

ORGANELLES INVOLVED IN MOUVEMENT

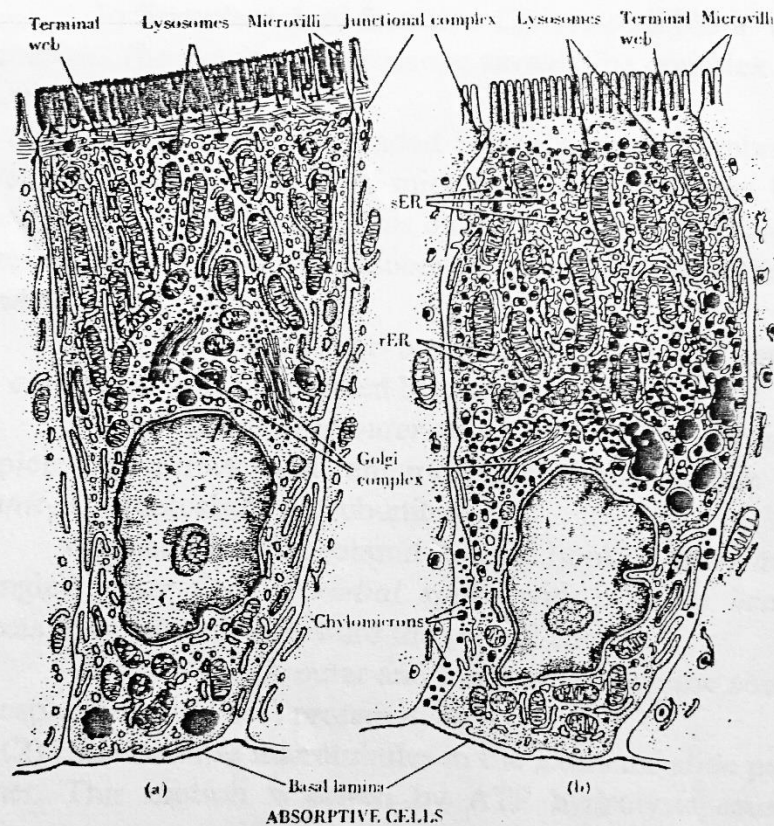
1. MICROVILLI

Cells from intestine and proximal convoluted tubule have a distinctive border of vertical striations (microvilli) at the apical surface of the cell, detectable with the light microscope.

This surface structure is called:

- Striated border-for the intestinal absorptive cell
- Brush border – for the Kidney tubule cell

Where there is no apparent surface modification based on light microscope observation, microvilli, if present, are usually short and not numerous; thus, they may escape detection with the light microscope.



a. Diagram of an enterocyte showing a striated border on its apical (luminal) surface and junctional complexes that seal the lumen of the intestine from the lateral intercellular space. The characteristic complement of organelles is depicted in the diagram. b. The cell shows the distribution of lipid during fat absorption as seen with the TEM. Initially, lipid is seen in association with the microvilli of the striated border. The lipid is internalized and seen in vesicles of the smooth

endoplasmic reticulum (sER) in the apical portion of the cell. The membrane-bounded lipid can be traced into the center of the cell, where some of the lipid-containing vesicles fuse, and then the lipid is discharged into the lateral intercellular space. The extracellular lipid, recognized as chylomicrons, passes beyond the basal lamina for further transport. (Based on Lentz TL: *Cell Fine Structure*. Philadelphia, WB Saunders, 1971, pp 179 and 181)

2. CILIA AND FLAGELLA

1. **CILIA** – are movable organelles that are 5-10 μm long and 0,2 μm in diameter.

a) **Locations:** Cilia are present on the apical epithelial surfaces of the:

- Respiratory tract (nasal cavities, larynx, trachea and bronchi) where they propel mucus and debris out of the system
- Female reproductive tract (uterine tubes and uterus), where they propel ova and mucus through the system
- Sensory organs (olfactory, auditory and visual epithelia), where modified cilia help to from chemoreceptors, mechanoreceptors, and photoreceptors.

b) **Structure and function:** Cilia are visible in the light microscope. The electron microscope reveals the complex internal structure of cilia.

(1) Each cilium is surrounded by the plasma membrane and contains a central doublet of microtubules surrounded by nine pairs of fused microtubules. This characteristic 9+2 *arrangement of microtubules* and its associated structures constitute the *axoneme*

- The central pair is two complete microtubules connected by a cm bridge and surrounded by a *central sheath*
- Each of the *nine outer pairs* of double consists of a complete *subunit –A* and an incomplete microtubule called *subunit – B*, which abuts on subunit – A
- Projecting from subunit – A are a hooked outer arm and an angled *inner arm*; a *radial spoke* with a *spoke head* also projects from subunit- - A toward the central sheath
- The subunit – A outer an inner arms have the adenosine triphosphatase (ATPase) protein *dynein*

(2) Cilia bend as microtubule in the axoneme slide past one another. This motion is driven by ATP hydrolysis caused by dynein.

2. **Flagella** - are similar to cilia; however, they are much longer. For example, spermatozoon flagella are about 50 μm long. In spermatozoon flagella, each outer doublet has a large, electron dense outer fiber, which is absent in cilia. Outer fibers provide the flagellum with rigidity.

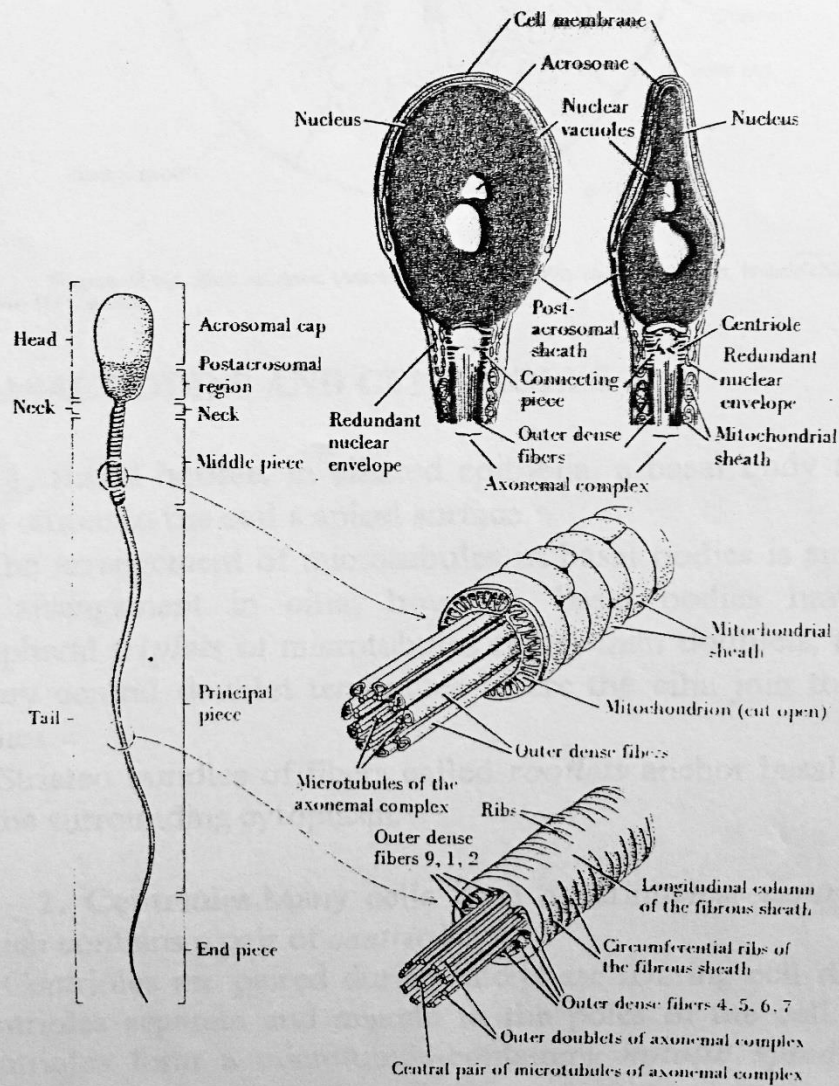
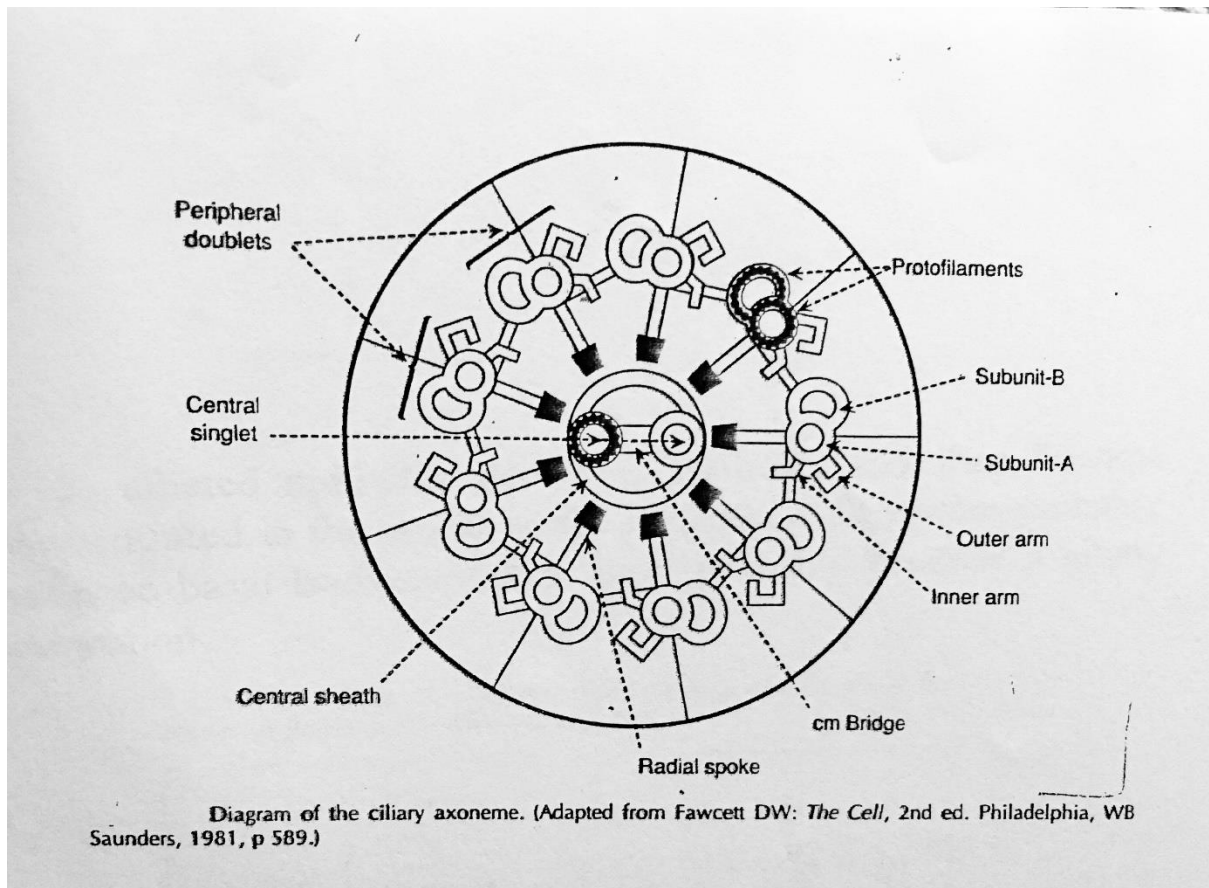


Diagram of a human spermatozoon. Regions of the spermatozoon are indicated on the left. Key ultrastructural features of the head (viewed in its major and minor dimensions) and the middle piece and principal piece of the

spermatozoon are illustrated on the right. (After Pederson and Fawcett. In: Hafez ESE (ed): *Human Semen and Fertility Regulation in the Male*. St Louis, CV Mosby, 1976, figs. 7.1, 7.4, and 7.13.)

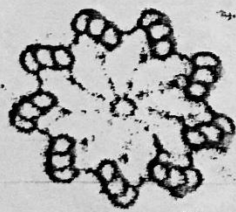
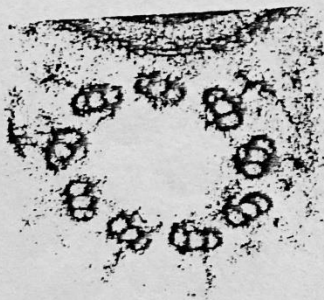
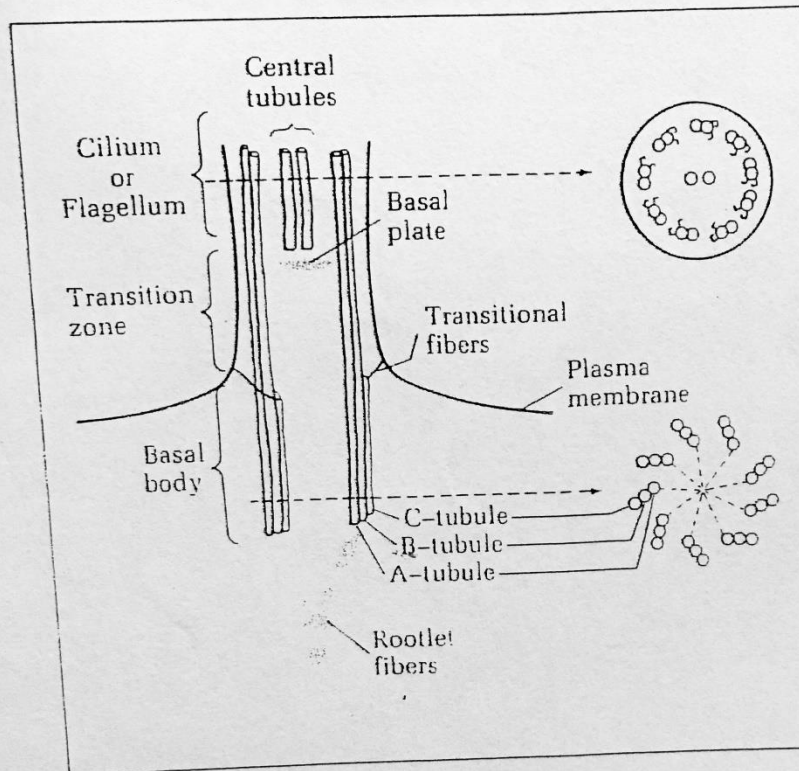


3. BASAL BODIES AND CENTRIOLES

1. **Basal bodies.** In ciliated epithelia, a basal body anchors each cilium to the cell apical surface.
 - a) The arrangement of microtubules in basal bodies is similar to the arrangement in cilia; however, basal bodies have nine peripheral *triples* of microtubules rather than doublets, and the ciliary central doublet terminate where the cilia join the basal bodies.
 - b) Striated bundles of fibers called *rootlets* anchor basal bodies to the surrounding cytoplasm.
2. **Centrioles.** Many cells have a perinuclear centrosome, which contains a pair of centriole.
 - a) Centrioles
 - b) Each centriole has a nine peripheral microtubule triples but lacks a central pair. It also has electron-dense *pericentriolar satellites* that radiate away from the triplets the vanes of a pinwheel.

- c) In ciliated epithelia, centrioles replicate and then become concentrated in the apical epithelial surface. Centrioles probably produce basal bodies, which, in turn probably produce a ciliary projection.

Diagram of the basal body and its relationship to the cilium or flagellum to which it attaches.



0.1 μm

Cross section through a basal body at two levels, the top one closer to the cilium and the lower one closer to the point where the basal body is attached to the cell interior. In addition to the characteristic triplet arrangement of the microtubules, note the cartwheel spokes that occur in the lower section. Courtesy of F. D. Warner.