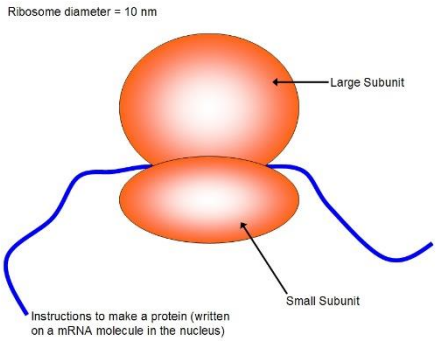
Ribosomes

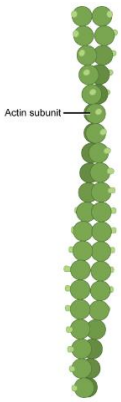
- Granular non-membranous structures first observed by George Palade (1953).
- Composed of ribonucleic acid (RNA) and proteins.
- The eukaryotic ribosomes are 80S while prokaryotic cell & some eukaryotic organelle (plastids & mitochondria) has 70S ribosomes.
- Composed of two subunits 80S (consist of larger 60S and 40S smaller) 70S ribosome consist of (50S and 30S).
- 'S' (Svedberg's Unit) stands for the sedimentation coefficient.

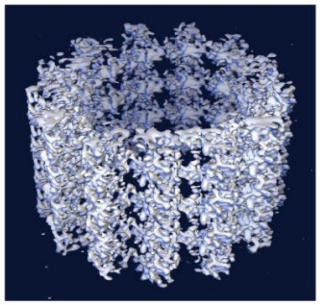


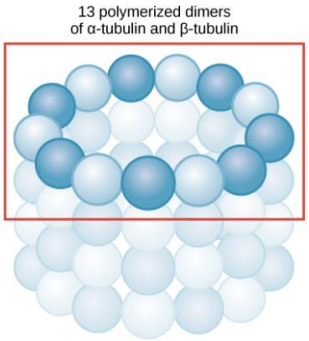
Cytoskeleton

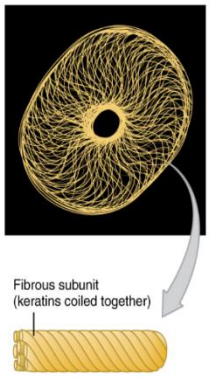
Network of filamentous proteinaceous structures that, motility, maintain the shape of the cell:

1) **Microtubules-** Long, hollow cylinders like tubulars structure made up of Tubulin Protein provide mechanical support and intracellular transportation. Helps in formation of Centrioles and spindle fibres.
2) **Microfilaments** – Double-stranded helical filamentous structure made up of Actin protein. Present at the edges of plasma membrane. Contribute to the cell's movement on a surface.
3) **Intermediate filaments** – Made up of multiple strands of fibrous protein vimentin, keratin etc. Structurally support the cell, anchoring nucleus and maintain cell shape. Play major role in hair, nail and skin formation.



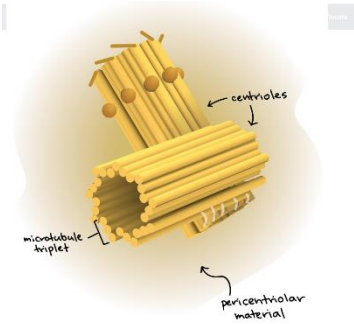




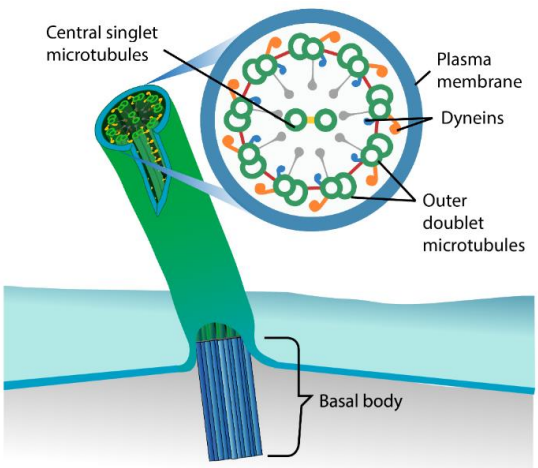


Centrosomes and Centrioles

- Centrosome consist of two cylindrical structures perpendicular to each other known as centrioles.
- Surrounded by an amorphous pericentriolar materials.
- Made up of nine peripheral triplet- fibrils (made up of tubulin protein) linked to Hub (central rod) by radial spokes forming like the cartwheel like organisation.
- From the basal body of cilia or flagella.
- Give rise to spindle apparatus during cell division in animal cells.



Cilia and Flagella



- Hair-like projections of cell membrane.
- Both cilia and flagella are identical in structure but differ in length.
- Cilia are hair like structures that work like oars causing the movement of either the cell or the surrounding fluid.
- Flagella are comparatively longer in size than cilia and are responsible for the movement of cell.

Cilium & flagellum are covered with plasma membrane.

- Core called the axoneme, contains an array of **(9 + 2) microtubules**, running parallel to the long axis.

Usually, Nine doublets of **peripheral microtubules** that are radially arranged and a pair of centrally located microtubules.

- The central tubules are connected by bridges and is also enclosed by a central sheath, which is connected to one of the tubules of each peripheral doublets by a radial spoke.
- Thus, it has been estimated that there are nine radial spokes.
- The peripheral doublets are also interconnected by linkers.
- Flagella in prokaryotic are structurally different from that of eukaryotic.
- Flagellum is differentiated into the following three parts
  (i) Filament- the longest portion, (made up of protein-flagellin).
  (ii) Hook- a curved and tubular
  (iii) Basal Body- base part emerge from centriole