

Section One: Observation of Cells

- . Cells range from 10 – 150 μm (0.01 – 0.15 mm)
- . Optical microscopes can magnify cells up to 400 times
- . Electron microscopes magnify 1000 – 200 000 times
- . They allow cells' ultra structure with organelles to become visible



. Advantages:

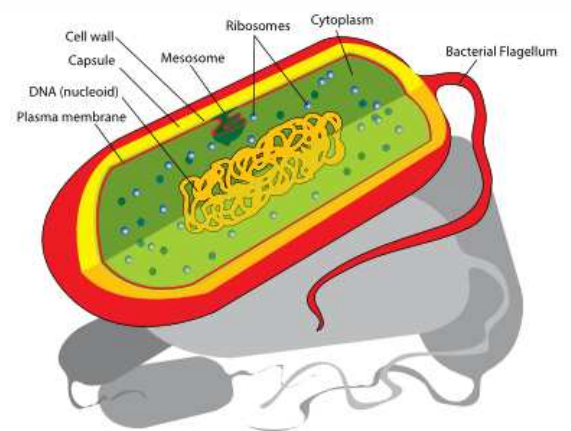
- Huge powers of magnification and resolution
- Cell ultra structure seen for the first time

. Disadvantages:

- Impossible to look at living materials as specimens are examined in a vacuum
- Specimens undergo severe treatment liable to result in artifacts
- Extremely expensive and need constant temperatures and pressures to operate

Prokaryotic cells (0.5 – 10 μm diameter)

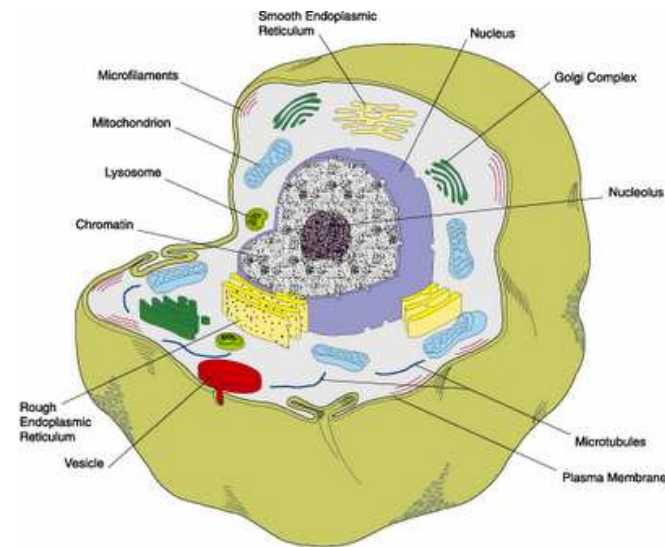
- . Include bacteria and blue-green algae
- . Lack a membrane-bound nucleus
- . DNA is free in the cytoplasm forming a coil (nucleoid) or plasmid
- . Respiration occurs on the mesosome (piece of the cell membrane)
- . Lack mitochondria, ER and Golgi body



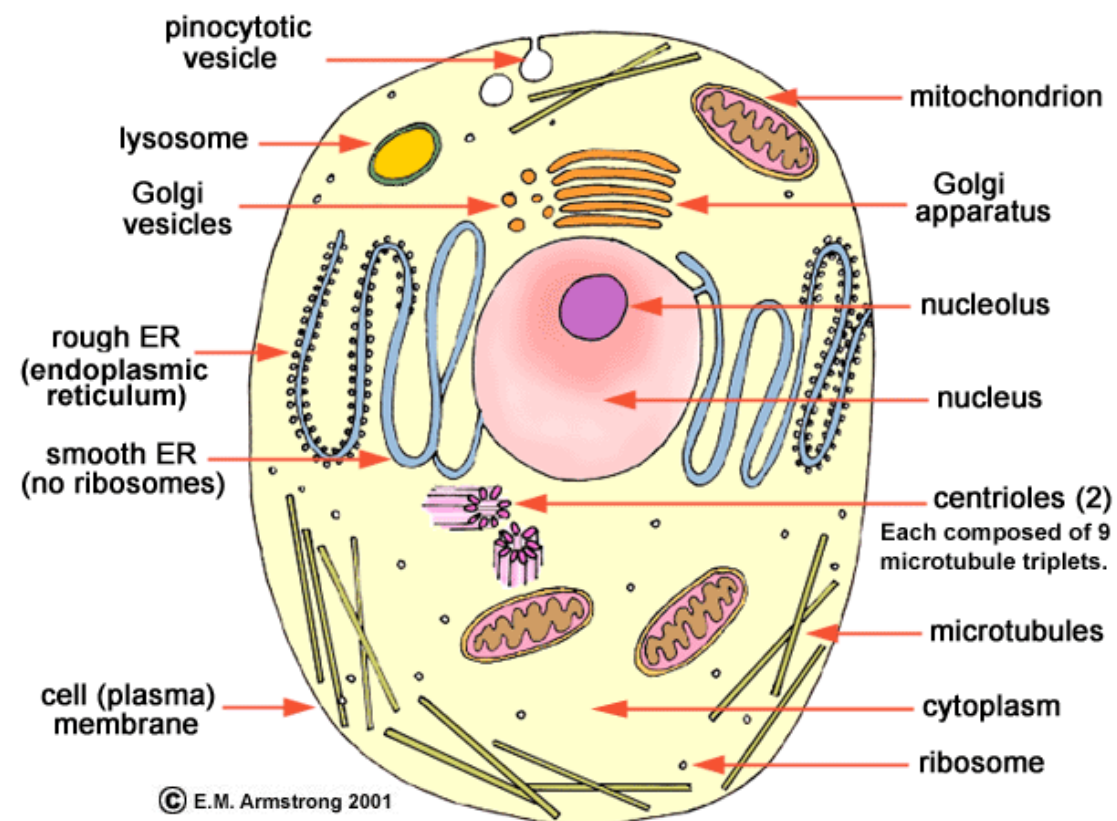
Eukaryotic cells (10 – 150 μm diameter)

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- . Membrane bound organelles
- . Complex structure of internal membranes and organelles
- . DNA as chromosomes in nucleus
- . Respiration occurs in mitochondria
- . Contain ER, ribosomes and Golgi body
- . Cell wall made of cellulose
- . Nucleolus present



Cell structure and function



1. Mitochondria

- . Double membrane, rod shaped structures
- . Typically 1 μm wide and up to 10 μm long

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. Sites of aerobic respiration

. Outer membrane is smooth but inner membrane is folded into shelf-like cristae

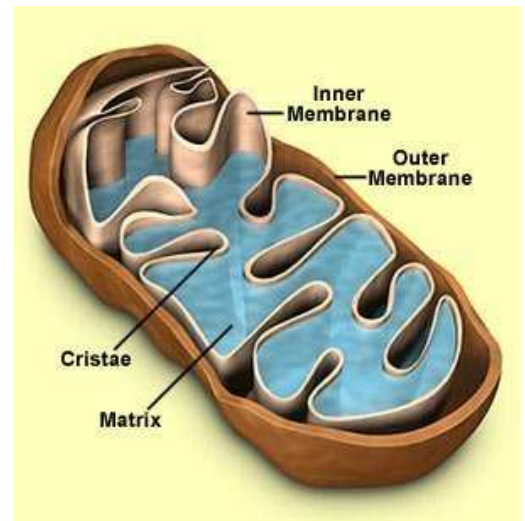
. Inner membrane encloses the mitochondrial matrix

. ATP synthesis occurs on the cristae

. Matrix contains enzymes involved in the Krebs cycle (energy cycle in the cell)

. Stalked particles contain the enzyme involved in ATP synthesis (ATPase)

. Mitochondrial ribosomes are also present in the matrix. These are smaller than cytoplasmic ribosomes



2. Nucleus (and Nucleolus)

. Spherical structure 10 – 20 μm in diameter

. Controls all cellular activity by regulating the synthesis of proteins and enzymes

. Nuclear pores enable movement of mRNA out of the nucleus during transcription

. The nucleus contains nucleoplasm – contains the chromosomes in the form of DNA

. Nucleolus has 3 main functions:

- (1) Manufacture of rRNA
- (2) Assembly of ribosomes
- (3) Control of cell growth and division

3. Endoplasmic Reticulum (ER)

. A complex system of membrane bound flattened sacs called cisternae

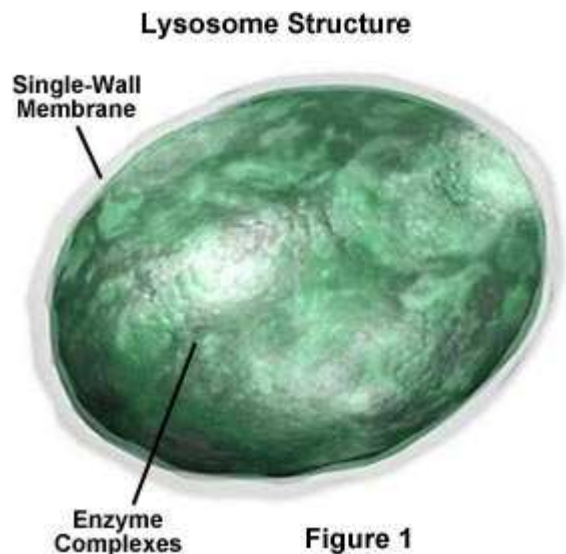


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- . ER spreads through the entire cytoplasm
- . Forms a large part of the transport system in the cell as well as being the site of synthesis of many important chemicals
- . Smooth endoplasmic reticulum:
 - Involved in the synthesis and transport of steroid hormones and lipids
 - Ribosomes are absent
 - SER is well developed in liver cells which make cholesterol
- . Rough endoplasmic reticulum:
 - . Contains ribosomes involved in protein synthesis
 - . Has large surface area for storage and transport of proteins
 - . RER involved in protein modification and transport to cell membrane

4. Lysosomes

- . Dark, spherical bodies within the cytoplasm
- . Contain powerful digestive enzymes
- . Function: breakdown of worn out organelles
- . Lysosomes can fuse with cell membrane and release their enzymes outside the cell by exocytosis E.g. to destroy bacteria
- . Lysosomes also self destruct and release their enzymes which destroys old cells
- . Known as apoptosis
- . Lysosomes also destroy cells in which DNA replication is non-functional
- . Failure of cells to die by apoptosis can lead to cancer (uncontrolled cell growth)

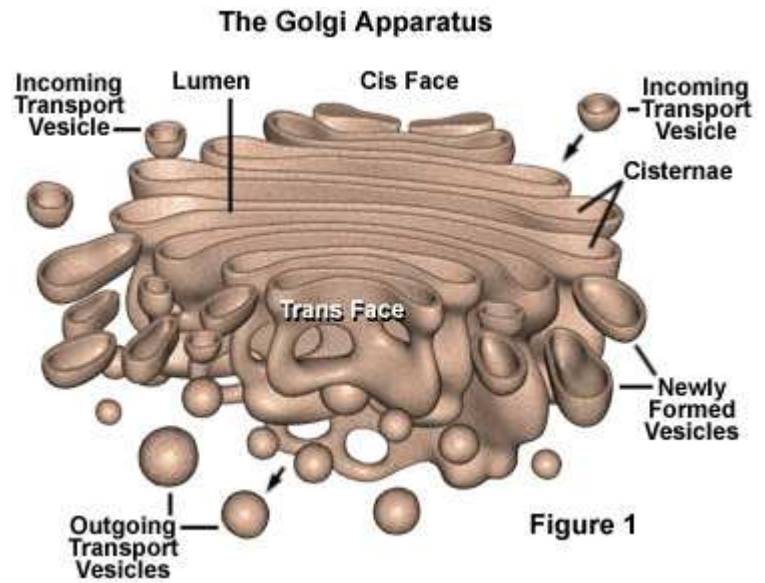


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- . Excessive apoptosis can lead to arthritis

5. Golgi apparatus

- . Consists of a stack of flattened cisternae and associated vesicles
- . Involved in the modification of proteins synthesized by the ribosomes
- . Also involved with lipid transport in cells and in lysosome formation
- . Vesicles are pinched off the RER and fuse with cisternae of the Golgi



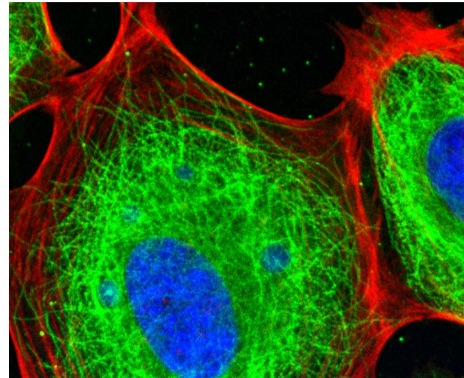
- . Vesicles contain proteins which then have carbohydrates attached to them forming glycoproteins
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- . Vesicles containing glycoproteins now bud off from cisternae and fuse with the cell membrane, releasing their contents
- . Some proteins bound in vesicles forming lysosomes
- . This pathway has been traced by using radioactively labeled amino acids
- . Formation of proteins is followed as well as their modification to glycoproteins and release from the cell by exocytosis
- . Further detailed study of the Golgi apparatus has been possible by use of electron microscopy
- . Further details:
 - Inner Golgi areas (closest to RER) are rich in enzymes that modify proteins

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- Golgi involved in orientation of proteins E.g. it ensures that areas of protein which need to be outside the cell membrane are (E.g. receptor binding sites)

6. Cytoskeleton

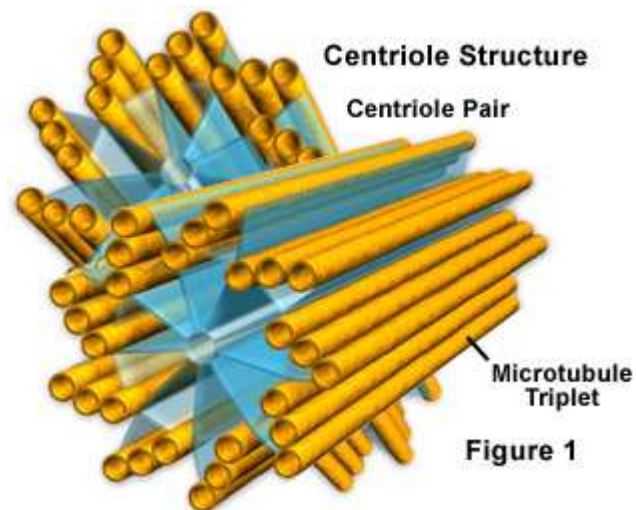
- . A network of fibrous proteins in the cytoplasm
- . Composed of very fine tubular organelles called microtubules
- . Diameter 20 – 25 nm



- . Microtubule wall estimated to be 5 nm thick and composed of the protein tubulin
- . Microtubules make up the spindle apparatus of a cell undergoing mitosis as well as other cell organelles such as centrioles
- . Microtubules have 3 main functions:
 - (1) Maintenance of the cell's shape
 - (2) Transport of granules and vesicles within the cytoplasm
 - (3) Movement of chromosomes during nuclear division

7. Centrioles

- . Hollow, cylindrical organelles with a diameter of 0.15 μm and length 0.5 μm
- . Walls composed of nine triplets of microtubule arranged at an angle
- . Arranged in pairs at right angles to each other
- . Main role is in organization of the spindle apparatus in animal cells



8. Cell membrane

- . See Unit One Topic Two: Genes and Health ☺