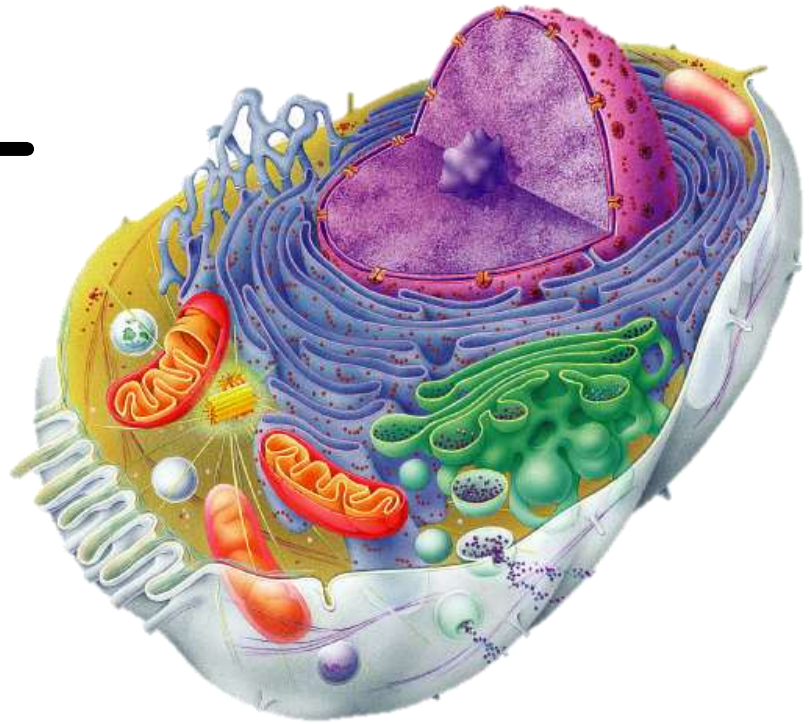
THE CELL



MR. RAVIKUMAR R. THAKAR
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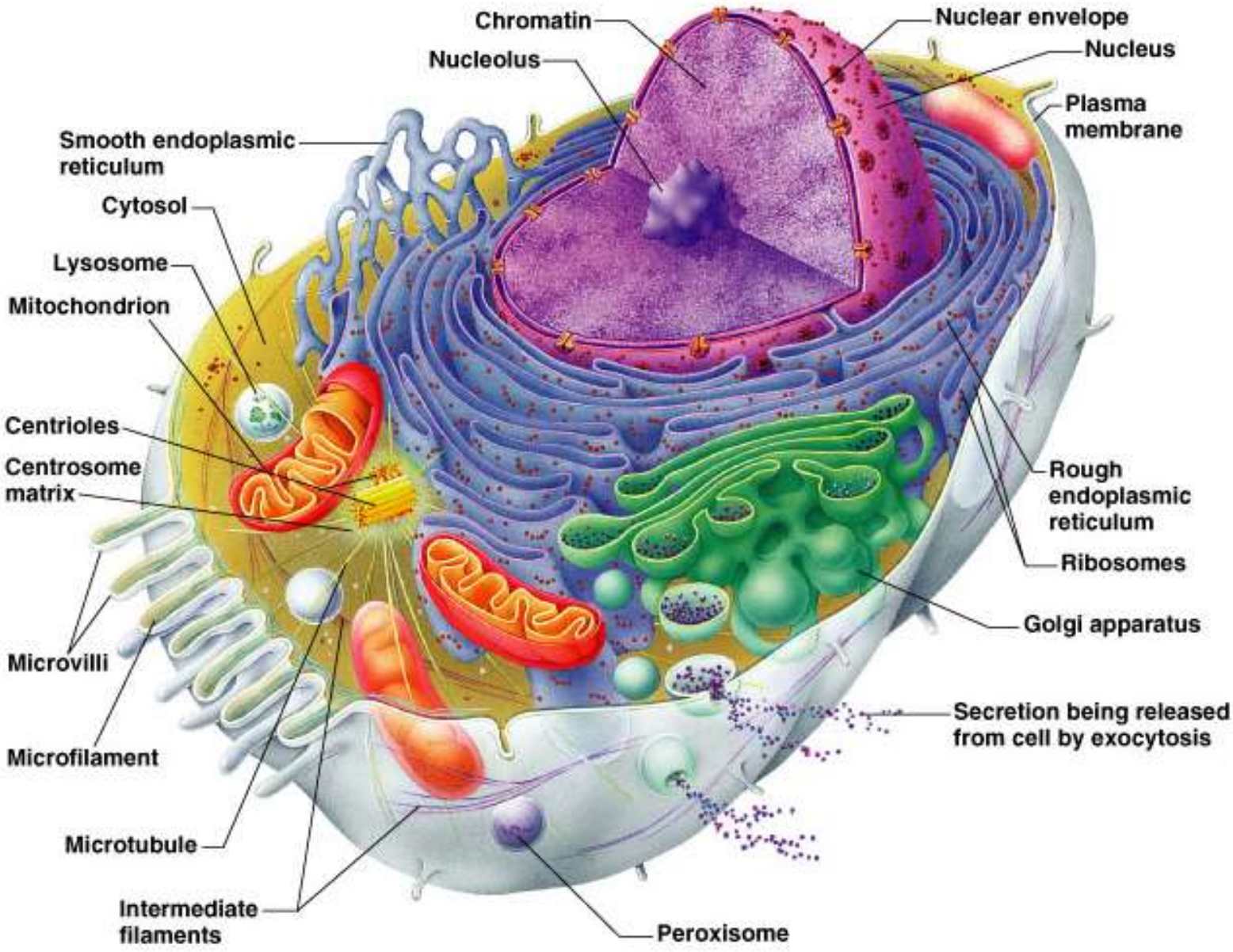
DEPARTMENT OF PHARMACOLOGY & PHARMACY PRACTICE
SARASWATI INSTITUTE OF PHARMACEUTICAL SCIENCES,DHANAP,
GANDHINAGAR – 382355

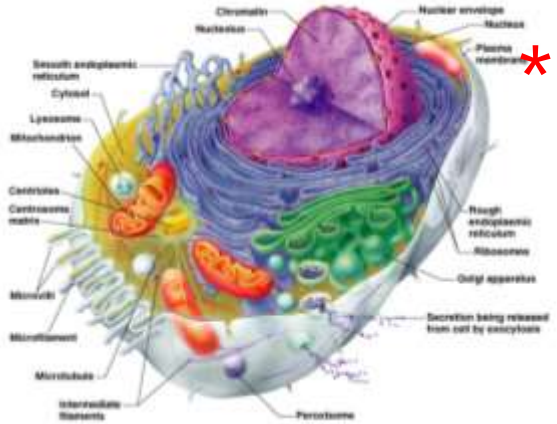
Introduction to Cells

- The basic structural and functional unit of all living things

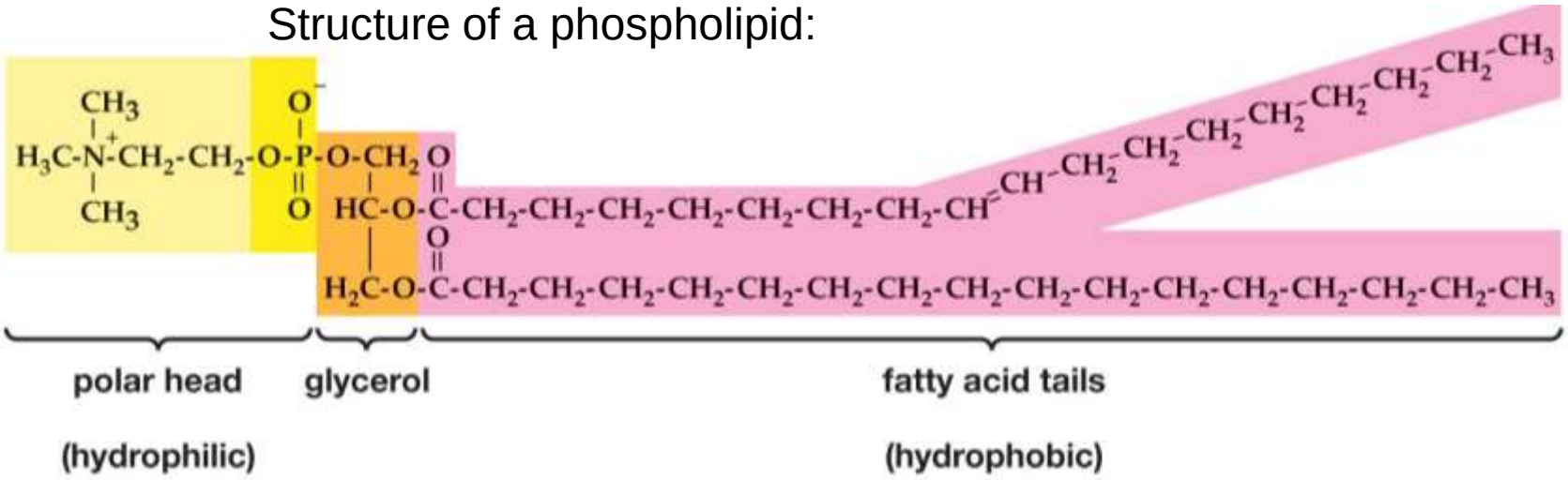
- Major cellular regions
  - The plasma membrane
  - The cytoplasm
  - The nucleus


Chromatin
Nuclear envelope
Nucleolus
Nucleus
Plasma membrane
Smooth endoplasmic reticulum
Cytosol
Lysosome
Mitochondrion
Centrioles
Centrosome matrix
Rough endoplasmic reticulum
Ribosomes
Golgi apparatus
Microvilli
Secretion being released from cell by exocytosis
Microfilament
Microtubule
Intermediate filaments
Peroxisome

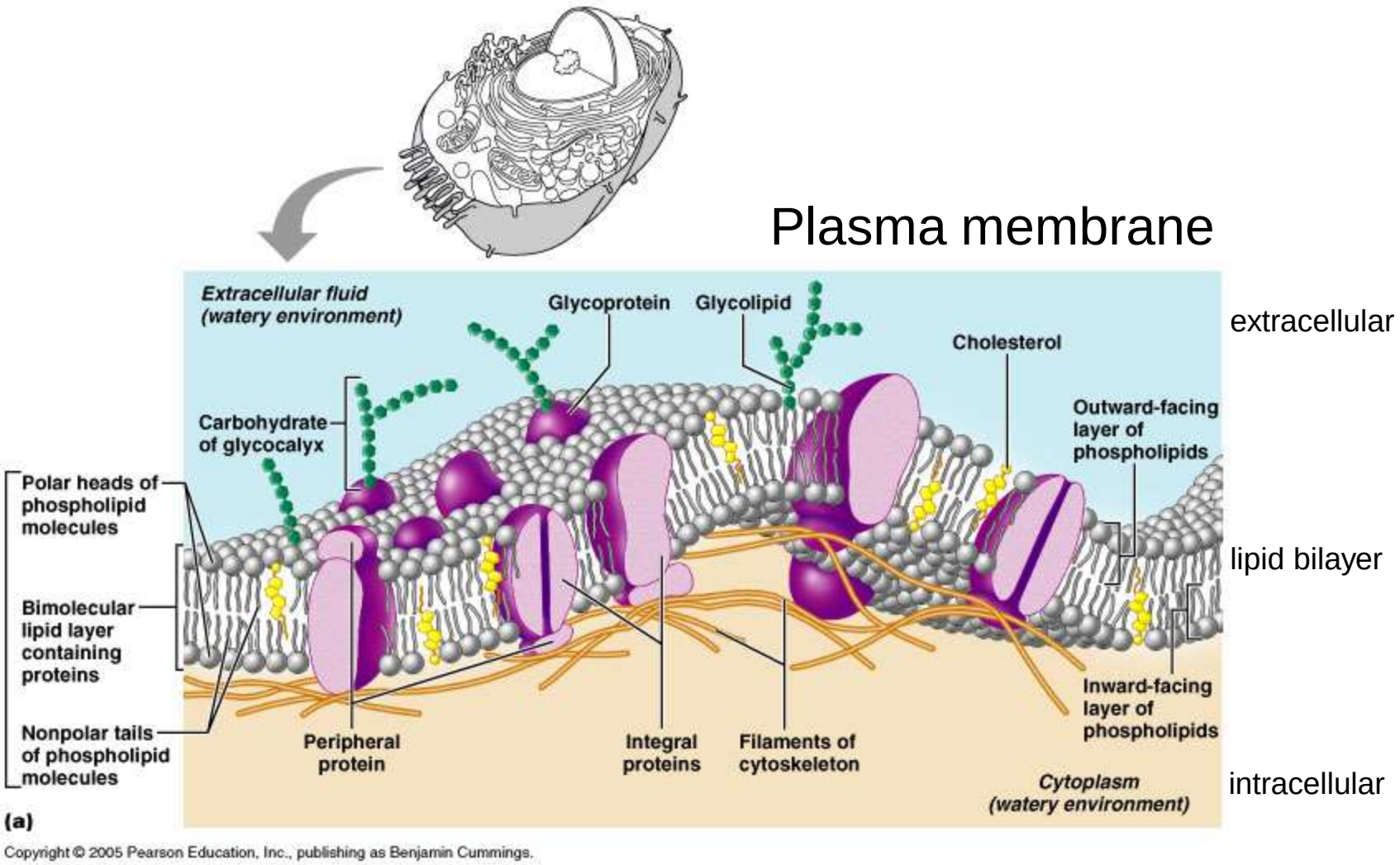
- The Plasma membrane*
  - Structure
    - Double layer (bilayer) of lipid molecules
    - Phospholipid polar heads (hydrophilic) outward
    - Fatty acid chains (hydrophobic) are tail to tail
    - Protein molecules are dispersed within



Structure of a phospholipid:



The membrane structure is actually fluid, with proteins moving around in it



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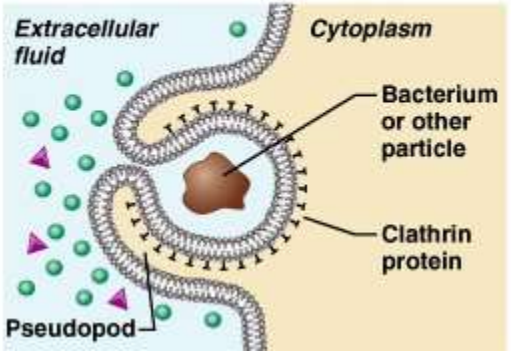
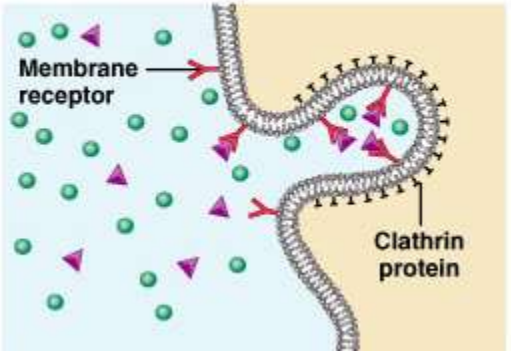
Functions of the plasma membrane

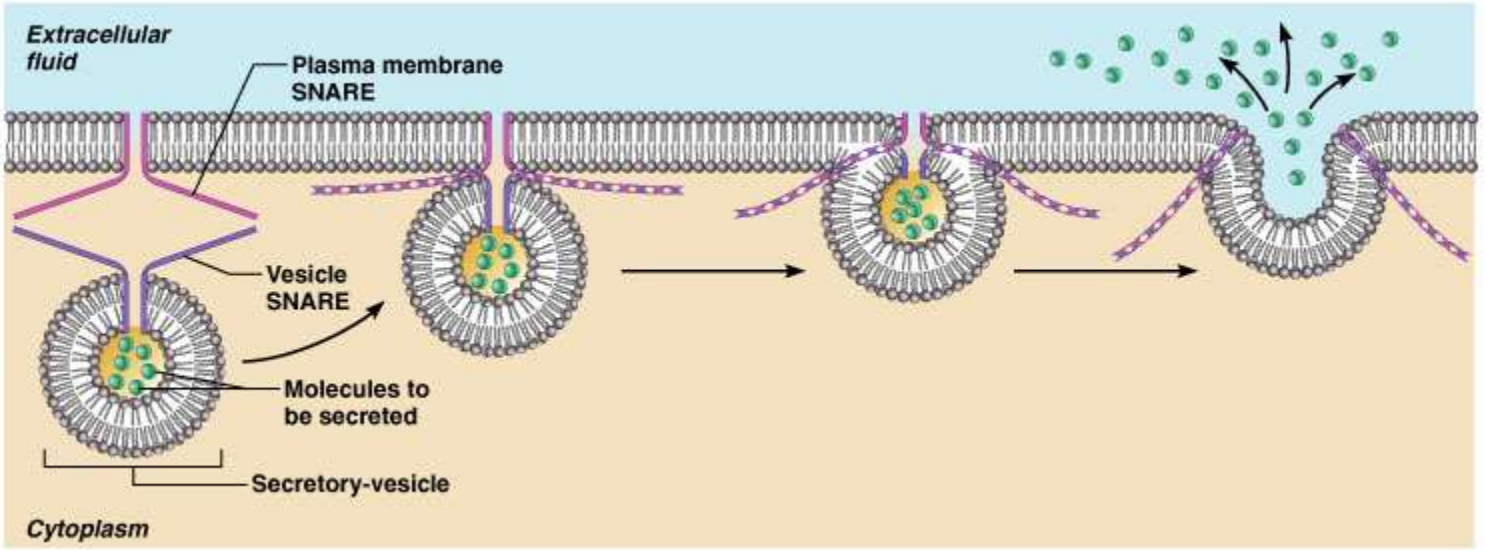
- Separates intracellular fluid from extracellular fluid
- Acts as a barrier
- Some membrane proteins act as receptors
- Determines which substances enter and leave cell
  - Diffusion
  - Specific transport mechanisms
  - Bulk (vesicular) transport
    - Exocytosis
    - Endocytosis



Phagocytosis
(a type of endocytosis)



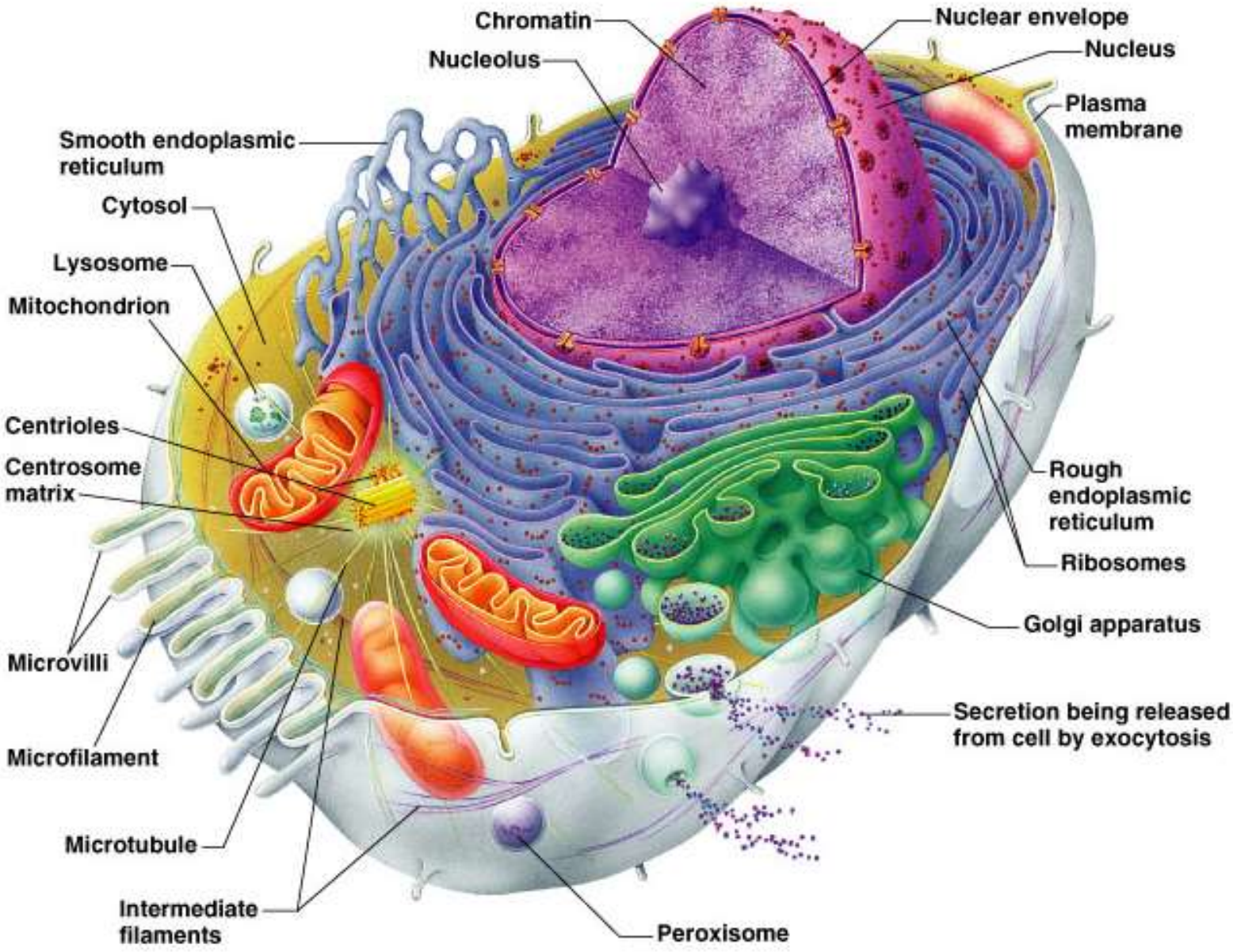
Receptor-mediated endocytosis



Exocytosis

The Cytoplasm

- The Cytosol: jelly-like fluid matrix
- Organelles (about nine types)
  - Ribosomes: sites of protein synthesis
  - Endoplasmic reticulum (rough and smooth): products synthesized (protein, lipid, steroid); store calcium
  - Golgi apparatus: packages and modifies proteins
  - Mitochondria: synthesizes ATP (energy source)
  - Lysosomes: intracellular digestion (“disintegrators”)
  - Peroxisomes: detoxify substances
  - Cytoskeleton: supports cellular structures
  - Centrosomes and centrioles: organize microtubule network
- Inclusions: not permanent (eg. food storage units and pigments)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Secretion being released from cell by exocytosis
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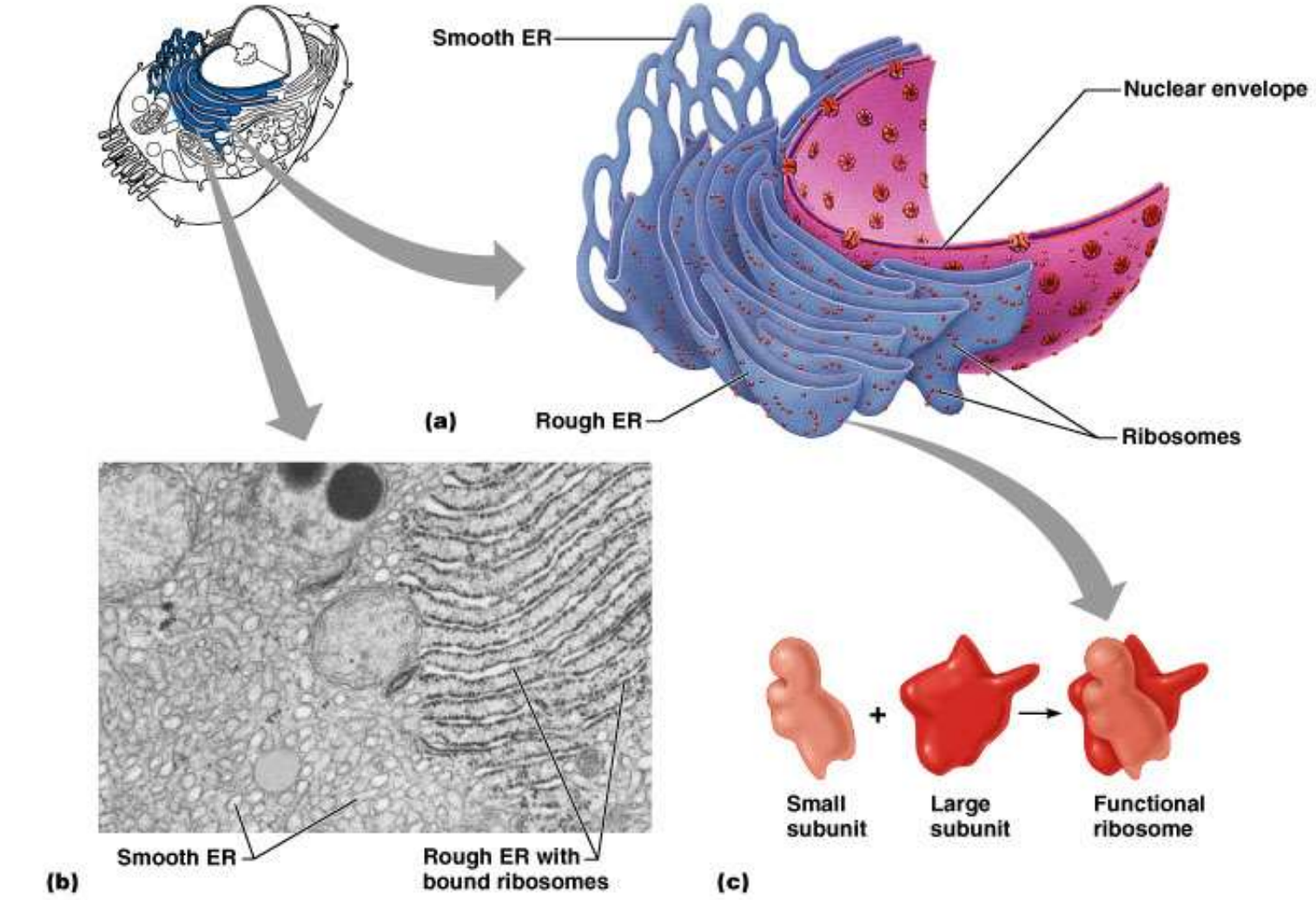
Endoplasmic reticulum



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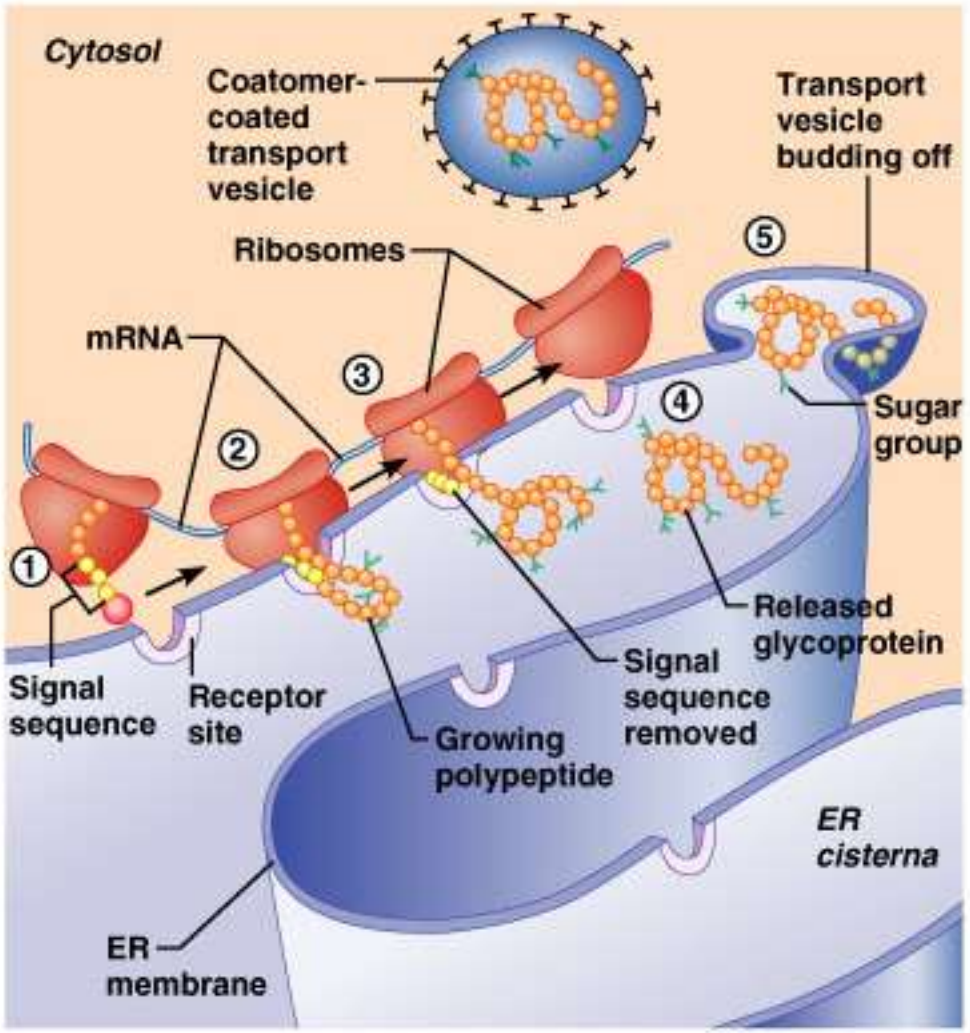
Assembly of proteins at the rough endoplasmic reticulum

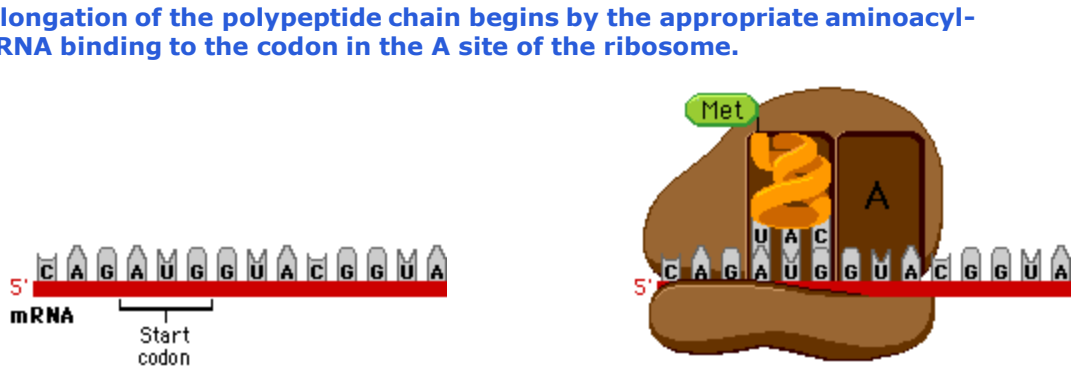


The “Genetic Code”

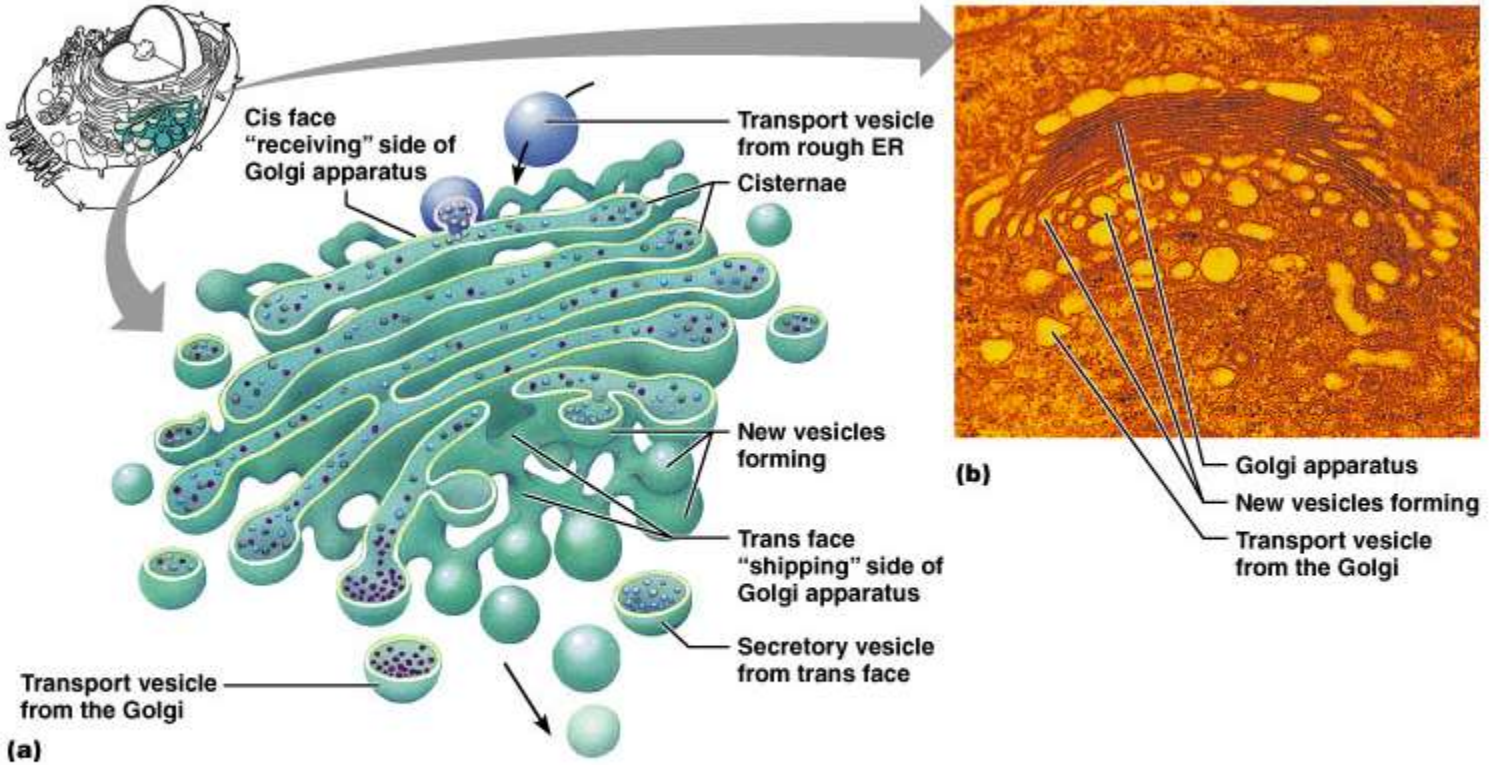
Replication: DNA making a copy of itself
Transcription: making of RNA from code of DNA
Translation: making of protein coded by tRNA via mRNA via DNA
(3 bases make one protein)

DNA “bases” – T, A, C, G (thymine, adenine, cytosine, guanine)
RNA “bases” – U, A, C, G (uracil instead of thymine)
mRNA – messenger RNA
tRNA – transfer RNA
rRNA - ribosomal RNA

For animation of translation: http://biology.kenyon.edu/slonc/bio3/ribo/ribo1.html



Golgi apparatus



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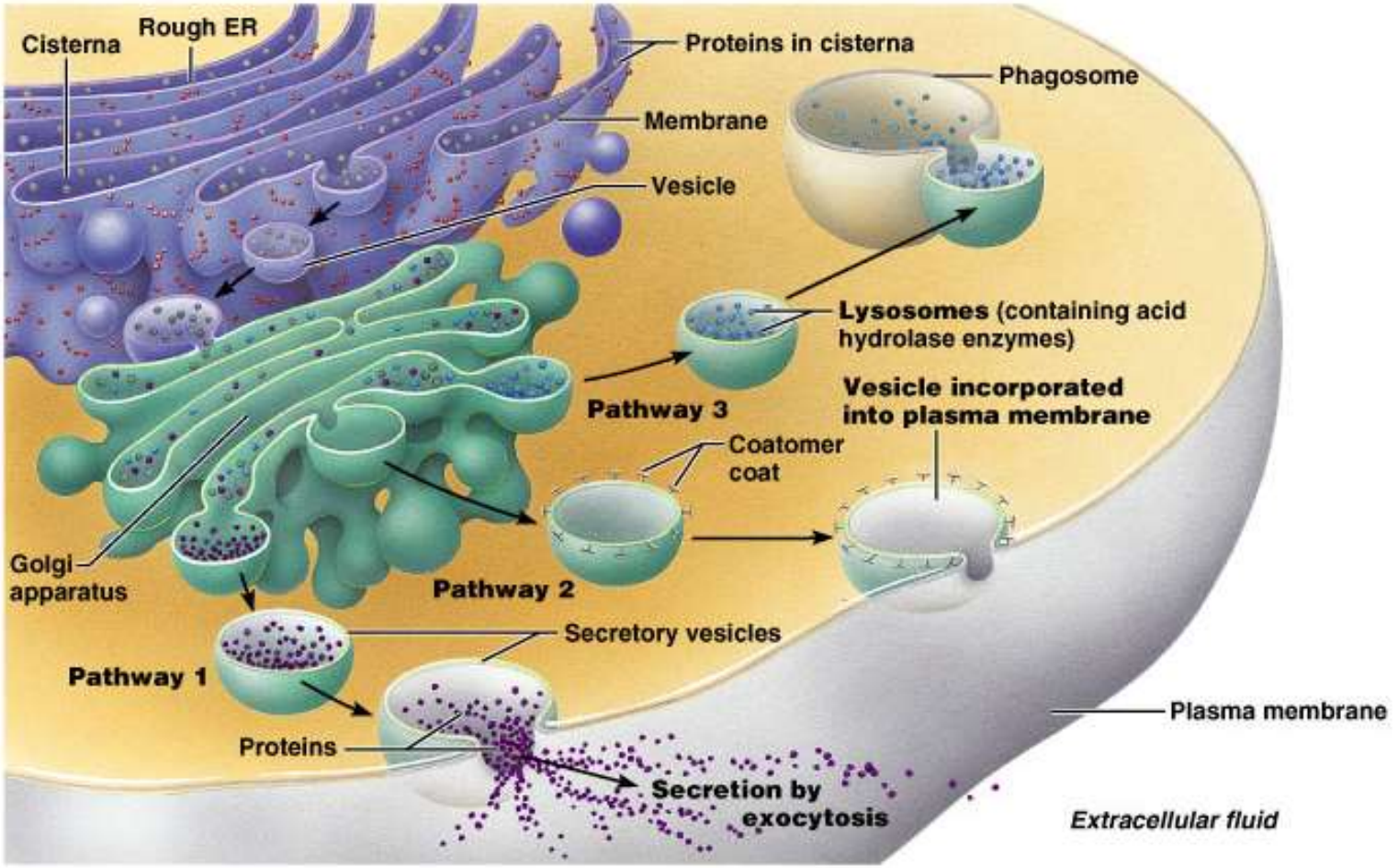
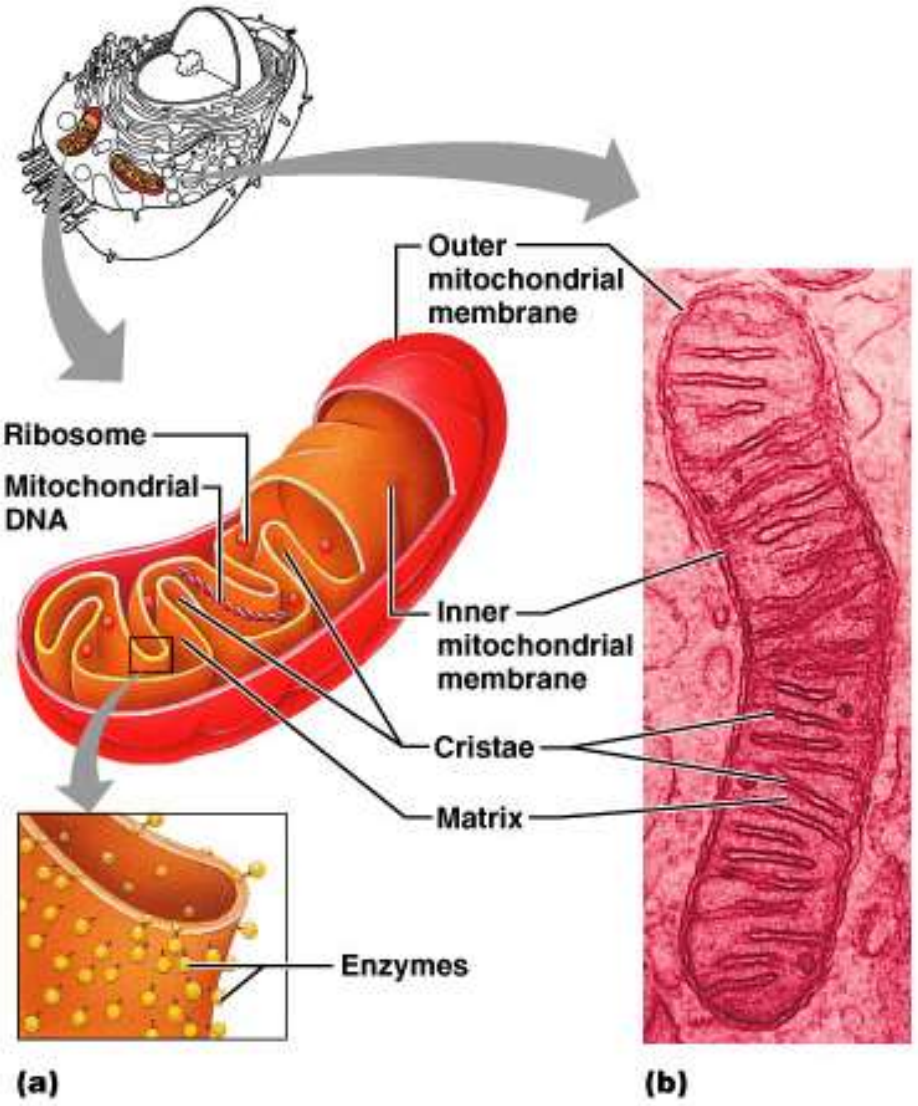
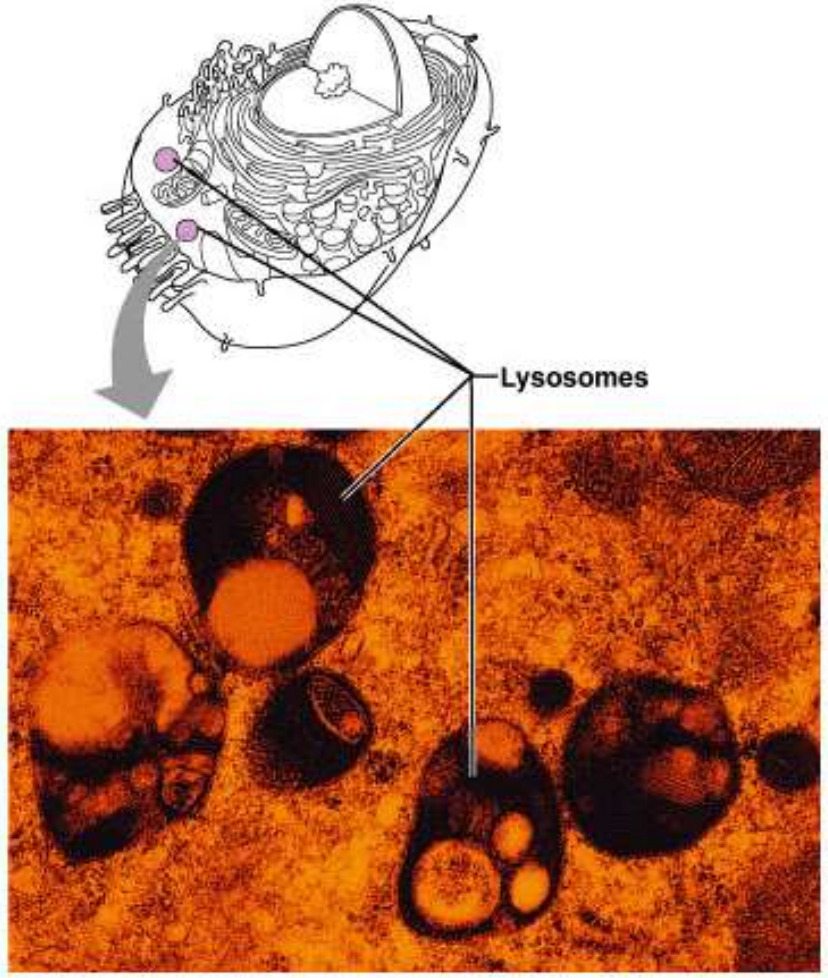
Role of golgi apparatus in packaging products of rough ER for use in the cell and for secretion



Mitochondria



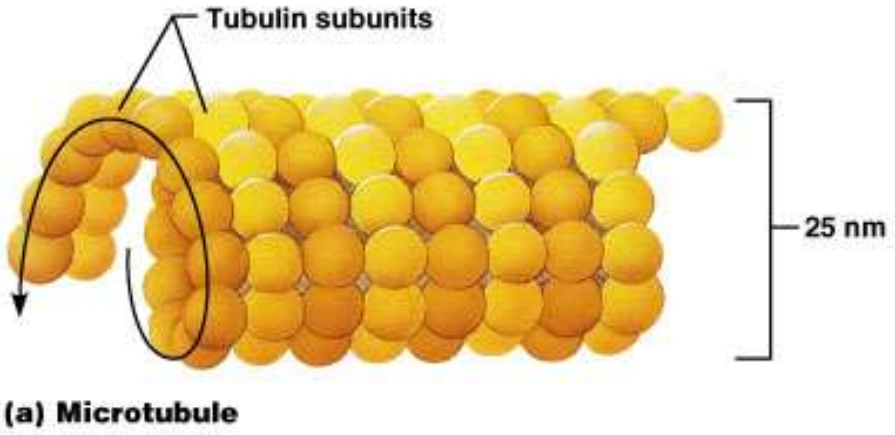
Lysosomes

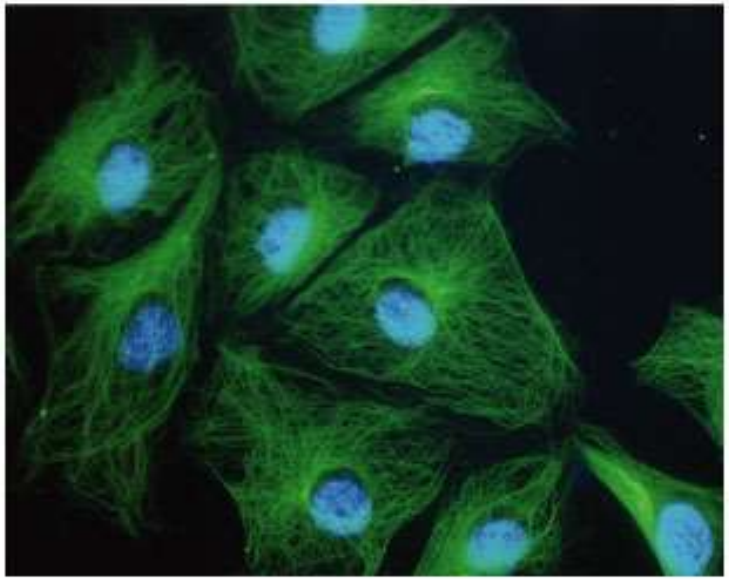


Peroxisomes: like small lysosomes

The cytoskeleton: 3 types of rods

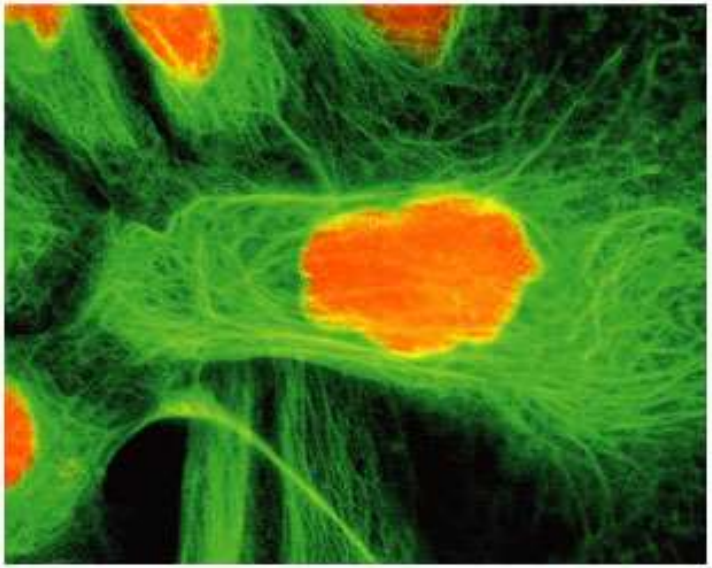
(a) microtubules
(b) microfilaments
(c) intermediate filaments



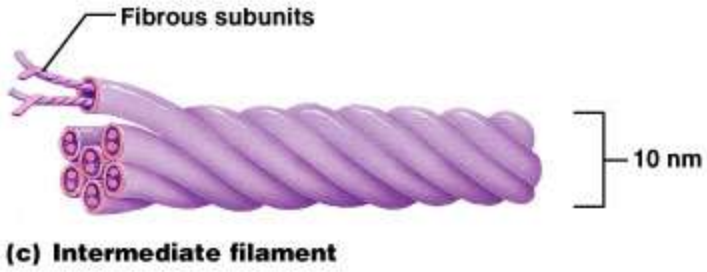


Microtubules appear as green network surrounding the cells' blue nucleus

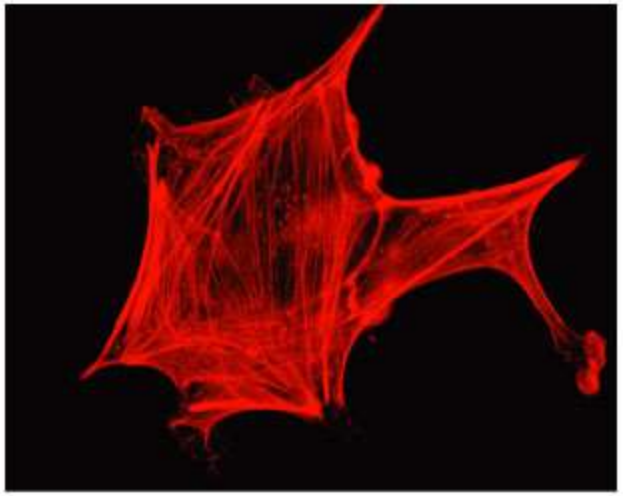
Microfilament: thinnest



Intermediate filament: the most permanent, like guy wires



(c) Intermediate filament



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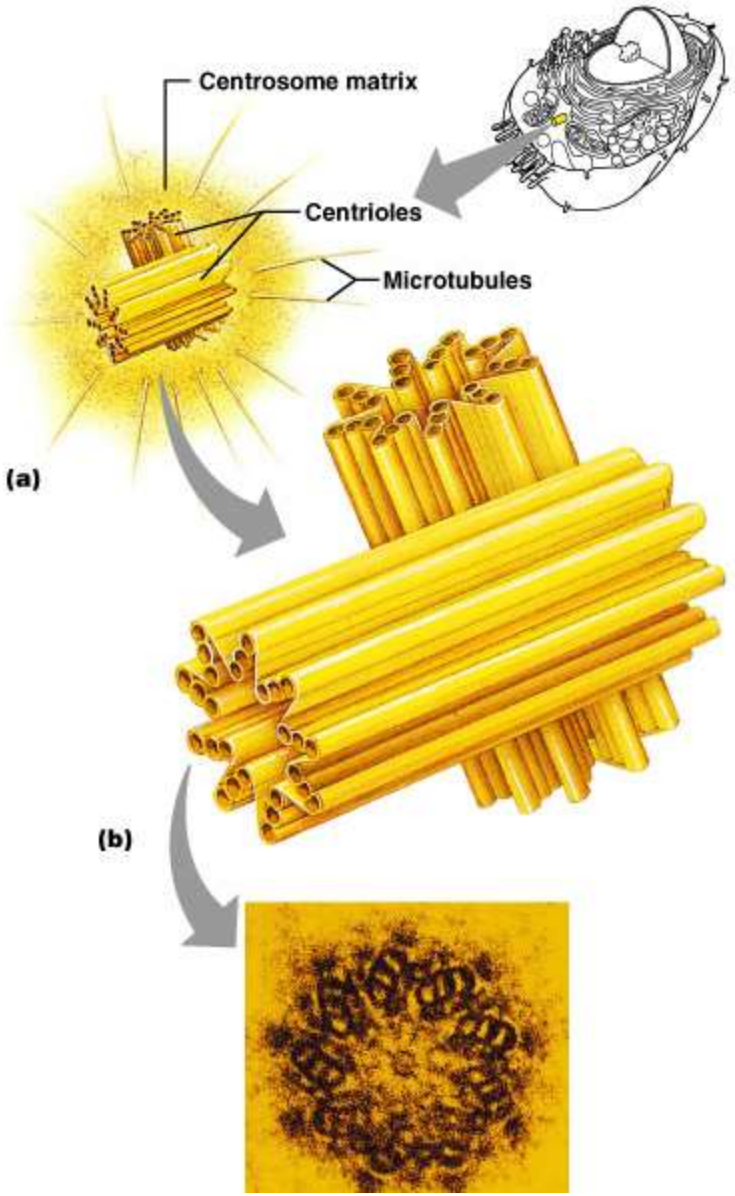
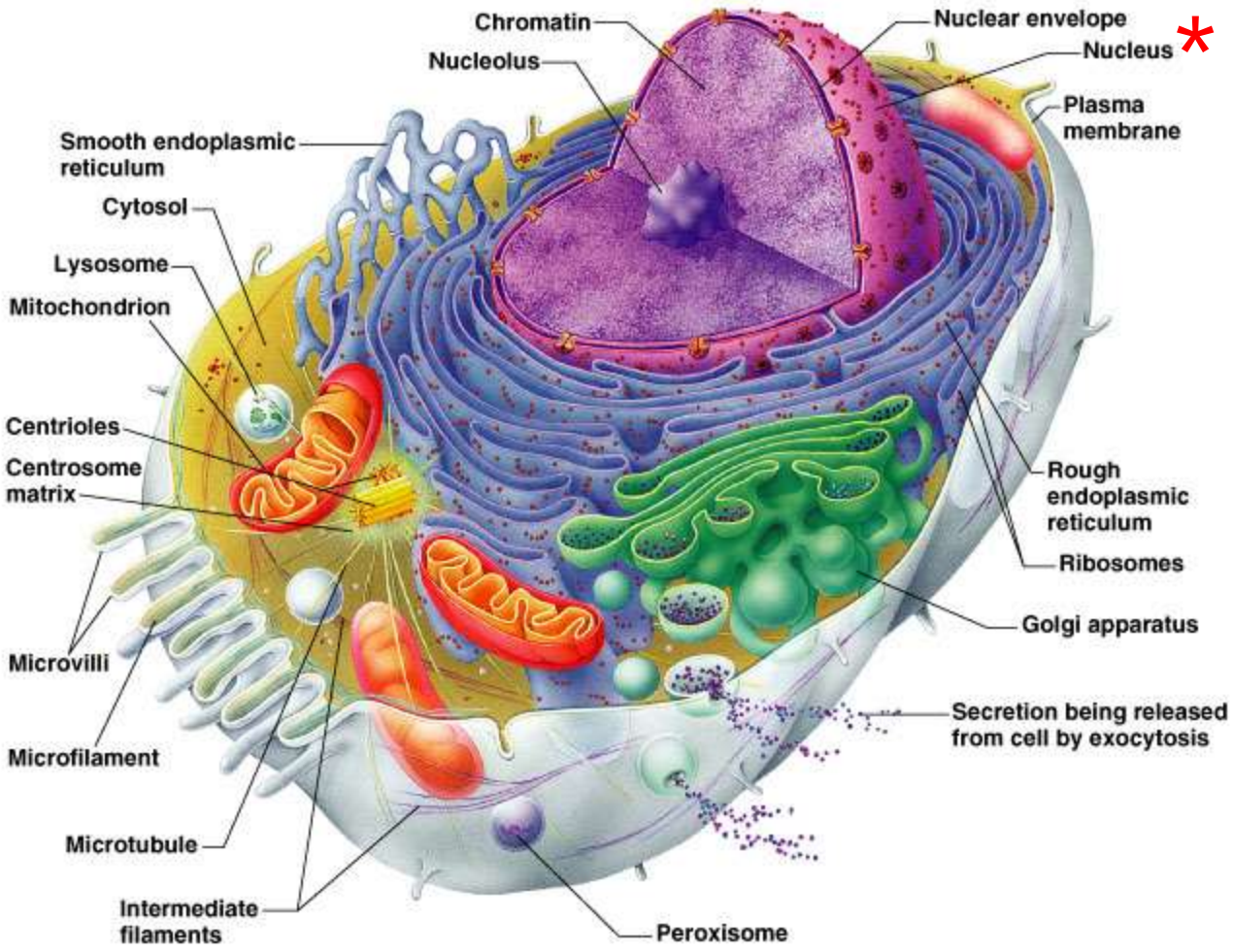
Centrosomes and centrioles



The Nucleus*



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The nucleus

- Control center of the cell
- Surrounded by a nuclear envelope
- Nucleolus associated with ribosome production
- Chromatin - extended & condensed
  - DNA and histones (packaging material)
  - Four types of nucleotides: A, T, G, C
  - Nucleosomes: 8 histones wrapped in DNA
  - Chromosomes

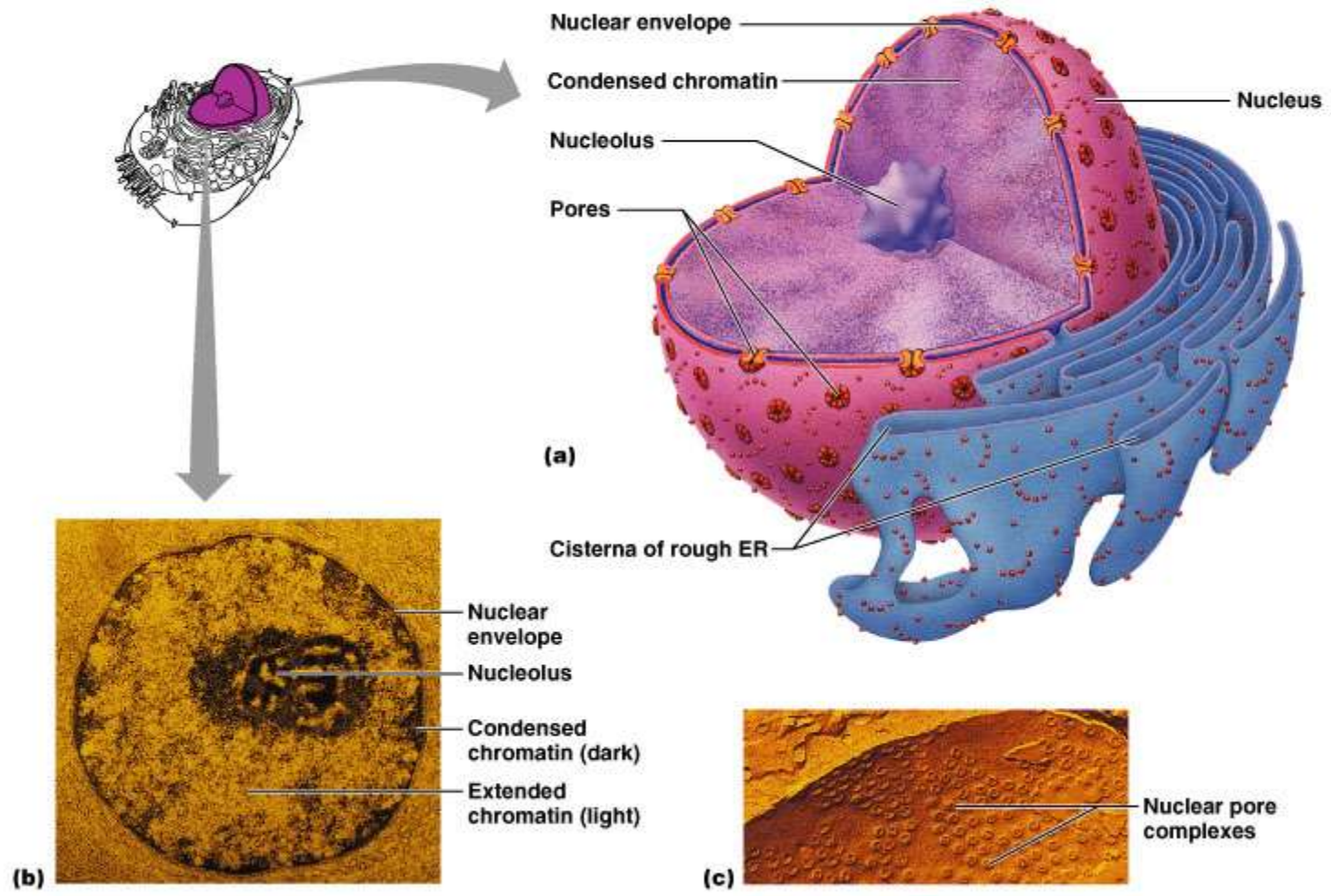
NUCLEUS

Control center of the cell

Surrounded by a nuclear envelope

Nucleolus associated with ribosome production

Chromatin - extended & condensed



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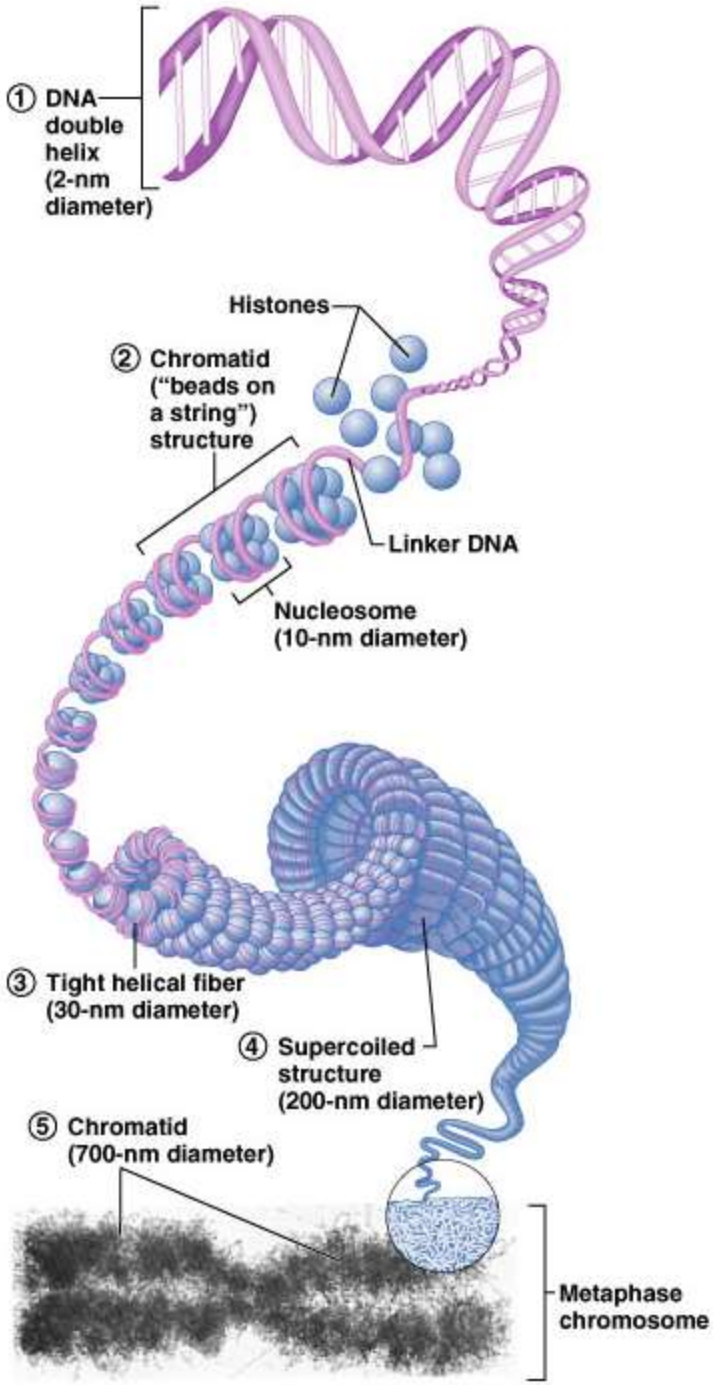
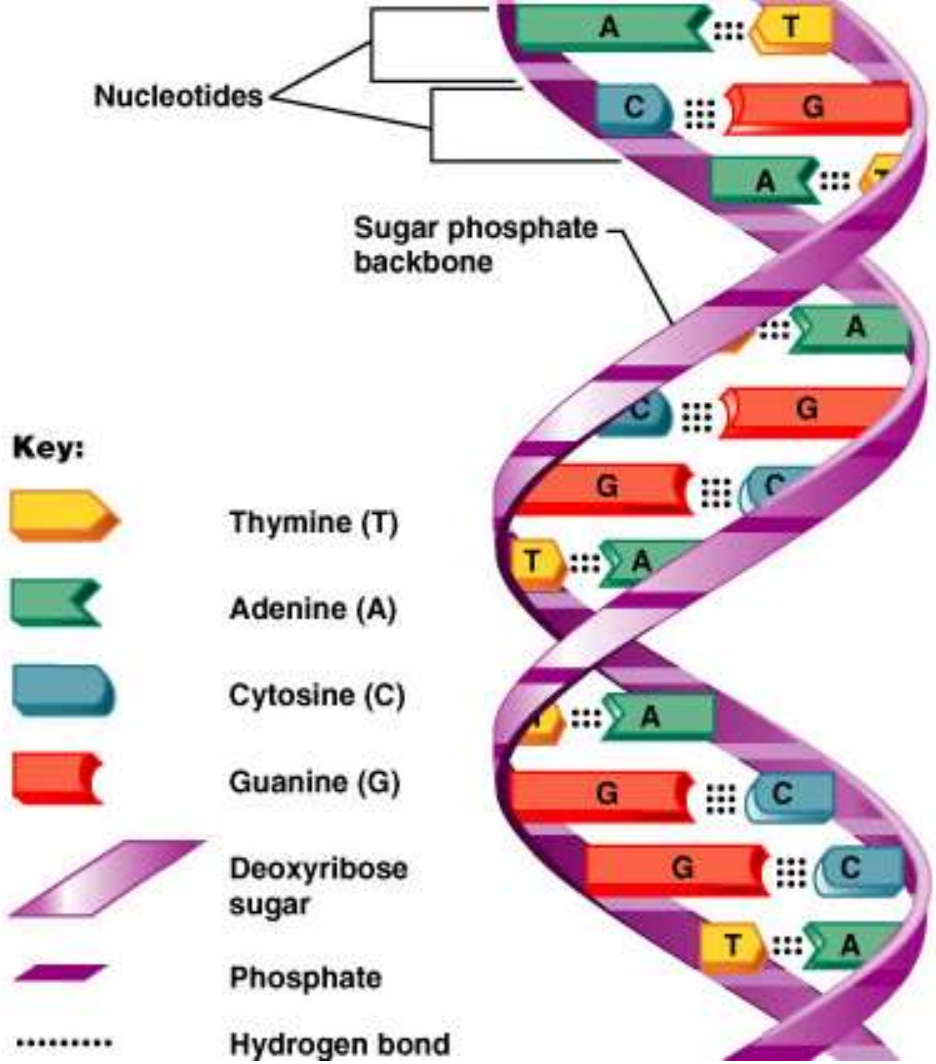
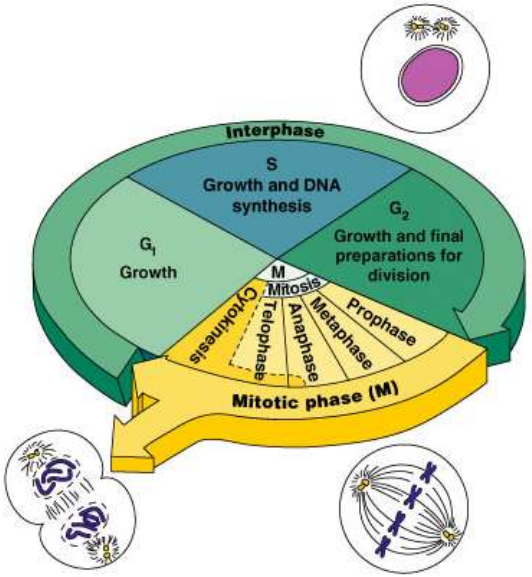




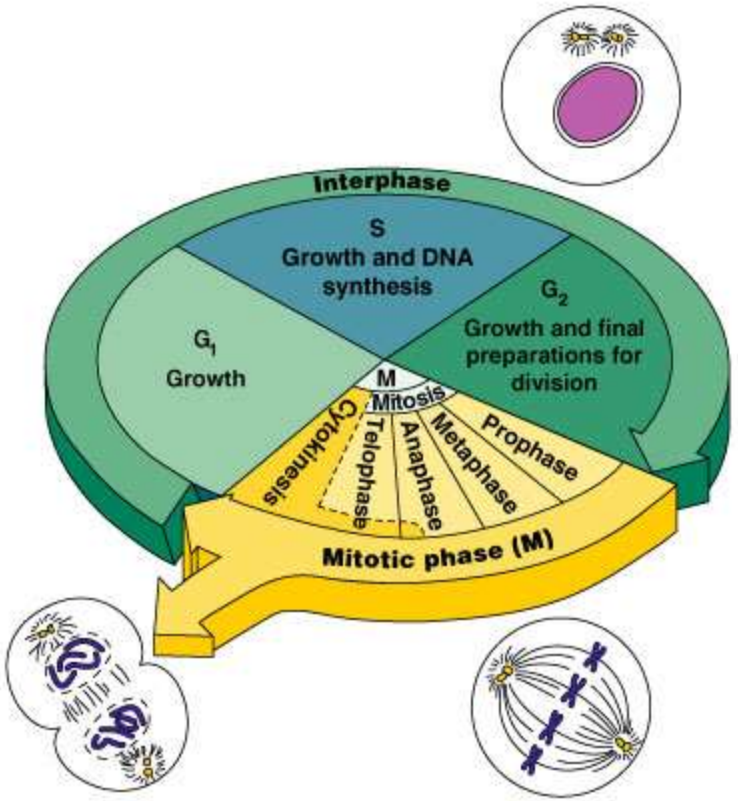
CHROMATIN: extended and condensed DNA and histones (packaging material)
Four types of nucleotides: A, T, G, C
Nucleosomes: 8 histones wrapped in DNA
Chromosomes

The cell life cycle

- Interphase
  - Variable time length
  - Divided into G1, S (DNA replication) and G2 subphases
- Mitosis: division into two daughter cells
  - Interphase
  - Early prophase
  - Late prophase
  - Metaphase
  - Anaphase
  - Telophase and cytokinesis



Cell life cycle



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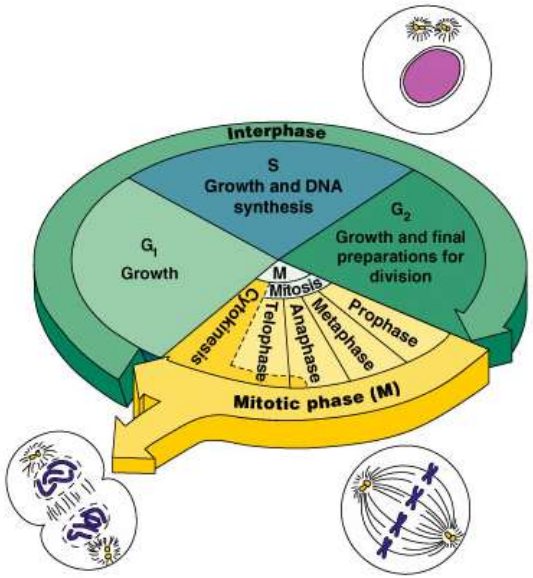
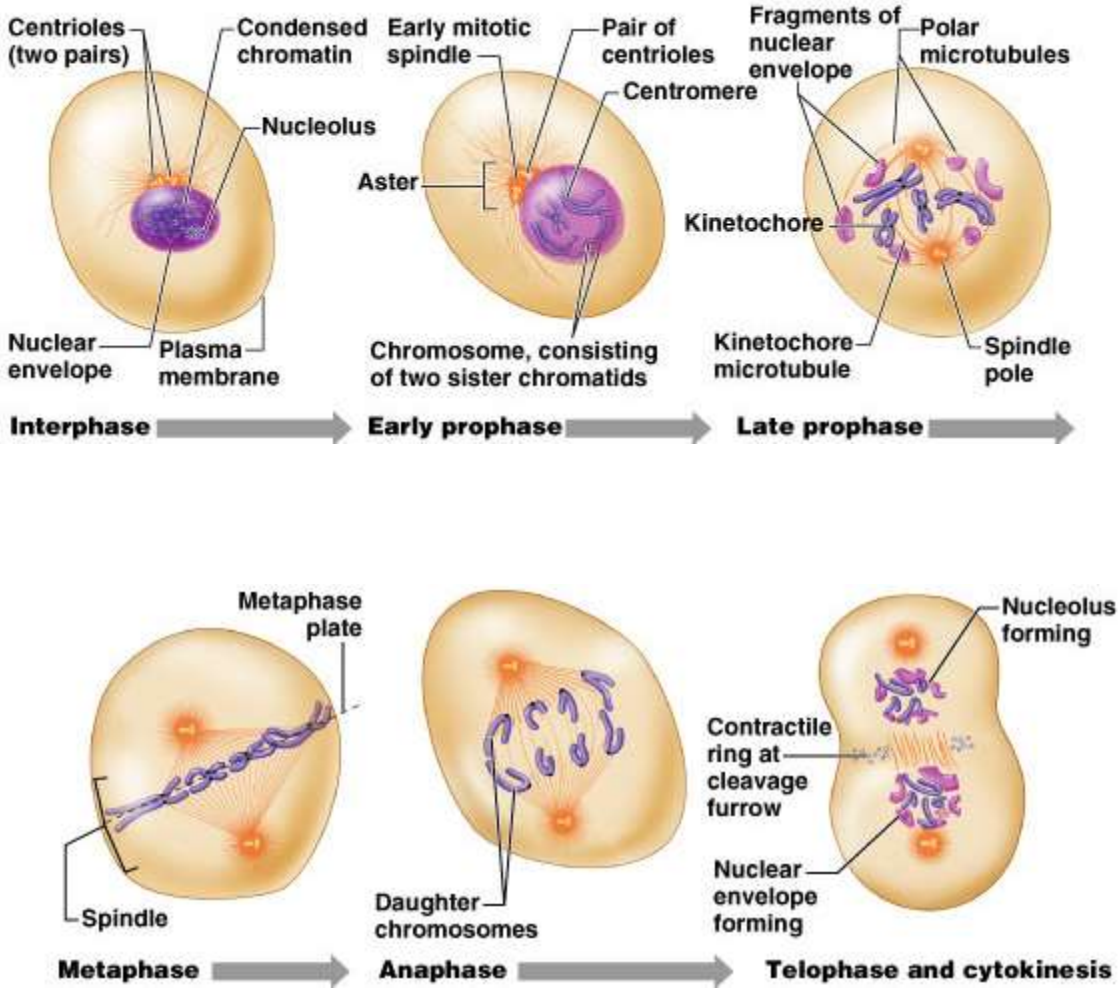
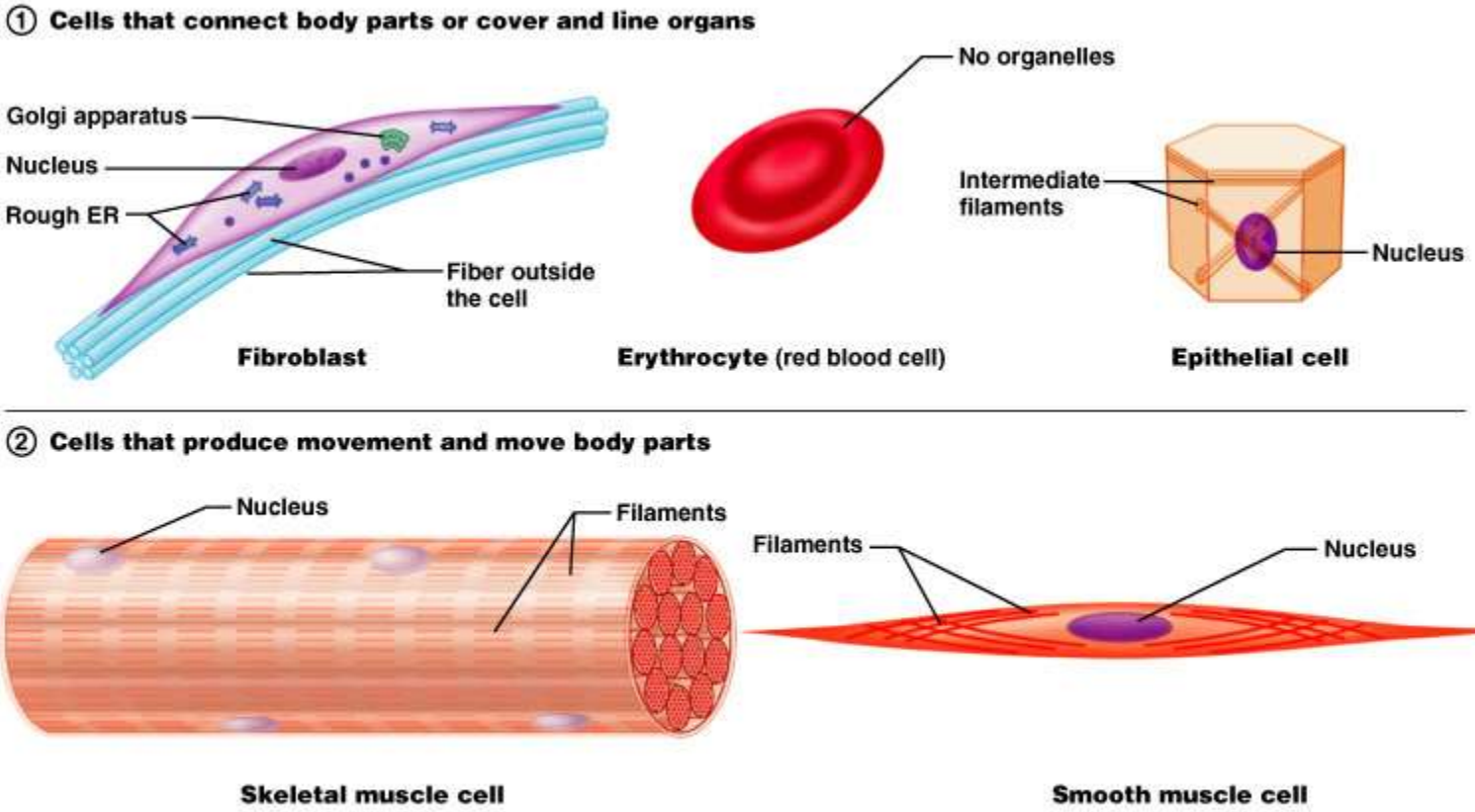
Mitosis (the replicated DNA of the original cell is parceled out into 2 new cells)





When chromosomes are ordered clinically, they are usually in metaphase

Cell diversity



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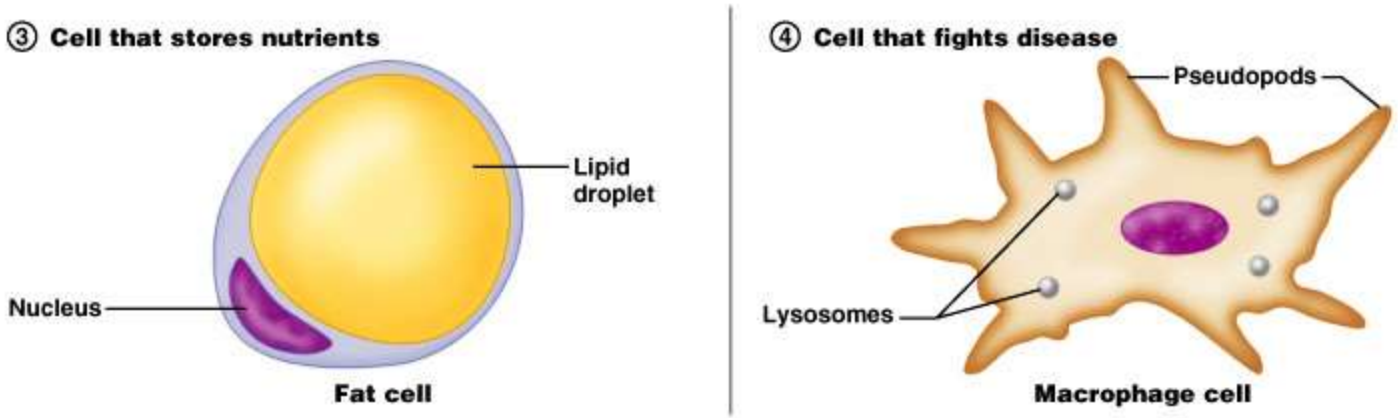

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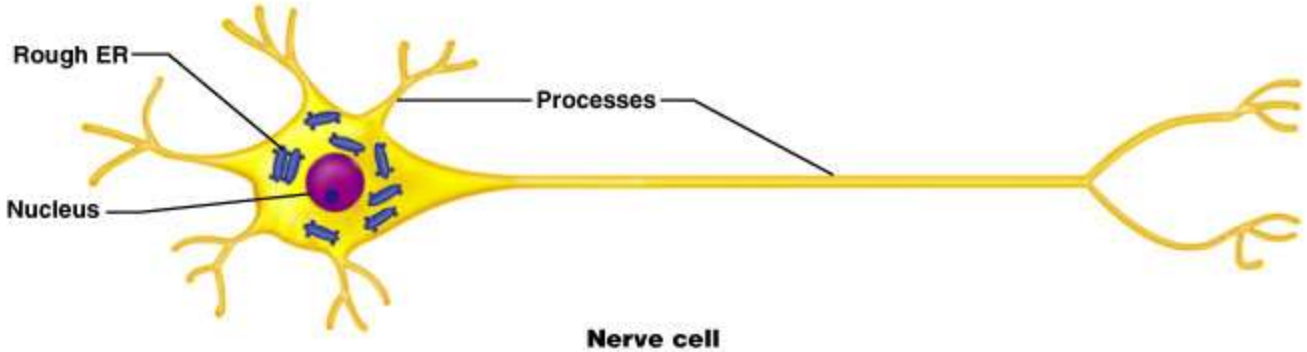
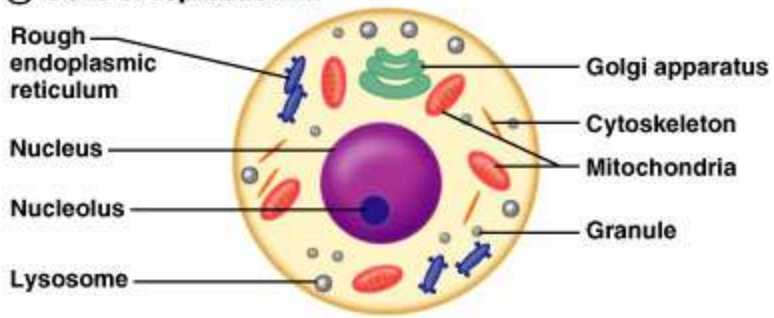
⑤ **Cell that gathers information and controls body functions**

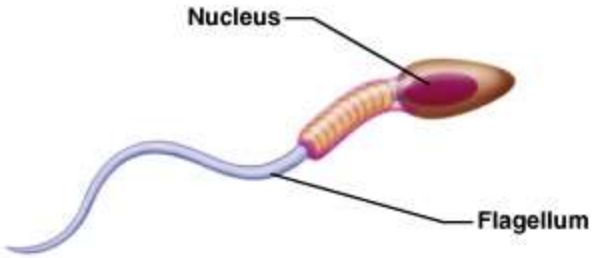


Nerve cell

⑥ **Cells of reproduction**



Ovum (egg)



Sperm

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Developmental aspects

- Human life begins as a single cell
  - From it, all the cells of the body will arise
  - All cells have the same genes yet specialization indicates differential gene activation
- Cell differentiation: the development of specific and distinctive features
- Aging
  - Cellular
  - Organismal

Cancer

"a malignant, invasive cellular tumor that has the capacity of spreading throughout the body"

- Neoplasm – "new growth" AKA tumor
  - Cells fail to honor normal controls of cell division
  - Abnormal mass of proliferating cells
  - Classified as
    - Benign – local growth
    - Malignant - cancer (Latin for "crab")
      - Invades neighboring tissue
      - Can metastasize = spread
- Many gene mutations may be necessary for normal cells to transform

Additional terms

- Dysplasia – change in cell size, shape or arrangement; can be due to irritation; can be a precursor to cancer
- Hyperplasia – increase in the ***number*** of cells
- Hypertrophy – growth due to an increase in the ***size*** of the cells
- Apoptosis – programmed cell death
- Necrosis – death of cells or tissues because of disease or injury

THANKING YOU