Welcome to

Biomedicine: Human Sciences

The College of Naturopathic Medicine (CNM)
Learning Outcomes

In today’s topic you will learn:

- The characteristics of life.
- Homeostasis, positive and negative feedback control.
- Cell structure and organelle functions.
- DNA, RNA, gene structure, function and inheritance.
- The two types of cell division.
- Understand protein synthesis.
- Types of tissues in the human body.
Biomedicine

**Anatomy:**
Study of the structure

**Physiology:**
How the parts of the body work

**Pathology:**
Study of abnormalities from normal function

*Please refer to your Glossary and Prefixes and Suffixes (on the website) to see definition & derivation of these words.*
Characteristics of Life

- **Metabolism**: Sum of all the *chemical processes* in the body.
- **Responsiveness**: Ability to respond to *detect and respond to changes* in the environment.
- **Movement**: Movement of the whole organism or of individual organs, cells and structures inside cells.
- **Reproduction**: Formation of new cells or production of a new individual.
- **Growth**: Increase in size or increased number.
- **Differentiation**: Development to *specialised state*.
- **Vital Force / Life Force / Chi**
Characteristics of Death

- Loss of heartbeat
- Absence of breathing
- Loss of brain function
- No Vital Force / Life Force / Chi
Homeostasis

*Homeo = sameness  Stasis = still*

- Fundamental principle of physiology

- “The condition of equilibrium (balance) in the body’s internal environment maintained by the body’s own regulatory processes”

- It is **dynamic** and **ever-changing** whilst always remaining within certain **narrow limits** to ensure optimal functioning of all life processes
The following physiological variables must be kept within narrow parameters (homeostatic balance) in the body:

1. Core temperature (36.5-37.5°C)
2. Water and electrolyte concentrations
3. pH (acidity or alkalinity) of body fluids
4. Blood glucose levels
5. Blood and tissue O$_2$/CO$_2$ levels
6. Blood pressure
7. Flow of Life Force
Important aspect is to maintain **composition and volume of body fluids** - intracellular or extracellular (blood plasma, synovial fluid, lymph, interstitial etc.)

Proper functioning of body cells relies on **interstitial fluid composition**. It changes as substances move back and forth between it and blood plasma.

**Synovial fluid** = a lubricating fluid found in many joints

**Inter** = between (cells) / **stitial** = positioned
Homeostatic Control

- Homeostasis is constantly being **disturbed** by external and internal environments.
- **It is maintained by control systems that bring back balance**

**These Control Systems are made up of:**
1. **Disruptor:** Changes homeostatic parameter
2. **Detectors:** **Receptors** that detect disruption. Typically nerve or chemical signals.
3. **Control Centre:** Determines limits within which parameters should be maintained. Evaluates input and generates output eg. Nerve impulse
4. **Effectors:** Structure that receives output.
A feedback system:
“A group of receptors and effectors communicating with their control centre”

Negative  Positive
Negative Feedback System

- Output reverses the input
- Accounts for most body variables
- The effector response *decreases* the effect of the original stimulus, maintaining or restoring homeostasis.

**Examples:**
1) Increase **blood pressure** (detected by baroreceptors)
2) **Temperature**

- Works like a central heating system

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Positive Feedback System

• Tends to strengthen/reinforce change in one of body’s controlled conditions (Amplifier)

• Like negative feedback, it still provides commands to an effector. However this time it reinforces

• Stimulus progressively increases the response as long as the stimulus is continued

• Only a few of these systems exist in the body

• Examples: Childbirth, milk production, enzyme reactions, immunity, blood clotting
Body Organisation

- **Chemical level**: atoms + molecules
- **Cells**: The smallest living unit in the body. The basic structural and functional unit of an organism
- **Tissues**: Groups of cells that work together to perform a function
- **Organs**: Groups of tissues working together with a specific function
- **Systems**: Related organs that have a common function form a system.
- **Vital Force**: Life energy throughout the body creating life.
- **The organism**: All parts of the body functioning together make the living organism.
Differentiated cell types → Tissues → Organ (kidney) → Organ system (urinary system) → Organism

Muscle tissue cell → Nerve cell → Epithelial cell → Connective cell

Systems of the Human Body

- Skeletal System
- Muscular System
- Respiratory System
- Cardiovascular System
- Digestive System
- Endocrine System
- Lymphatic System
- Integumentary System
- Urinary System
- Reproductive System
- Nervous System
- Immune System
- **Soul / Vital Force**
Body cavities

The body’s organs are primarily located within 4 cavities:

1. Cranial
2. Thoracic
3. Abdominal
4. Pelvic
Cytology

CELL THEORY

- Proposed in 1938
- All known living things are made up of cells and vital force.
- The cell is the structural & functional unit of all living things.
- All cells come from pre-existing cells by division.
- Cells contain hereditary information which is passed from cell to cell during cell division.
- All cells are basically the same in chemical composition.
- All energy flow (metabolism & Life Force) of life occurs within cells.
Cell Memory

• Sustained cell response to a transient stimulus

• Your cell’s ability to remember all experiences which influence Vital Force in our cells and body.

• Vital Force/Life Force is free flowing throughout the body in a healthy person but can become blocked resulting in lack of energy to areas of the body creating the possibility for disease.

• Affected by all our life experiences.

Source: www.vet.cornell.edu
**Disease**

*Disruption of body physiology can cause disease*

- **Cells are interconnected** making up organs and systems through their energy flow – when this is disrupted diseases manifest in these organs.

- Caused by a disruption to cell function by **blocking vital force**.

- Factors which can cause disease include **toxins** from foods, environment or drugs not naturally meant to be in the body.

- **Stagnation of energy** can be caused by many factors such as dietary choices, lifestyle influences and exposure to harmful substances such as radiation.

- **Healing is to correct energy blockages** promoting self healing.
Toxins

- **Toxins** such as Lead can build up in the body and cause serious **disruption to cell processes**

- **Lead** accumulates slowly in the body. 95% deposited in teeth and bone. Also affects red blood cells, the nervous system, kidneys

- Widely distributed industrial metal. Less common because previously used in paints and petrol

- Health threat to children because developing GIT and nervous system

- **Symptoms include:** Abdominal pain, vomiting, lethargy, aggression, headaches, hearing loss
Cells: Prokaryotes vs Eukaryotes

**Prokaryote**
- Cells: Prokaryotes
- Prokaryote
- Prokaryotes: “without nucleus”
  - Capsule
  - Cell Wall
  - Membrane
  - Cytoplasm
  - Pili
  - Plasmid
  - Ribosome
  - Flagellum

**Eukaryote**
- Eukaryotes
- Eukaryote: “with nucleus”
  - Mitochondrion: Where respiration takes place and energy is produced
  - Nucleus: DNA occurs in the nucleus within strands of chromatin
  - Lysosome: Sites where proteins are synthesized
  - Nucleolus
  - Ribosomes: Gel-like fluid inside the cell
  - Cytoplasm
  - Nuclear membrane
  - Golgi apparatus
  - Cell membrane
  - Centrioles
  - Endoplasmic reticulum

[https://dbscience4.wikispaces.com/Francis](https://dbscience4.wikispaces.com/Francis)

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### Cells

#### Characteristic

<table>
<thead>
<tr>
<th></th>
<th>Prokaryote</th>
<th>Eukaryote</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Cell size</strong></td>
<td>0.2-2μm</td>
<td>10-100μm</td>
</tr>
<tr>
<td><strong>Nucleus</strong></td>
<td>No Nucleus (DNA/RNA dispersed through cytoplasm)</td>
<td>Membrane bound nucleus</td>
</tr>
<tr>
<td><strong>Membrane bound organelles</strong></td>
<td>Absent</td>
<td>Many present</td>
</tr>
<tr>
<td><strong>Cell wall</strong></td>
<td>Present</td>
<td>Only present in plants and fungi</td>
</tr>
<tr>
<td><strong>Ribosomes</strong></td>
<td>Present but smaller</td>
<td>Present</td>
</tr>
<tr>
<td><strong>Cell division</strong></td>
<td>Binary fission</td>
<td>Involves mitosis</td>
</tr>
<tr>
<td><strong>Uni/multicellular</strong></td>
<td>Always single celled (unicellular)</td>
<td>Can be multicellular</td>
</tr>
<tr>
<td><strong>Includes</strong></td>
<td>Bacteria &amp; other lower organisms</td>
<td><strong>Human/Animal cells</strong></td>
</tr>
</tbody>
</table>

*Please refer to your Glossary and Prefixes and Suffixes*

**DNA** = Deoxyribonucleic acid  
**RNA** = “Ribonucleic acid”  
**Ribosomes** = small structures that synthesise proteins within a cell
Cell Components

CELL WALL
• **NOT IN HUMAN CELLS!** Only plant, fungal and bacterial cells
• Controls turgidity (firmness/distended/swollen due to water content)
• 2 layers surrounding the plasma membrane.

PLASMA MEMBRANE
• Membrane surrounding / encompassing the cell.

Cell Contents:
• **CYTOSOL**: Basic watery fluid
• **ORGANELLES**: Small structures within the cell with specialised functions eg. produce proteins, digest worn our cell structures, production of energy
• **CYTOPLASM**: Cell content *excluding* the nucleus (that contains nucleoplasm)

*Organ* from the Latin *organum*’ meaning instrument/tool
*Organelles* are any of a number of specialised structures within a living cell
Plasma Membrane

- **Flexible, semi-permeable membrane** that separates the cells external and internal environment

- Structurally has a **phospholipid bilayer** that contains other fats eg. Cholesterol.

- Bilayer arrangement occurs because lipids are **hydrophobic** (“water hating” - tails on the inside) and the phosphate heads are **hydrophilic** (“water loving” - on outside)

- Membrane is also embedded with **transmembrane proteins** (integral or peripheral)

- The membrane controls movement of substances in/out of cell. **Selectively permeable. The membrane maintains concentration gradient between cytosol and extracellular fluid.**
Plasma Membrane

- The membrane is a **fluid structure**
- Fluidity allows **mobility** and assists in cell processes such as growth, movement and secretion.

- **Function of Trans Membrane Proteins:**
  1. **Ion channels** for movement of ions. Allow single type of ions to pass
  2. **Carriers:** Transport larger substances across membrane and may require energy
  3. **Immunological identity:** Help identify foreign cells. Also for blood groups and transplants.
  4. **Receptors:** Recognition sites for hormones etc.

**Ions** = a molecule with an electric charge eg. hydrogen
Plasma Membrane

Lipid tails (green)

“Bilayer”

Phosphate heads (purple spheres)
Plasma Membrane

In this diagram, note the phospholipid bilayer.

The ‘hydrophobic’ lipid tails face inwards whilst the ‘hydrophilic’ phosphate heads face outwards.

The membrane also is also embedded with transmembrane proteins.

Molecules enter and exit the cell through this membrane.
Organelles

- NUCLEUS
- MITOCHONDRIA
- RIBOSOMES
- ENDOPLASMIC RETICULUM
- GOLGI APPARATUS
- VESICLES & VACUOLES
- LYSOSOMES
- CENTRIOLES
- MICROTUBULES

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Organelles: Nucleus

• Every eukaryotic cell (all body cells) has a nucleus except red blood cells (they lose their nucleus during development to maximise the space available to carry oxygen in blood)

• The nucleus is a spherical shape structure.

• Some cells have single nucleus, others have multiple eg. Skeletal muscle

• **Nucleolus:**
  - Structure that produces RNA.
  - A spherical cluster of protein, DNA & RNA
  - Visible when cell is not dividing
  - Prominent in cells that synthesise large amounts of protein

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**DNA = Deoxyribonucleic acid. DNA is a self replicating material present in nearly all living organisms as the main constituent of chromosomes. It is the carrier of genetic information**

**RNA = “Ribonucleic acid” (essential for genetics and protein synthesis)**
• The nucleus is surrounded by a double layered ‘Nuclear Membrane’ that separates the nucleus from cytoplasm.

• The membrane is continuous with the rough endoplasmic reticulum.

• The nuclear membrane contains nuclear pores for substance movement in/out of the nucleus.
Chromosomes

• Chromosomes are threadlike structures of nucleic acids and protein found in the nucleus of most living cells, carrying genetic information in the form of genes.

• Within the nucleus are most of the cells hereditary units called genes. Genes are arranged along chromosomes. (46 in a human somatic cell).

• Each chromosome is a long molecule of DNA. 6 feet of DNA per human cell.

• DNA forms a double helix which coils around proteins called histones.

• DNA is organised into compact, dense string-like fibres called chromatin.

• Just before cellular division the chromatin condenses even further and is subdivided into 46 individual molecules called chromosomes.

• Chromosome shape = when DNA coiled up.
Chromosomes

**Chromosome set**

**X and Y Chromosomes**

Determine gender

**XX** = Female

**XY** = Male

(Y chromosome is much smaller than X)

Therefore if there is a genetic disease on the single X chromosome the Y cannot counteract it which leads to some sex-linked, genetic diseases in males e.g. Haemophilia.
• **Subunits (portions of DNA) on the chromosomes are called genes** – many thousand per chromosome.

• A gene holds the information to build & maintain cells and pass genetic traits to offspring.

• All body cells (somatic cells) contain the full genome (full set of genes)

• ‘One gene = one protein’ hypothesis (1 gene contains recipe to make 1 protein)

• Only certain genes are working depending on the cells job (only certain genes are switched on)

• **Changes in the DNA = mutation**
Organelles: Cytoskeleton

- Network of protein filaments that extends through the cytosol

- Formed by microtubules and microfilaments

- Microfilaments are mostly at the periphery of the cell and help generate movement and provide support

- Microtubules are larger and as assembled in the centrosome

- The centrosome: Located near the nucleus, consisting of 2 centrioles at right angles to each other. Plays a critical role in cell division.

**Centro- = centre  
Soma = body**

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Organelles: Mitochondria

- Second largest organelle. ‘Bean shaped’

- **Powerhouse of the cell because they generate ATP** *(Adenosine Triphosphate)*. ATP is the energy currency of body cells

- One hundred to several thousand depending on cell activity *(what cells might be highest?)*

- Located near where oxygen enters cells (for example, towards periphery/outside) or where ATP is used in cell

- Double membrane with small fluid filled space between. Inner membrane has a series of folds called **cristae** which produces enormous surface area for reactions
Organelles: Mitochondria
Organelles: Ribosomes

- **Sites of protein synthesis**

- Name reflects high content of ribonucleic acid (RNA)

- Either free (“mobile”) in cytoplasm or bound to rough endoplasmic reticulum (“stationary”)

- Thousands per cell (25% cell mas)

- **Synthesise proteins for:** 1) Specific organelles 2) Insertion into plasma membrane 3) Export from cell.

- Free ribosomes make protein for inside cell, those on rough endoplasmic reticulum make protein for outside cell.
Organelles: Endoplasmic Reticulum (ER)

- A network of membranes in the form of flattened sacs

- Extends from the nuclear envelope through-out the cytoplasm (to plasma membrane)

- **Rough ER**: Continuous with nuclear membrane. Its outer surface is *studded with ribosomes* (hence rough appearance). Synthesises and transports proteins.

Organelles: Golgi Apparatus

• Located near the nucleus, but not as close as ER. Most cells have several golgi.

• It consists of 3-20 flattened membranous sacs called cisternae.

• Modifies, sorts, packages and transports proteins received from the rough ER.

• A transport vesicle that buds off from the rough ER moves towards the Golgi complex and releases proteins into its lumen. Enzymes modify the proteins and they bud off in transport vesicles.

“The Cell Post Office”

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Organelles: Lysosomes

- Special types of membrane enclosed vesicles.

- As many as **60 powerful enzymes** can break down a variety of molecules once fused with it.

- **Recycles worn out cell structures.** Engulfs organelle, digests it and returns components to cytosol for re-use.

- Most enzymes work within cell. Some operate in extracellular digestion. Eg. Sperm releases enzyme to assist entry into oocyte.

*Lyso = “loosen” or breakdown / Soma = body*
Organelles: Lysosomes
Toxins and Cells

- Toxins such as heavy metals (eg. Lead, mercury) are considered cytotoxic.

- One mechanism through which toxins can produce harmful effects is by producing highly reactive molecules contain oxygen. These can cause oxidative damage (damage of a structure by a species containing oxygen).

- Oxidative damage damages the cell membrane, cell organelles and even causes genetic mutation!

- The damage caused leads to cell death.

*cyto-* = cells
*toxic* = poison
Video & Summary Quiz!

Video: Cell Animation:
www.youtube.com/watch?v=URUJD5NEXC8

1) Define the term ‘homeostasis’
2) Briefly explain how a negative feedback system works and give one example
3) Describe the structure of the cell plasma membrane
4) Describe 2 functions of the cell plasma membrane
5) What is meant by the term ‘hydrophilic’?
6) How many chromosomes does a human have?
7) What is the main function of ribosomes?
8) What part of the cell is involved in energy (ATP) production?
9) What cell structure modifies and packages proteins?
10) What is the role of lysosomes?
Have a go at labelling this cell:
Cell Reproduction: Mitosis

Mitosis; from Greek, mitos, warp thread AND osis, process.

- **Somatic cells** reproduce this way to create 2 cells **identical** to original mother cell.
- Used for **growth & repair**.
- A full set of chromosomes is first **duplicated** and then evenly distributed into both daughter cells.
- **1 division creating 2 identical daughter cells**
Rates of Mitosis

- Different cells undergo mitosis at different rates
  - **Skin cells** – continuous mitosis
  - **Nerve cells/muscle cells/egg cells** - no mitosis soon after birth
  - **Liver cells** – do not undergo continual mitosis *unless* repairing minor damage.
  - Major liver damage (cirrhosis) may present too much damage to be repaired through simple mitosis.

We replace dead skin cells all the time...
Cell Reproduction: Meiosis

From Greek meioun, to diminish

• 2 divisions

• Creating 4 haploid cells = **GAMETES** (Sex Cells ie. Egg/sperm)

• **ALL gametes** have a **haploid nucleus**

• **ALL somatic** cells (**body cells**) have a **diploid nucleus**

Diploid (2n)= 46 Chromosomes.
Haploid (1n/n) = 23 Chromosomes
Cell Reproduction: Meiosis

- A gamete is a sex cell.
- Gametes are haploid cells.
- A female gamete = larger & immobile - called an Ovum (or egg).
- Male gamete = smaller & mobile - called a Sperm.
- Fertilisation (conception) = fusion of male & female gamete.
- This leads to the formation of a zygote = diploid cell (indicated by $2n$) which has two copies of each chromosome (23 pairs), usually one from the mother and one from the father.
- The zygote then undergoes mitosis & develops into the embryo and finally a foetus (after 8 weeks).

Q: How many chromosomes does a haploid cell contain?
## Cellular Reproduction

<table>
<thead>
<tr>
<th></th>
<th>MITOSIS</th>
<th>MEIOSIS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Number of divisions?</td>
<td>1 division</td>
<td>2 divisions</td>
</tr>
<tr>
<td>Number of daughter cells?</td>
<td>2</td>
<td>4</td>
</tr>
<tr>
<td>Number of chromosomes in daughter cells?</td>
<td>46</td>
<td>23</td>
</tr>
<tr>
<td>Diploid or haploid</td>
<td>Diploid</td>
<td>Haploid</td>
</tr>
<tr>
<td>Daughter cells - identical or different?</td>
<td>Identical</td>
<td>Different</td>
</tr>
<tr>
<td>End results</td>
<td>2 new identical, diploid body cells</td>
<td>4 unique, haploid reproductive cells</td>
</tr>
<tr>
<td>Purpose</td>
<td>Body cell growth and repair</td>
<td>Reproduction – making eggs and sperm (gametes)</td>
</tr>
</tbody>
</table>

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Mitosis & Meiosis

Video: Mitosis vs. Meiosis animation: www.youtube.com/watch?v=Ba9LXKH2ztU
Mutation

**Definition:** Change in the Genetic information (change in DNA sequence/ Number).

**NUCLEOBASES**
- Cytosine (C)
- Guanine (G)
- Adenine (A)
- Thymine (T)
- Uracil (U)

**Causes for mutations:**
- Chance (spontaneous mutations)
- Induced by mutagenic agents e.g. X-rays

Mutations **in gametes** (sex cells) are passed **on to offspring**. Mutations in somatic cells cannot be passed on/inherited.
Protein synthesis

- Cells use the DNA code as a template for the synthesis of a specific protein
- Some proteins help assemble cell structures (e.g., Plasma membrane), others are hormones, antibodies, enzymes etc.

**Occurs via the following process:**

1. **Transcription:**
   A copy of one gene from the DNA segment is made into mRNA. This then travels out of the nucleus to a ribosome where translation occurs.

2. **Translation:**
   The ribosome reads the code & synthesises a chain of amino acids to form the required protein.
Transport of materials across plasma membrane is essential to cell life
• Certain substances must move into the cell to support metabolism
### Passive Transport

**Crossing plasma membrane**

**Moving down the concentration gradient**

**NO energy required**

| DIFFUSION | FACILITATED DIFFUSION
| Protein-Mediated Transport | OSMOSIS |
| --- | --- | --- |
| • Movement of small substances from an area of **high** concentration to an area of **low** concentration  
  • Faster in larger gradients and warmer temps  
  • e.g. Transfer of O2 from lung alveoli (high) into the blood (low) | • Movement of larger substance from an area of **high** concentration to an area of **low** concentration with the aid of Protein carrier-molecules / sites in the membrane.  
  • Protein Carrier changes shape (forms a Protein Channel) & deposits the substance on the other side  
  • Carrier sites are specific (‘lock and key’ - one substance only!) and there is a transport maximum | • Movement of WATER down its concentration gradient when equilibrium cannot be achieved by diffusion (molecules usually too big!)  
  • Water dilutes the concentrated solution and concentrates the diluted solution to reach equilibrium |
| | • Occurs in Gases, Liquids & Solutions of Ions (Ca, Na & K) | • Used by substances unable to diffuse unaided e.g. Glucose, Amino acids & IONS |

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Passive Transport

Several factors affect diffusion rate:

1. Steepness of gradient
2. Temperature (higher increases speed of body processes eg. Fever)
3. Mass
4. Surface area

**Facilitated diffusion:**
- Substances that are too charged for diffusion.
- **Assisted by transmembrane protein**
- High to low concentration
- Includes potassium, chloride, sodium, calcium
- Glucose binds to specific membrane protein which alters shape to allow transport. Eg. Glucose binds to GLuT which releases it into cell.
Passive Transport

- Passive transport
  - Diffusion
  - Facilitated diffusion
- Active transport
  - ATP
### Active Transport

**Moving up the concentration gradient. Energy/ATP required**

Several ions eg. Sodium, potassium, **hydrogen, chloride**

**Carrier proteins = pumps**

| SODIUM-POTASSIUM PUMP | The transport of substances from an area of **low** concentration to **high** concentration  
Chemical energy (ATP) is used to activate Protein - Carrier Molecules to transport substances against/up the gradient (either direction).  
Carrier sites are specific (lock/key): the number of sites limits the transfer rate | Sodium  
Potassium  
Calcium  
Hydrogen |
|------------------------|-------------------------------------------------------------------------------------------------|--------------------------------------------------|
| ENDOCYTOSIS            | Particles are engulfed and enclosed by extensions of the Cytoplasm & Plasma membrane, forming a Membrane-bound Vacuole  
Lysoosomes adhere to the vacuole membrane, releasing enzymes to digest the contents  
**Phagocytosis** - ‘Cell Eating’ large particles  
**Pinocytosis** – ‘Cell Drinking’ small particles | Liquids  
Microbes  
Cell Fragments |
| PHAGOCYTOSIS & PINOCYTOSIS | **EXOCYTOSIS**  
Removal of WASTE MATERIAL  
Reverse phagocytosis | Secretory granules formed by the Golgi apparatus  
Indigestible residue of phagocytosis |

Think about pushing a trolley uphill instead of down. Requires more energy!
Active Transport

Video: Active v Passive Transport:
www.youtube.com/watch?v=2-icEADP0J4
Histology

*Tissue = groups of cells that work together to perform a function.*

**Cell Junctions** = contact/communication points between the adjacent plasma membranes of tightly packed cells. Key types include:

1. **Tight Junctions**
   - Strands of transmembrane protein fuse the outer surfaces of the cells together to reinforce the junctions & seal off passageways
   - Found in the *stomach, intestines & bladder*
   - Prevents the contents of these organs leaking into blood/other tissues

2. **Gap Junctions**
   - **Small fluid filled tunnels** between neighbouring cells. Eg muscle/nerve

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Histology

The structure is closely related to its function
- e.g. Skull bones are tightly joined for protection
- e.g. Fingers bones are loosely joined for movement
Epithelial Tissue

- **Epithelial Tissue** = Covering / Lining Tissue

- Consists of **closely packed cells** arranged in continuous sheets, in either single or multiple layers.

- Divided into covering and glandular

- **Functions**: Selective barrier, secretions and protection

- **Where do we find them**: Blood vessels, Heart, Lungs, Bladder/urinary tract, Gastrointestinal tract (GIT), Skin, Eyes, Reproductive organs

Source: www.quizlet.com/53222361/44-epithelial-tissue-quiz-1-flash-cards
Glands

- A single cell or groups of epithelial cells that produce secretions.

- **Exocrine Glands**: Secrete their products **into ducts**. Secretions include saliva, milk, sebum, sweat, enzymes

- **Endocrine glands**: Enter interstitial fluid and then diffuse **into blood**. Includes hormones
Connective Tissue

- **Highly vascular.** One of the most abundant and widely distributed tissues in the body (e.g. Blood, cartilage etc.)

**Consists of two basic elements:**

1) **Extracellular matrix:**
   - Made of Ground substance and Fibres.
   - Ground substance is between cells and may be fluid, semi fluid or calcified
   - Contains water and an assortment of materials including Hyaluronic acid and Chondroitin sulphate

2) **Cells:**
   - The cells are widely spaced unlike epithelium
## Fibres

<table>
<thead>
<tr>
<th>Collagen fibres</th>
<th>Elastic fibres</th>
</tr>
</thead>
<tbody>
<tr>
<td>Made from the protein <strong>collagen</strong></td>
<td>Made from the protein <strong>elastin</strong> surrounded by a layer of the <strong>glycoprotein</strong> - to add strength</td>
</tr>
<tr>
<td><strong>Strong fibres</strong> which resist pulling forces</td>
<td><strong>Smaller diameter</strong> than collagen fibres</td>
</tr>
<tr>
<td>Especially in bone, ligaments, tendons</td>
<td><strong>Strong but stretchy.</strong> Allow tissue to return to original shape (can stretch to 150% of normal length)</td>
</tr>
<tr>
<td>Occur in <strong>parallel bundles</strong> for extra strength</td>
<td>In skin, blood vessel walls, lung tissue</td>
</tr>
</tbody>
</table>
Connective Tissue Cells

1. **Fibroblasts:**
   Large, most numerous cells. **Secrete protein fibres to make collagen, elastin & matrix.** Active in repair & healing.

2. **Adipocytes:** Store **triglycerides (fat)**

3. **Leukocytes (white blood cells):**
   - **Macrophages** - Phagocytose debris & pathogens. Initiate defence mechanisms.
   - **Plasma Cells** - Synthesise and secrete antibodies for defence
   - **Mast Cells** - Mostly alongside blood vessels. Produce & release heparin, histamine & other substances (inflammation)

*adipo = fat*  
*cyte = cell*
Connective Tissue Functions

1. **Structural** framework (bone, cartilage)
2. **Transport** nutrients and wastes (blood)
3. **Protection** for vital organs (bone, cartilage, adipose)
4. **Support** and **interconnection** (tendons, ligaments etc.)
5. **Insulate**
6. **Store energy**
7. **Produce blood** and **lymphatic cells** (adipose tissue, bone marrow)
8. **Defense** and **repair** (blood, lymph)
Connective Tissue Summary

Connective Tissue

Extracellular matrix
- Ground Substance
- Fibres

Cells
- Leukocytes
- Fibroblasts
- Adipocytes
Membranes

• Flat sheets of pliable tissue that cover or line part of the body

4 TYPES OF MEMBRANES:
1. Synovial (not epithelial membrane)
2. Cutaneous
3. Mucous
4. Serous

Synovial = a lubricating fluid found in many joints
Cutaneous = Latin for skin
Mucous = a secretion lining mucous membranes
Serous = a thin watery fluid

• An epithelial membrane constitutes an epithelial layer with an underlying connective tissue layer
Membranes

- **SYNOVIAL Membrane**: Layers of connective tissue & elastic fibres which line the cavities of moveable joints & surround tendons

- **EPITHELIAL Membrane**: Sheets of epithelial & connective tissue covering internal structures / cavities

  - **Cutaneous Membrane**
  - **Mucous Membrane**
  - **Serous Membrane**
Cutaneous/Mucous Membranes

1. **Cutaneous Membrane** - skin

2. **Mucous Membrane** (mucosa)
   - Lines entire digestive, respiratory & genitourinary tracts (open to exterior)
   - Secretes enzymes needed for digestion and is the site for absorption
   - Epithelial layer contains **goblet cells** that produce & secrete **mucus** – a slimy tenacious fluid, which:
     1. **Protects** the lining membrane from mechanical & chemical injury/drying
     2. **Traps** foreign particles in the respiratory tract

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3. **Serous Membrane**: Lines a body cavity that does not open to exterior

- **Double layer** of loose **areolar** connective tissue:
  1. **Parietal layer** lines a cavity
  2. **Visceral layer** surrounds organs (viscera) within the cavity

- **Serous fluid** secreted by the epithelium.
- Serous fluid enables an organ to glide freely within the cavity without frictional damage
Serous Membranes

3 sites where serous membranes are found (3 types):

1. **Pleura**: lining the **thoracic cavity** and surrounding the **lungs**

2. **Pericardium**: lining the **pericardial cavity** & surrounding the **heart**

3. **Peritoneum**: lining the **abdominal cavity** and surrounding abdominal organs as well as some pelvic organs

Remember that each of these contain a parietal and visceral layer..
Synovial Membranes

- **NOT** an epithelial membrane!

- Lines cavities of freely movable joints

- Consists of synviocytes that secrete synovial fluid

- Secretes clear, sticky, oily, **synovial fluid** which lubricates & nourishes the moveable joint cavities which it lines.

- Also surrounds tendons that could be injured by rubbing against bones e.g. over the wrist joint

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Summary Quiz!

1. Briefly describe what the process mitosis produces
2. Meiosis is a process that produces what type of cells?
3. Define the term ‘mutation’
4. State two major differences between passive and active transport
5. What component of a cell membrane is essential for facilitated diffusion
6. What is transported via osmosis?
7. An endocrine gland secretes its products into ducts (True or false)
8. Name 2 fibres found in connective tissue
9. Name the main systems of the body where mucous membranes exist
10. Name the membrane surrounding the lungs