The cell II.

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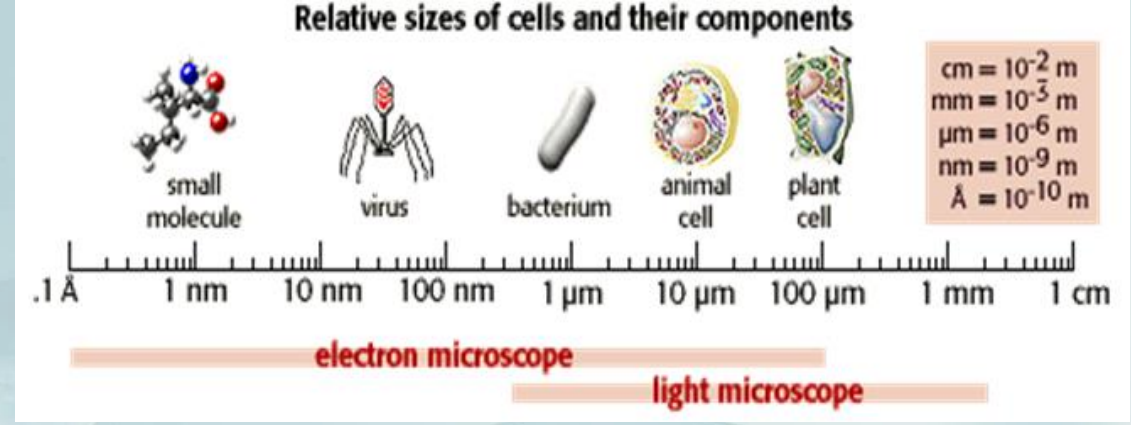
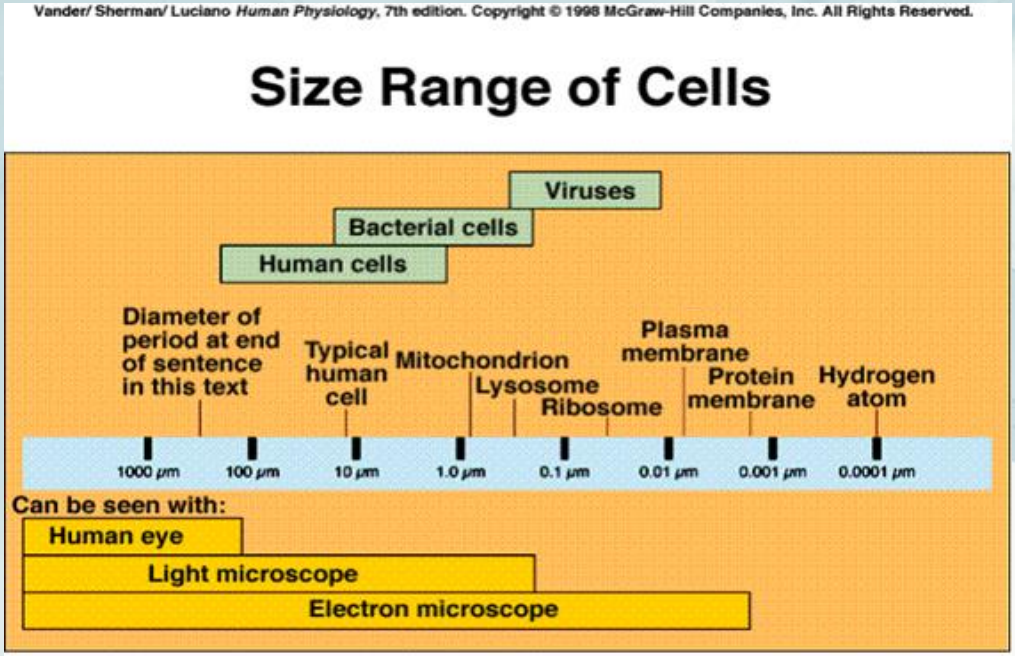


Size and Biology

- Biology is a visually rich subject
- many of the biological events and structures are smaller than the unaided human eye can see
- resolution of the human eye is about 100 µm



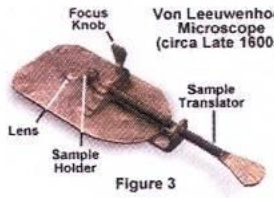
History of studying cells

- 1632 – 1723: Antonie van Leeuwenhoek builds a microscope and draws protozoa, from rain water, and bacteria from his own mouth.
- 1665: Robert Hooke discovers cells in cork
- 1839: Matthias Jakob Schleiden and Theodor Schwann described the cell theory.
- 1855: Rudolph Virchow states that cells always emerge from cell divisions
- 1898: Camillo Golgi discovered the Golgi apparatus
- 1931: Ernst Ruska builds first transmission electron microscope
- 1953: Watson and Crick made their first announcement on the double-helix structure for DNA.
- 1981: Lynn Margulis published the endosymbiotic theory

History of studying cells

Major events in cell biology & imaging

- 1655 — Robert Hooke observes cells of a cork tree though a primitive microscope
- 1683 — Leewenhoek discovers bacteria
- 1674 — Leewenhoek discovers protozoa
- 1838 — Schleiden & Schwann propose the Cell Theory
- 1857 — Kolliker describes mitochondria in muscle
- 1882 — Koch uses aniline dyes to identify bacteria causing TB and cholera
- 1898 — Golgi stains cells with silver nitrate, discovering the Golgi apparatus
- 1931 — Ruska builds the first transmission electron microscope
- 1965 — 1st commercial scanning electron microscope
- 1997 — Sheep "cloned"



History

The cell Theory

Classical interpretation

- All organisms are made of one or more cells.
- Cells are the fundamental functional and structural unit of life.
- All cells come from pre-existing cells.
- The cell is the unit of the structure, physiology, and organization in living things

Modern interpretation

- Energy flow (metabolism and biochemistry) occurs within cells.
- Cells contain hereditary information (DNA) which is passed from cell to cell during cell division
- All cells basically have the same in chemical composition.
- Some organisms are unicellular, i.e., made up of only one cell.
- Others are multicellular, composed of a number of cells(humans have an estimated 100 trillion cells).

Definition of cell

The cell is the smallest structural and functional unit of all known living organisms

(The word cell comes from the Latin cellula, meaning a small room (was chosen by R. Hooke)

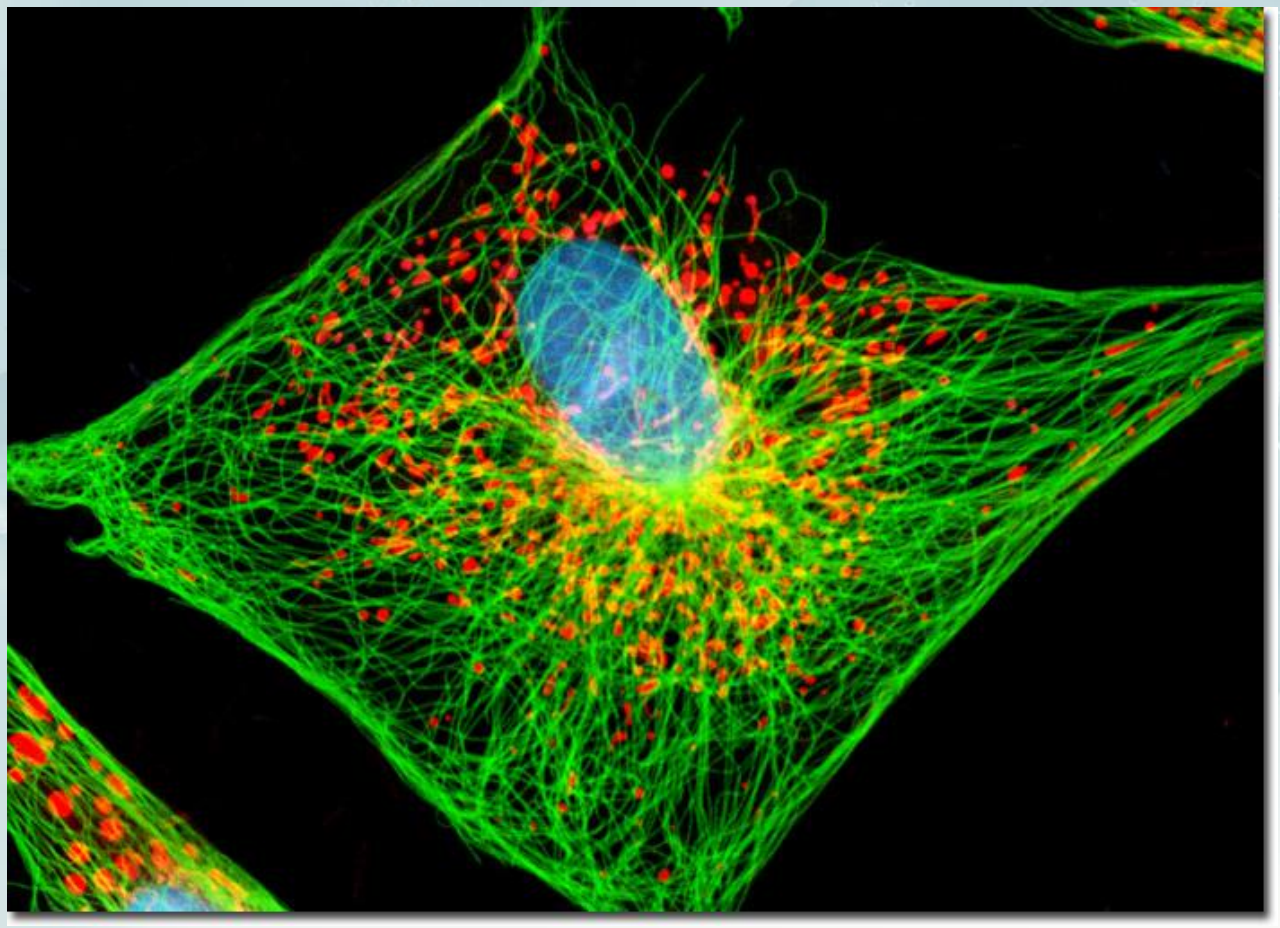
General principles

Each cell is at least somewhat self-contained and self-maintaining

- Reproduction by cell division
- Use of proteins coded by DNA genes and made via mRNA and ribosomes
- Metabolism: taking in nutrients, converting these into energy and molecules, building cell components
- Response to external and internal stimuli, such as changes in temperature, pH
- Transport processes

The structure of cells:

The cytoplasm and the cytoskeleton



Cytoplasm

- The cytoplasm is the part of a cell that is enclosed within the plasma membrane (between the cell mebrane and the nuclear membrane).
- This three-dimensional, jelly-like material
- In eukaryotic cells the cytoplasm contains organelles
- The cytoplasm is the site where most cellular activities occur eg. metabolic reactions
- Contains mostly water 80 to 97% in different cells
- The dry component contains macromolecules: proteins, carbohydrates, nucleic acids, and lipids

Components

- The cytoplasm has four major elements: the cytosol, the cytoskeleton organelles and inclusions

Cytoplasm

Cytosol

- Is a fluid in which the other cytoplasmic elements are suspended.
- Makes up about 70 % of the cell volume and is composed of water, salts and organic molecules/ potassium, sodium, magnesium, calcium,iron/

Organelles

- Organelles are membrane-bound compartments within the cell that have specific functions.

Cytoplasmic inclusions

- The inclusions are small particles of insoluble substances suspended in the cytosol
- calcium oxalate or silicon dioxide in plants
- granules of energy-storage materials such as starchs, glykogen in animal cells
- lipid droplets

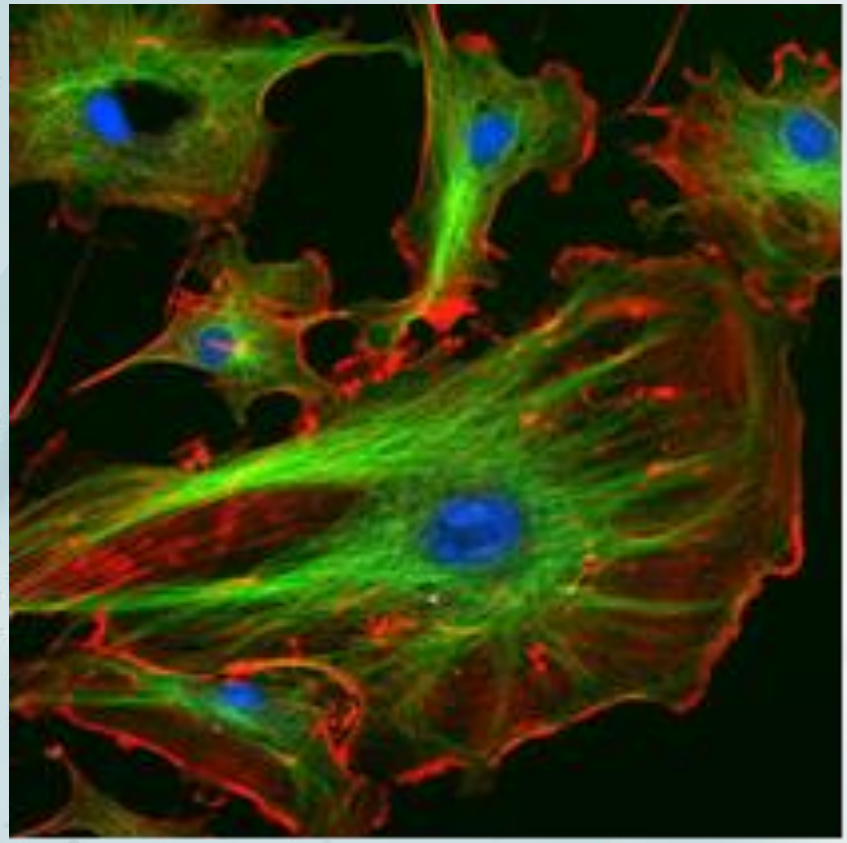
Cytoskeleton

Structure

- The cytoskeleton is present in all eukaryotic cells
- Eukaryotic cells contain three main kinds of cytoskeletal filaments: **microfilaments, intermediate filaments, and microtubules**.

Functions

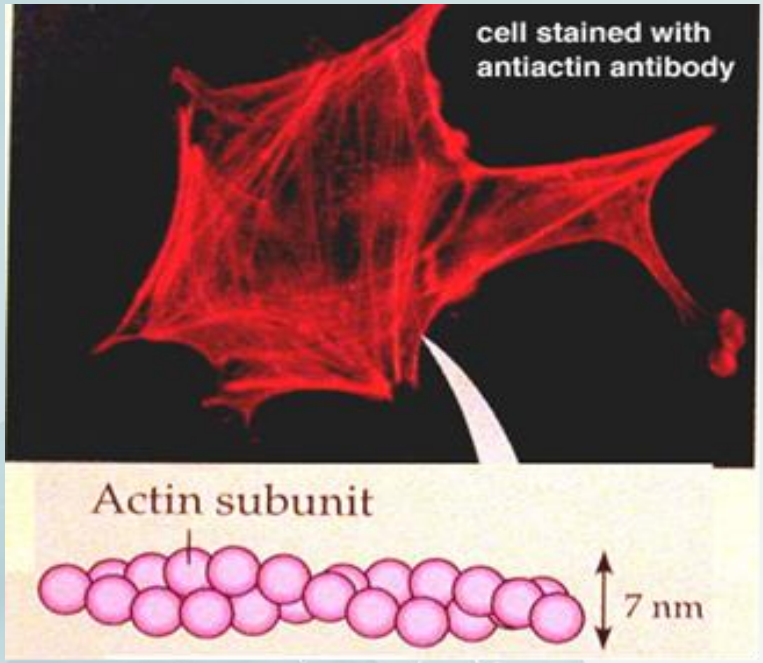
- determines cell shape
- Mechanical support
- drives active cell movements
- transport organells
- drives cell division
- Signaltransduction



The eukaryotic cytoskeleton/actin, microtubules, nuclei/

Microfilaments

- Made of actin proteins (most abundant cellular protein)
- 3-7 nm in diameter (smallest type)
- 2 possibilities for organization:
  - ➢Actin bundles in the cytoplasm
  - ➢Actin network eg. under the cell membrane
- Capable of dynamic changes → cell shape change, cell movement
- Muscle cells: contraction by myosin proteins
- Intracellular transport by myosin also
- participation in some cell-to-cell or cell-to-matrix junctions
- important for cytokinesis



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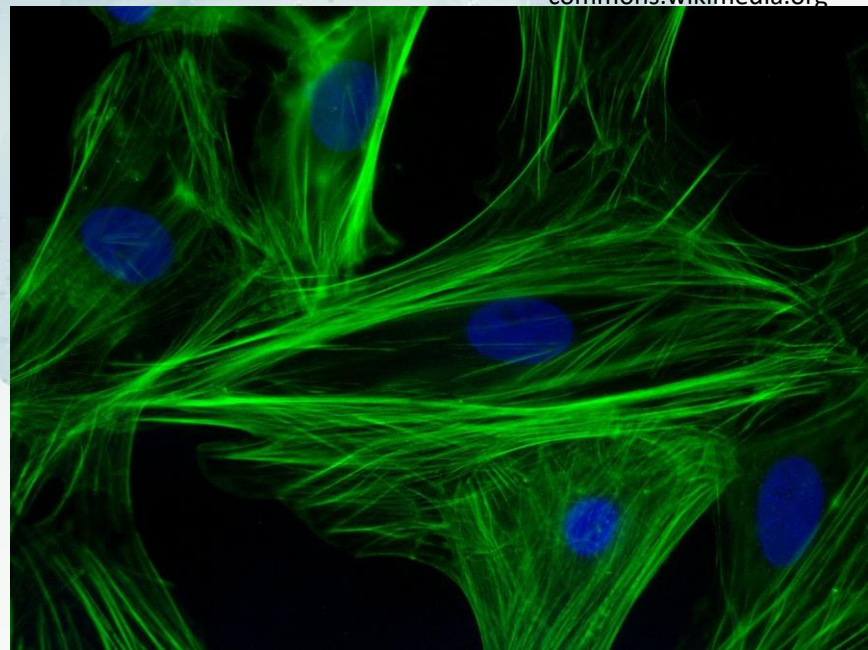
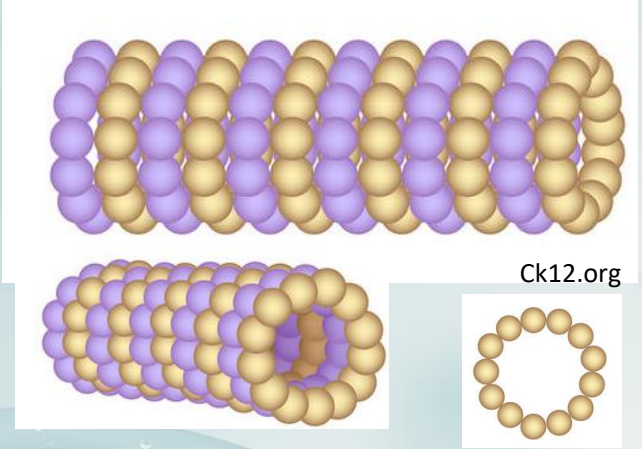


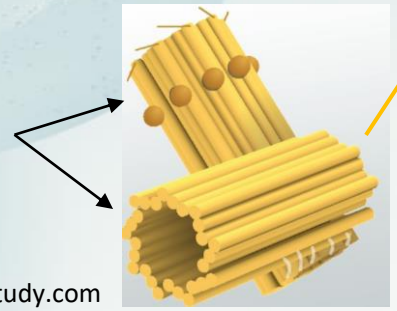
Microtubules

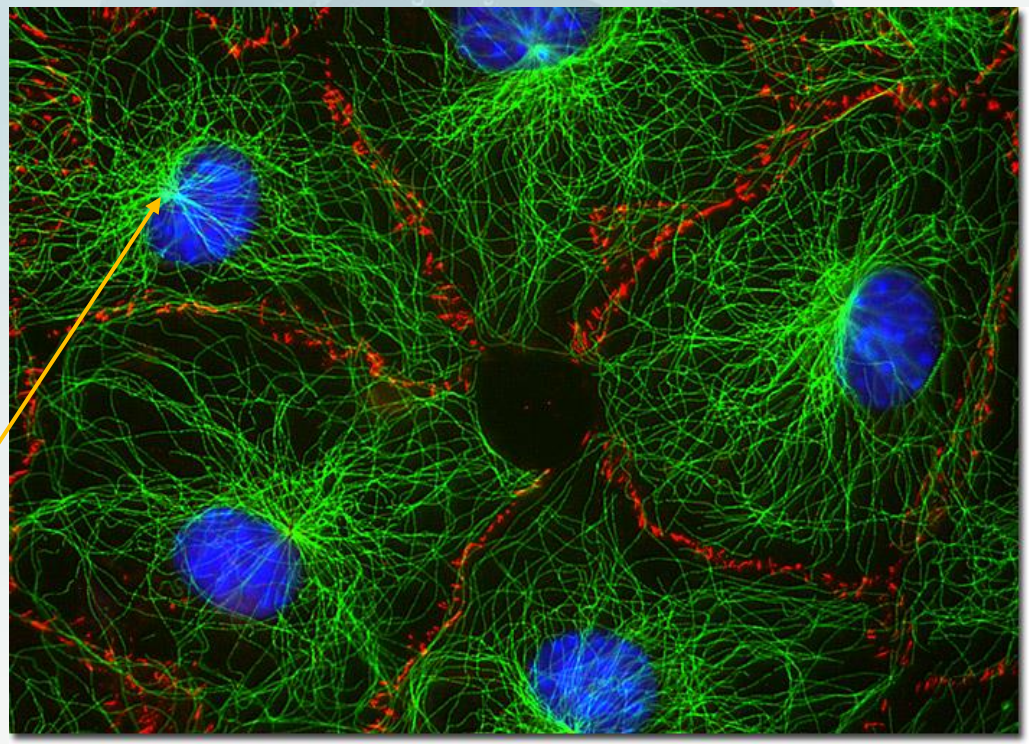


- Diameter: 20-25 nm (largest type)
- Made of tubulin proteins
- Globular monomers → dimers → tube-like structure
- Their center is the centrosome composed of 2 centrioles
- They are dynamic, important in cell division (eg. movement of chromosomes as components of the mitotic spindle)
- intracellular transport
- ciliae and flagellae
- synthesis of the cell wall in plants

centrosome

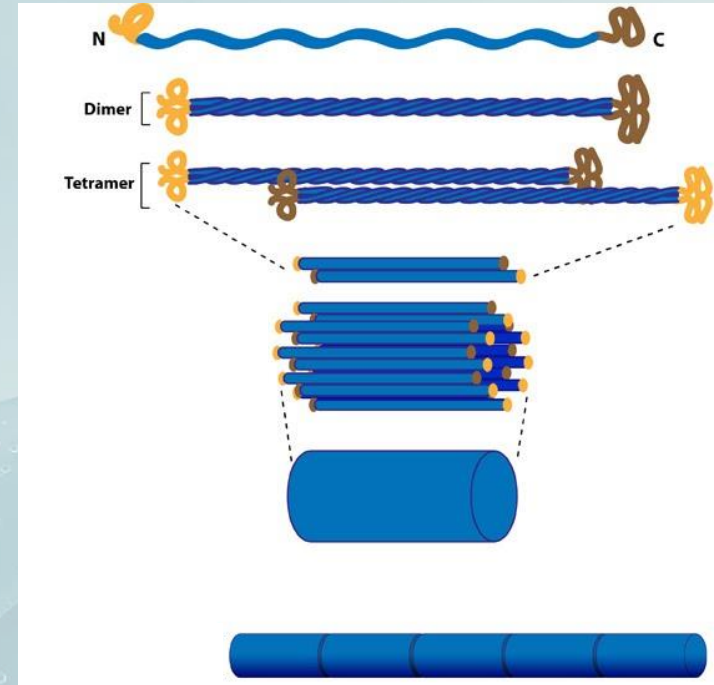
centrioles





Intermediate filaments

- Diameter: 10nm
- organize the internal 3D structure of the cell in a stable fashion
- They are less dynamic, more stable
- anchoring organelles
- participate in some cell-cell and cell-matrix junctions
- There are more than 50 types of proteins composing intermediate filaments (ie. they are tissue specific)
- Keratins, cytokeratin, →epithelial cells
- vimentin→connective tissue, smooth muscle cells, leukocytes
- desmin→striated and heart muscle
- peripherin→peripheral neurons
- neurofilaments→central nervous system
- lamins→nucleus (in all cells): serving as structural components of the nuclear lamina



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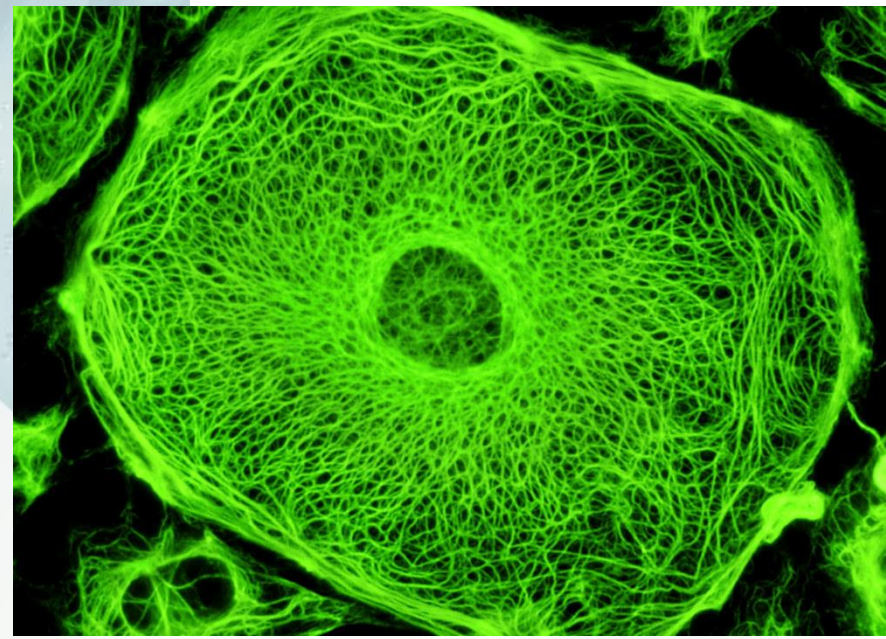

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