

A-subtubule is made up of (13) thickening globular protein molecules. It is slightly curved, giving it two arms in clockwise direction. Outer arm ends in a hook. Each arm are 150 \AA in length and 50 \AA in thickness. They are 130 \AA apart. Outer arm ends in a hook, where as Inner one is attached with B-subtubules of adjacent microtubules for their coordinated action.

B-subtubules is slightly outer in position. B-subtubules is formed up (10) ten globular protein (protofilaments).

A radial spoke arise inwardly from A-subtubules inwardly in form of thickening of dense material (DMT) which ends into another D-M thickening called spoke head near the central sheath.

All peripheral doublets are connected by B-A linkers (Interdoublet linkers).

During beating spoke heads are connected to central sheath of central microtubules, coordination or coordinating central and peripheral microtubules.

Chemically peripheral microtubules are made up of protein tubulin where as central microtubules are formed of an ATPase enzyme D. dynein protein. The linker are composed of the protein nexin.

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Protein: 71-84%; Lipids: 13-23%
Carbohydrates: 1-6%; Nucleotides: 0.2-0.8%

Flagella or cilia originate from basal bodies inside the cytoplasm.

Functions :- 1. Locomotion, conjugation in protists.
 2. Cilia of trachea (wind pipe) expell out particulates matter. (dust or food).

Though flagella or cilia are similar in many aspects but they also differs as follows:

Table: ~~Sex~~ Difference between cilia and flagella.

Characters	Flagella	Cilia
1. Number 1. Size	Long Long Large, about (15 μ m)	small (5-10 μ m)
2. Number	Less (1-8)	More (upto 14000)
3. Motion	Undulatory	Sweeping or rowing
4. Beating	Independent	Synchronous or metachronous
5. Function	Locomotion	Locomotion, feeding, circulation, reproduction.
6. Distribution	Generally Located at anterior end end end	On whole body

GOLGI BODIES

Golgi bodies were first observed by George in the year 1867 A.D. Its detail was described by Camilo Golgi in 1898 A.D. in the nerve cells of cats and barn owl. They are also known as Lipochondria or Idiosomes or Dalton particles or Golgi complex or Golgi apparatus.

They are present in all eukaryotic cells except mature mammalian RBCs, spermatozoa of Bryophytes and Pteridophytes and sieve tube cells of phloem of Angiosperms.

In plant cells and invertebrates many a number of Golgi bodies are seen in the cytoplasm. This condition is known as diffused. Here the Golgi bodies are also known as Dictyosomes. They are near endoplasmic reticulum.

In vertebrates Golgi body is single localized having a fixed position. Here it is also known as Golgosome.

Size and number varies greatly.

In non-secretory cells size is small, e.g. muscle cells but in secretory and mature cells size is large e.g. pancreatic and liver cell. In plant cell they are found more. Minimum (1) one to (25000) twenty five thousand in rhizoidal cell of Chara sps.

They are pleomorphic i.e. capable of changing shape according to function.

Electron microscopic studies done by Dalton and Felix in 1954 A.P. reveals that Golgi body consists of three different types of structures -

(a) Cisternae → They are also known as flattened sacs or saccules or parallel membranes. They are double layered elongated structures flattened curved structures swollen at ends. They are arranged in such a form that giving saucer shaped. The swollen ends are known as Golgian vacuoles. Intra cisternal cisternal space is $60-90 \text{ \AA}$. In animal cells they are 3-12 or 3-12 in number, where as in plant cells and protists they are 10-20 in number. The space between two cisternae is known as intercisternal space which is about 130 \AA . Cisternae may be interconnected also.

(b) Vesicles → They are present towards ~~concave side~~ convex surface or at the edge of cisternae. They are small in size. They are of two types.

(i) Smooth Vesicles → Their surface is smooth. They contain secretory products of Endoplasmic reticulum and Golgi body.

(ii) Coated Vesicles → Their surface is rough. They lie generally the convex surface.

(c) Vacuoles → These are spherical structures, each about 600 \AA in diameter. They lie towards concave side of cisternae.