# BMED2401 (Cellular Foundations)

**Histology** is the study of how the body's cells and tissues are organized into organs

**Pathology** is the study of abnormal or diseased tissue

**Steps in tissue preparation:**

- Specimen Acquisition
- Fixation
  - We fix to prevent **autolysis** (tissue breaking down and cell attacks itself)
  - We also want to prevent **osmotic alterations** (sudden movement of soluble ions across the membrane with dehydrate and explode the cell)
  - We also want to prevent **ischemia** (this is the loss of blood that leads to the above)
- Dehydration
- Embedding
  - This involves stiffening the cell to make it easier to cut
- Section
  - We section of a specific area of the cell so that the resolution (ability to distinguish two points) increases
- Stain
  - This produces a contrast
  - Different stains highlight different areas and things (H&E dye stains cytoplasm pink and nuclei blue)

**Microscopes**

| | ***Light microscopy*** | ***Electron microscopy*** |
|---|---|---|
| resolving power | 0.2μm | 3nm |
| Max. magnification | 2,000x | 500,000x |
| section thickness | 1um – 100um (5μm) | 0.025um |

- Other differences:
    - Since electron microscopy does not use light, it uses density. The darker something appears, the denser it is!

**Tissue**

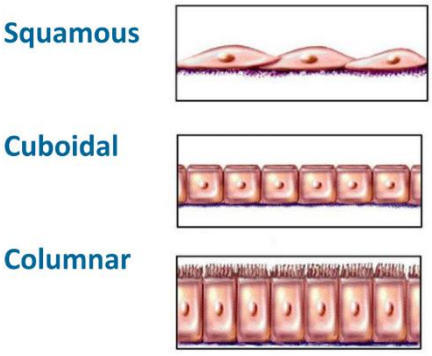
- There are 4 different types of tissue:
    - Epithelial
    - Connective

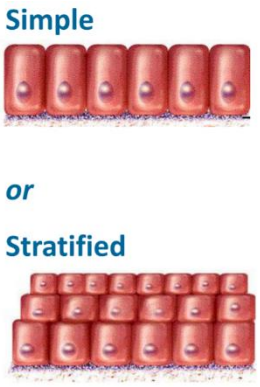
    Classified by what they look like (**MORPHOLOGY)**

    - Muscular
    - Nervous

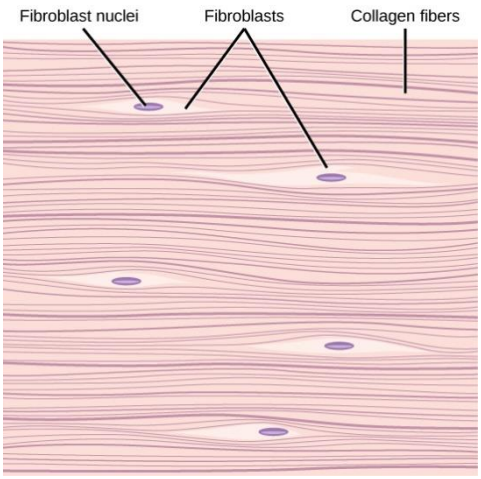
    Classified by their function **(FUNCTION)**

- Epithelial
    - Always **present on free surfaces** in continuous lining
    - Is able to **repair and renew**
    - Present when there are closely located cells to create a **barrier**
    - Can be in single or multiple layers
    - **Classification:**

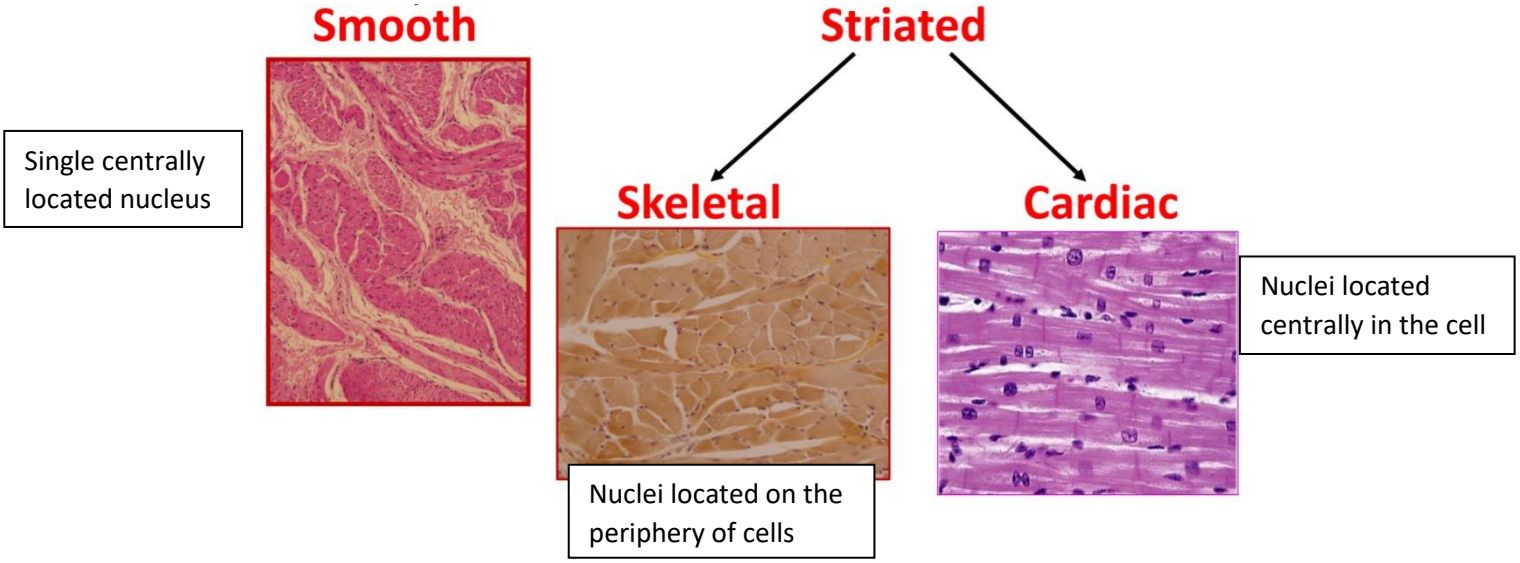



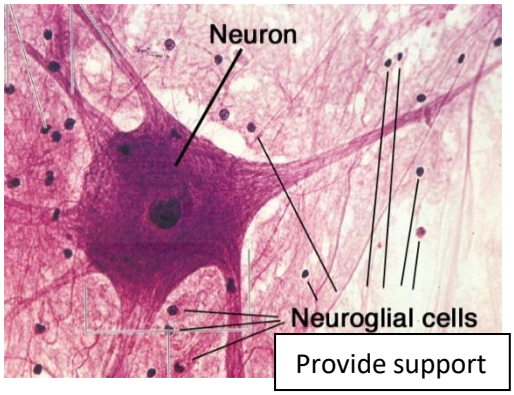

- Connective Tissue
    - Acts as a s**upport tissue**
    - **Ground substance** that often surround cells
        - Blood and bone are both connective tissue
    - Made up of **fibroblast cells** that produce **fibres** and **collagens**
    - **Classification:**
        - Can be **loose** or **dense**
        - Can be **regular** or **irregular**



- Muscle Tissue
  - Very **elongated** and **orientated**
  - Arranged in **bundles** of tissue
  - **Smooth muscle tissue** is found on the walls of blood vessels and organs
    - Has **slow contractions**
    - **No control** over it
  - **Striated muscle** can be **skeletal** and **cardiac**
    - **Skeletal muscle** is found in bones and ligaments. We **have control** over skeletal muscle
    - **Cardiac muscle** is found in the **heart.**




- Neural Tissue
  - The nerve cell is the neuron
  - They are **classified by function:**
    - **Peripheral system** (anything not central)
      - White matter has nerves (axons)
      - Grey matter has ganglia
    - **Central system** (brain and spine)
      - White matter has nerves (axons and blood vessels)
      - Grey matter has neuron body, nucleus




**Cellular Compartmentalization**

- Why compartmentalize?
  - Maintains **disorder** and keeps them **entropically favourable**
  - Molecules get to the **right place easier**

- How?
    - Compartments function in **cooperation**
    - Create enormous amounts of **membrane** to create the compartments

**Cytoplasm**

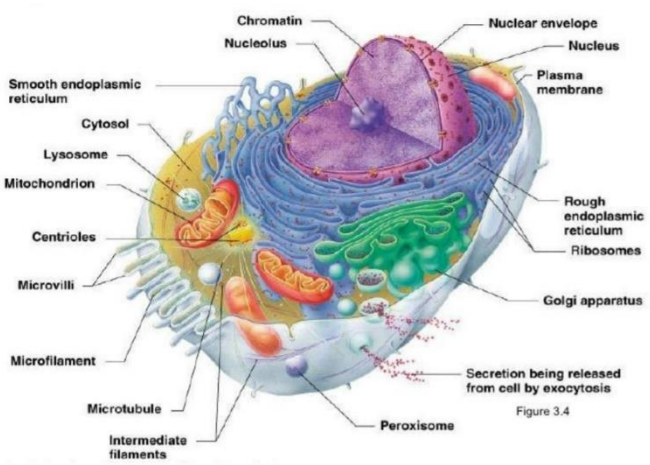


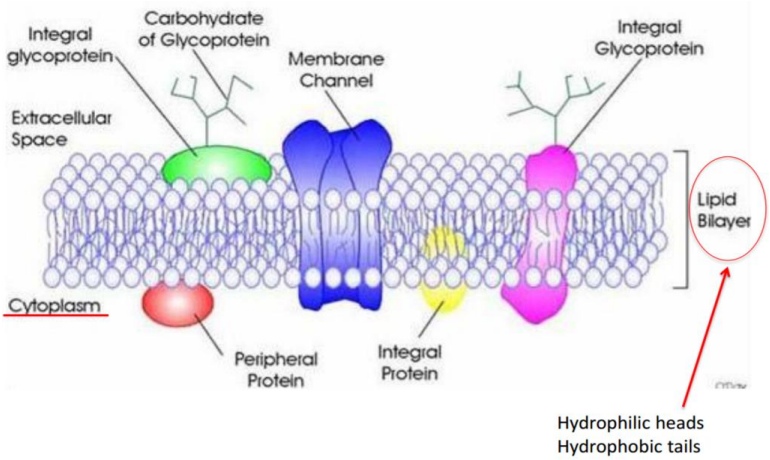
Figure 3.4

- <u>Organelles</u> are membrane-bound and have specific functions (golgi apparatus, nucleus, reticulum)
- <u>Inclusions</u> are small insoluble particles (calcium crystals, glycogen, lipid droplets)
- <u>Cytosol</u> is not possible to be seen with a microscope we must assume it is there (water, salts, soluble proteins)

**Plasma Membrane**

- <u>Compulsory Features:</u>
    - Lipid-bilayer structure
    - **9nm wide**
    - Surrounds the cell
- <u>Voluntary Features:</u>
    - Selectively permeable
    - **Lipids and proteins** (the type of these changes from cell to cell)
    - Pumps, channels and receptors differ from cell to cell

- <u>Other:</u>
    - Has hydrophilic heads facing outwards and hydrophobic heads facing inwards
    - **Plasma membranes of two different cells never meet! There is always an intercellular space created between the two membranes**
    - It is **very dense** at the membrane because there is a high concentration of **protein heads**



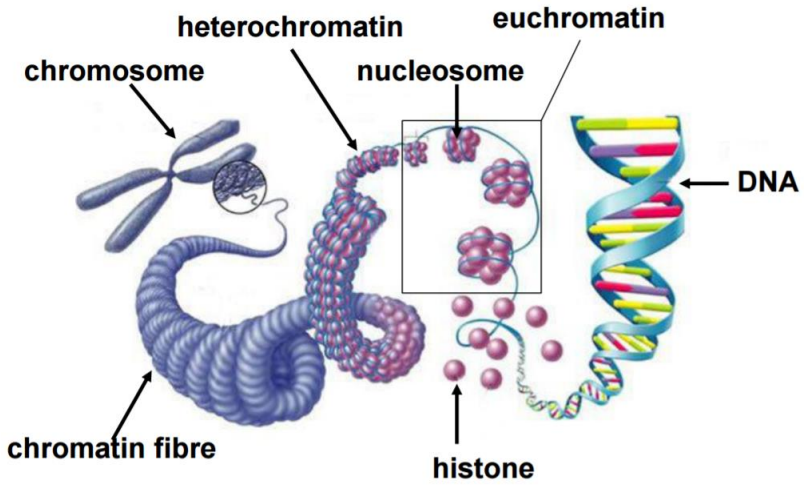

<u>Vesicles, Lysosomes and Endosomes all have membranes with the same basic structure but different proteins</u>

- Definitions:
    - **Cisternae** are flat sheets of membrane (golgi apparatus, endoplasmic reticulum)
    - **Cristae** are folds of membrane (mitochondria)

**Chromatin vs Chromosomes**

- **Chromatin is the stable and resting state**. It is found in cells that are **not undergoing division**. It is very loose chromosomes
- **Chromosomes are the unstable form**. They are found in cells that are undergoing mitotic division. **Chromosomes are very compact** so they can easily be transferred during cell division.

- Definitions:
    - **Euchromatin is made from DNA wrapped around histones** to form nucleosomes (beads on a string)
        - Is **extended and active**. Appears as the pale areas in a photo
    - **Heterochromatin is much dense**r and appears as the darker areas in a photo
        - Many heterochromatin clump together to form chromatin fibres




**The ratio of euchromatin to heterochromatin tells you how active the cell is. The more heterochromatin there is present, the more inactive the cell is.**

**Cell Features/Functions**

- Nucleolus
    - Site of **rRNA synthesis** and ribosomal activity
        - The RNA that was coded for by the DNA **leaves the nucleolus via the Nuclear pores** and travels to the cytoplasm
        - The nuclear pores are always 70nm wide which is enough room for the rRNA to leave but not the chromatin
    - Around **2µm in diameter**