ANATOMY I

**CYTOLOGY**

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**Histology: A Text and Atlas (Ross, 4th edition)** – Scan Chapter 1, 1-17; Chapter 2, 18-77; Fig. 2.2, 2.3, 2.4, 2.23, 2.24, 2.29, 2.31, 2.35, 2.37, 2.49, 2.51, 2.53, 2.54, 2.57, 2.58b, 2.60

**Basic Histology: Text & Atlas (Junqueira, 10th edition)** – Scan Chapter 1, 1-21; Chapter 2, 23-51; Chapter 3, 53-67; Fig. 2.2, 2.13, 2.22, 2.25, 2.26, 2.28, 2.29, 2.31, 2.32, 2.33, 2.34c, 2.37, 2.38, 2.39, 3.1, 3.4, 3.6, 3.14

**OBJECTIVES** – As a result of attending the audiovisual presentations, reading/viewing the textbook, atlas and notes, the physical therapy student should understand and be able to:

1. List and define the common units of measure used in light and electron microscopy.

* **Angstrom (A)** \*smallest\*
* **Nanometer (nm)** 🡪 formerly called millimicron
* **Micrometer (um)**
* **Millimeter (mm)** \*biggest\*
* 10 Angstroms = 1 Nanometer
* 1000 Nanometers = 1 Micrometer
* 1000 Micrometers = 1 Millimeter

1. Describe the basic cell

* Cell
  + Basic structural and functional units of all multicellular organisms
  + A mass of **protoplasm** – “living matter” = nucleus + cytoplasm(“everything else”)

1. Describe the basic structure and function of the cell components listed below:
2. cell membrane (plasma membrane)
   * Functions:
     + Barrier between Environment/Cytoplasm
     + Selective Permeability
       - Passive vs. Active Transport
     + Cell Communication (hormones)
     + Immune fxn
       - Binding site for antigens/antibodies
       - B-cells stay in cell – T-cells move cell-to-cell
     + Retain enzymes
   * Size:
     + 8 – 10 nm (80-100 A)
     + NOT visible on LM
   * Composition:
     + Trilaminar structure of proteins and lipids forms bilayer of phospholipids
     + Fluid and dynamic system – “Fluid-Mosaic Model”
     + Proteins
       - Move laterally and spin
       - Can be *integral* (transmembrane)or *peripheral* (inner/outer membrane)
         * Types: pumps, channels, receptors, transducers, enzymes, structural
       - Technique that confirmed integral proteins: Freeze Fracture Technique
3. glycocalyx (cell coat)

* CHO attaches to surface of plasma membrane
  + To protein: glycoprotein
  + To lipid: glycolipid
* Function:
  + Recognizes antigens/antibodies (immunity) and normal/abnormal cells
  + Act as cell’s ID
  + Receptors for hormones
  + Filtrate materials in/out of cell
  + Alter chemical concentrations @ cell surface 🡪 charge (AP) conduction

1. zona occludens
2. zona adherens
3. gap junctions (nexus)
4. phagocytotic vesicles

* Receptor mediated
* Cell eating (ingestion of large particles)

1. pinocytotic vescicles

* Not receptor mediated
* Cell drinking (ingestion of materials in sol’n)

1. centrioles

* Paired
* Function:
  + \*Determine cell polarity
  + Make/Organize microtubules in mitotic spindle
  + Make basal bodies of cilia

1. Filaments (intermediate)

* Function:
  + Cell-to-cell adhesion @ intracellular junction (desmosome, aka. *macula adherens*)
    - Desmosome + Hemidesmosome = Tonofilament (epithelial)

1. microtubules

* Function: Cytoskeleton
  + Support
  + Movement of cell
  + Cell polarity
* Location: Cytoplasm
* Made of: tubulin (protein)

1. Microvilli

* Finger-like projection on cell surface
* Function: Increase SA\* (for absorption and phagocytosis)
* Found in: intestines

1. Cilia

* Longer than microvilli
* Function: Aid transportation
* Found in: respiratory and genital tracts

1. stereocilia
2. endoplasmic reticulum – Rough (rER)

* System of interconnecting membranes
* Function:
  + Protein synthesis for export (ribosomes)
  + Segregates
  + Stores
  + Exports

1. endoplasmic reticulum – Smooth (sER)

* Function: Specific to organ/tissue/cell
  + Endocrine – Steroid hormone synthesis
  + Liver – Lipid synthesis, drug detox
  + Stomach – HCl formation
  + Muscle – Ca binding
* associated organelles: **perioxisomes**
  + membrane bound
  + contains: oxidative enzymes
  + function:
    - conversion of H2O2
    - metabolize cholesterol
    - generate steroids and heat

1. **Ribosomes**

* Function: Make proteins from mRNA
* **Polyribosomes**: group of ribosomes
* Present in: rER
* *Transcription*
  + Takes place in: Nucleus
  + DNA 🡪mRNA
* *Translation*
  + Takes place in: Cytoplasma
  + mRNA 🡪 protein

1. Golgi complex (apparatus)

* Receives transfer vesicles from rER at the *forming face* 🡪 *maturing face* gives off *condensing vacuole* which forms into *secretory granuole*
* *Secretory granule* = recycles membrane, assembles CHO, produces glycocalyxx
* Function:
  + Package material for export
    - Proteins, glycolipids, glycoproteins
  + Form: Lysosomes

1. Lysosomes

* Membrane bound
* Contains hydrolytic enzymes
* Function: digestion/phagocytosis of…
  + Cell constituents
    - ex: cell remodeling/normal
  + Bacteria/Viruses
    - ex: neutrophils & osteoclasts
* Formed by: Golgi
* Primary: new & not fxnal yet
* Secondary: mature & actively digesting
  + Called: Dense Body
  + Also called: phagosome or digesting vacuole

1. Mitochondria (cristae & mitochondrial granule)

* Functions:
  + Provide ATP – cell’s energy
  + Hold DNA and RNA 🡪 ONLY part other than nucleus that has RNA *and* DNA
* 2 Membranes:
  + Outer
  + Intermembrane Space
  + Inner
    - Cristae = infoldings (increase SA)
    - Where Kreb’s cycle takes place (elementary particles)
* Matrix
  + Floating granules
  + DNA and RNA

1. glycogen
2. Nucleus

* Defined: Membrane-limited, contains genome of eukaryotic cells, regulates cell fxn
* Cells that lack one: RBCs & Platelets
* Largest single membrane-bound structure
* Surrounded by: **Nuclear Envelope**
  + Consists of: 2 membranes (inner+outer)
  + **Nuclear Pore**:
    - In envelope, between Nucleoplasm/Cytoplasm
    - mRNA passes through here from nucleus 🡪 cytoplasm
  + **Nucleoplasm**: Material enclosed by nuclear envelope exclusive of chromatin and nucleolus
* Parts:

1. **Chromatin**

* Defined: w/in Nucleus 🡪 Protein & DNA
* Types:
  + **Hetero**chromatin (stains dark)
    - *Inactive* 🡪 coiled DNA
    - *Marginal* (peripheral) OR *Karyosomes* (descrete)
  + **Eu**chromatin (stains light)
    - Active 🡪 uncoiled DNA
    - Allow DNA to be transcribed
* Nucleosome: Smallest unit of chromatin
  + Found in both types of chromatin (Hetero-, Eu-)
  + Eventually are packed as chromosomes

1. **Nucleolus**

* Type: Non-membranous
* Function:
  + Synthesize RNA
  + Synthesize Protein
  + Initial Ribosomal Assembly
* More numerous as cell becomes more active

1. **Nuclear Cytoskeleton** ~ Nuclear Lamina

* Between *Marginal* chromatin and *Nuclear Envelope*

1. List and discuss the chemical components of the cytoplasm.

* **Organelles –** structure, living
  + Membrane Limited
  + Non-Membranous
* **Inclusions** – storage, non-living
  + Glycogen – beta (single) or alpha (cluster of beta)
  + Stored waste
  + Neutral fat
  + Pigment
  + Secretory granules
* **Cytoplasmic Matrix**