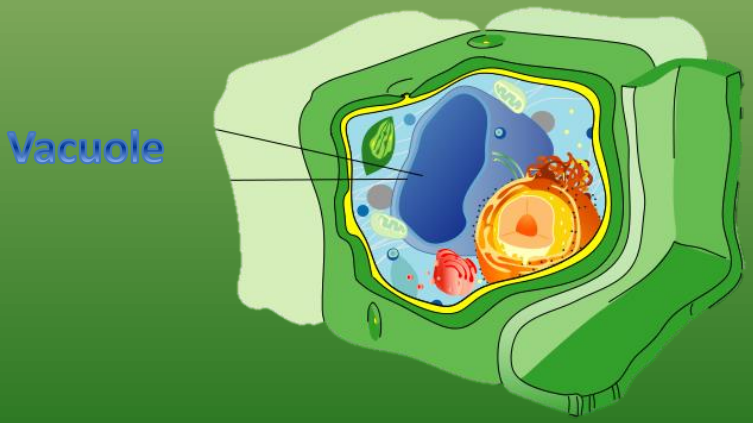
Large permanent vacuole

Location: Located in the cytoplasm of the plant cell.

Function: It plays an important role in storing ions and water, and provides tugor pressure for support.

Links: The waste products generated in cells are accumulated in vacuoles. Thus, vacuoles protect other organelles of the cell from harmful effects of wastes.

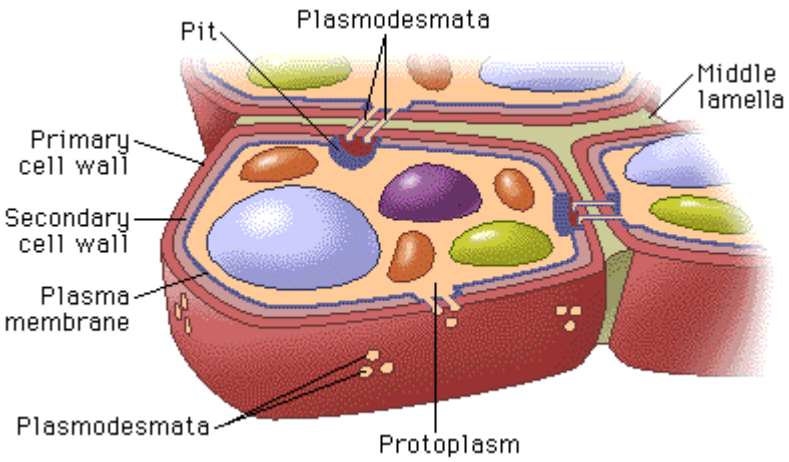
Structure:



Plasmodesmata

Plasmodesmata are strands of cytoplasm that extend between neighbouring plant cells

Link to other organelles- Plasmodesmata link other cells as they are gaps in the cell wall



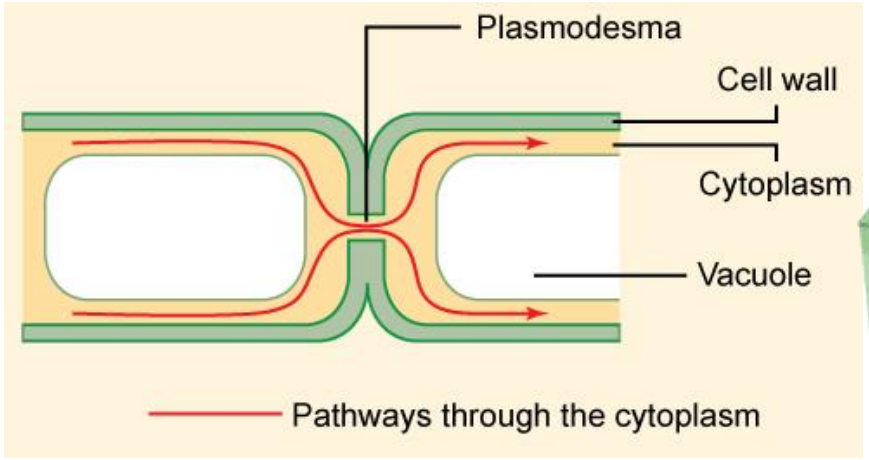
Function-

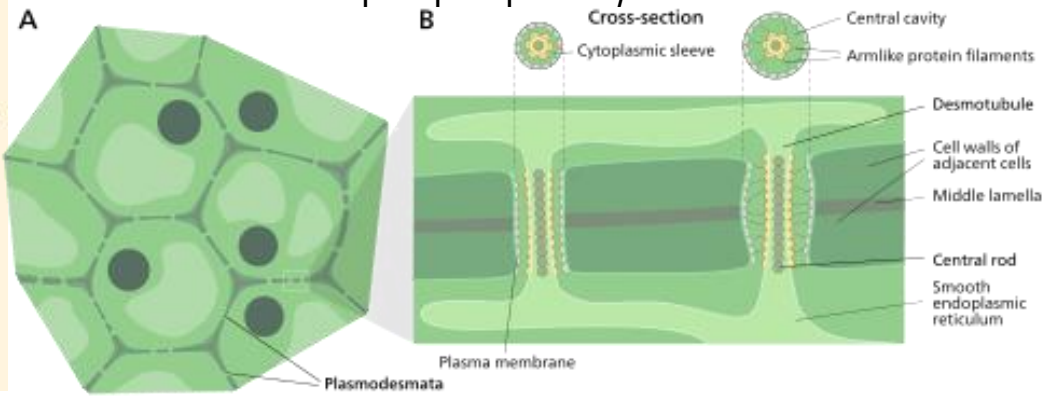
Plasmodesmata provide 'gaps' in the cell walls of adjacent cells that enable different kinds of molecules to pass through. As the cell membranes of the cells beside pass through the pores, the neighbouring cells are joined, physically and metabolically.

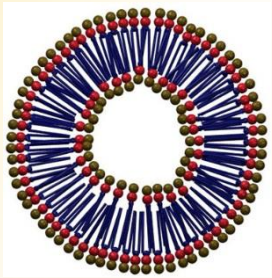
Structures-

A typical plant cell will have between 10^3 and 10^5 plasmodesmata connecting it with neighbouring cells equalling up to between 1 and 10 per μm^2. Plasmodesmata are roughly 50-60 nm in diameter at the midpoint and is made up of three main layers, the plasma membrane, the cytoplasmic sleeve, and the desmotubule. The plasma membrane part of the plasmodesma is a continuous extension of the cell membrane, as it has a similar phospholipid bilayer structure

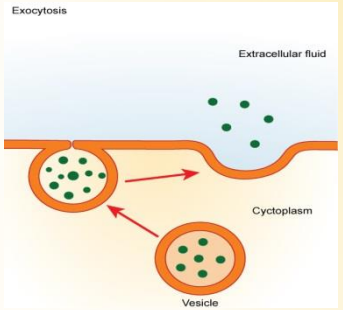
Location- In the plant cell







Vesicles



Structure

Vesicles are small structures within a cell that contain fluids and are bound by a single membrane.
Lysosomes are vesicles produced by the Golgi Apparatus (contain hydrolytic enzymes)

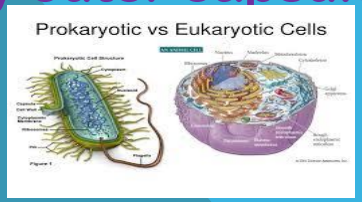
Function

- **Vesicles are used for storage and transport of substances.**
- **They 'pinch off' newly synthesised primary proteins from RER and transport it to the Golgi apparatus where it fuses with the forming face to allow protein modification.**
- **<u>Secretory</u> Vesicles then transport the modified protein from the concave face of the Golgi to the cell surface membrane. Here they fuse to release the contents outside the cell.**
- **Lysosomes combine with vesicles to destroy whatever it contains (worn out cell organelles etc)**

COMPARING PROKARYOTES AND EUKARYOTES

Prokaryotes: e.g. bacteria

- ✓ Have no nuclei
- ✓ Have no membrane bound organelles
- ✓ Possess naked circular DNA
- ✓ (not surrounded by a nucleus, not joined to proteins or arranged into chromosomes)
- ✓ Have small ribosomes (20nm)
- ✓ Have a cell wall made from peptidoglycan
- ✓ Can have plasmids (small circular DNA. Plasmids are readily accepted by other bacteria which is useful for genetic engineering.
- ✓ May have a slimy outer capsule



Eukaryotes: e.g. animal, plant, fungal cells

- ✓ Have a membrane bound nucleus
- ✓ Have chromosomes- linear helical DNA with a histone protein coat (this forms chromatin which forms chromosomes)
- ✓ Have other membrane bound organelles e.g. mitochondria, Golgi apparatus, vesicles etc.
- ✓ Have larger ribosomes (25nm)
- ✓ have microtubules(makes up the cytoskeleton of the cell, giving structure and transport pathways
- ✓ Are larger cells.
- ✓ No capsule