

CELLS

Smallest -- mycoplasmas

Cell size is limited by metabolic requirements

Surface area to volume ratio

Cell Fractionation

PROKARYOTIC	EUKARYOTIC
--Bacteria & archaeobacteria	--Kingdoms: Protista, Fungi, Plantae & Animalia
--Genetic material in nucleoid region	--Genetic material in nucleus (with nuclear envelope)
--No membrane-bound organelles	--Contains cytoplasm w/ cytosol & membrane-bound organelles

Nucleus – control center

- Nuclear envelope, double membrane w/ nuclear pores
- Nuclear lamina – network of protein filaments on the inside of the nuclear envelope
- Chromatin – DNA & histone proteins ! Chromosomes (46 in our somatic cells)
- Nucleolus – RNA & proteins, makes ribosomes

Ribosomes – site of protein synthesis

Endomembrane system:

Nuclear envelope
Endoplasmic reticulum
Golgi apparatus
Lysosomes
Vacuoles
Plasma membrane

Endoplasmic reticulum – tubules & sacs (*cisternae*) internal lumen (*cisternal space*)

SER (Smooth ER) – lacks ribosomes

- Synthesis of lipids, phospholipids & steroids (testis, ovaries, skin oil glands)
- In liver, SER has enzyme that catalyzes glycogen!glucose
- In liver, it detoxifies drugs and poisons
- Stores Ca^{++} for muscle contraction

RER (Rough ER) is studded with ribosomes

- Continuous with outer membrane of nuclear envelope
- Ribosomes produce proteins (mainly glycoproteins) for secretion
- Membrane production

Golgi Apparatus – finishes, sorts & ships all products

- Produces lysosomes
- Forms the cell wall

Made up of flattened membraneous

sacs (cisternae) and has a Cis face (forming face) and a Trans face (maturing face)

Cis face receives products from the ER via transport vesicles

Trans face pinches off vesicles ! go to other sites

Lysosomes – membrane enclosed bag of hydrolytic enzymes that digest (lipases, carbohydrases, proteases, & nucleases)

PH 5 optimal

Phagocytosis (autophagy)

Programmed cell destruction

Pompe's disease – missing enzyme is a carbohydrase that breaks down glycogen. Glycogen accumulation damages liver.

Tay-Sachs disease – lipase is missing. Lipids accumulate in the brain.

Vacuoles – large membrane-enclosed vesicle (transport vesicles, lysosome or microbody)

- ❖ Food vacuole
- ❖ Contractile vacuole
- ❖ Central vacuole – large vacuole in mature plant cells enclosed by a membrane called the *tonoplast*

Peroxisomes – large membrane-bound organelle w/ crystalline core

- Contain catalase that converts toxic H_2O_2 to water
- Break down fatty acids
- Detoxification of alcohol

Mitochondria & Chloroplasts – energy transformers

--Enclosed by double membranes

--Contain ribosomes & some DNA that programs a small portion of their own protein synthesis

--Are semiautonomous organelles that grow and reproduce within the cell

Mitochondria – sites of cellular respiration

- Move, change shape and divide
- Number per cell varies with the cell's metabolic activity
- Folds of inner membrane are called *crístae*

Plastids – membrane bound storage organelles

- Amyloplasts (store starch)
- Chromoplasts (store pigments)
- Chloroplasts – chlorophyll containing plastids which are the sites of photosynthesis

Chloroplasts – found in eukaryotic algae, leaves & other green plant organs

3 functional compartments:

1. Intermembrane space (separates the two membranes)
2. Thylakoid space (thylakoid space & stroma)

Thylakoid – flattened membraneous sacs inside the chloroplast.

Chlorophyll is found inside the thylakoid membranes. Some thylakoids are stacked into *grana*. Grana (singular, granum) stacks of thylakoids in a chloroplast.

3. Stroma – fluid outside the thylakoids.
Photosynthetic reactions that use chemical energy to convert CO₂ to sugar in the stroma.

Cytoskeleton – framework

- ✓ Support & shape
- ✓ Movement
- ✓ Regulatory role – helps signals from cell's surface to its interior
- ✓ 3 types of fibers: Microtubules (thickest), microfilaments (thinnest), and intermediate filaments

1. Microtubules – globular protein (tubulin)

(centrosomes, centrioles, cilia & flagella)

- move chromosomes during mitosis (spindle)
- Cilia & flagella (9+2 arrangement) basal body
Motor proteins dynein & kinesin bend (known as dynein walking)
- Centriole (in animal cells) organize spindle

2. Microfilaments (Actin Filaments)

- Cellular support
- Participate in muscle contraction
- Motor molecule = actin & myosin ATP makes a muscle cell shorten as thin actin filaments slide across myosin filaments
- Forms cleavage furrow in mitosis
- Elongation & contraction of pseudopodia
- Cytoplasmic streaming

3. Intermediate filaments (keratin subunits)

- Make up the nuclear lamina
- Reinforce cell shape
- Specialize for bearing tension

Cell walls (plant) cellulose

- ❑ Chemical composition varies cell to cell and species to species
- ❑ Protects, maintains shape
- ❑ Has *plasmodesmata* that connects the cytoplasm of neighboring cells

Young plants secrete thin primary cell wall. Between primary cell walls is a *middle lamella* of pectins (“glue”). Some cells add a secondary wall between the plasma membrane and primary wall.

Extracellular Matrix ECM (animal cells)

- Support & anchorage for cells
- Movement (embryonic cells migrate)
- Development
- Composed mostly of glycoproteins
- ***collagen

Intercellular Junctions

Plants: Plasmodesmata – channels through which cytoplasmic strands communicate between adjacent cells.

Animals: 3 Types

Gap Junction – protein (connexon) channels allows the passage of material or current between cells.

- Animal embryos
- Cardiac muscle

Desmosomes – intercellular junction that rivets (keratin) cells together into strong sheets, but still permit substances to pass freely through intracellular space.

Tight Junctions – hold cells together tightly to prevent leaks of substances through intracellular space. Frequently found in epithelial layers that separate two kinds of solutions.