

# HUMAN BIOLOGY

## Topic 1. Cell Structure & Function

### Exam-Ready Study Notes

Designed to replace hours of lecture rewatching and make revision faster, clearer, and less overwhelming.

### WHAT YOU'LL GET



**Clear,  
structured  
explanations**



**Custom  
diagrams &  
breakdowns**



**Simplified  
biological  
processes**



**Linked concepts  
& big-picture  
understanding**

Aligned with BIOL1008 (Human Biology)

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# ORGANISATION AND COMPLEXITY

## 1.1 EVOLUTION AND CELL THEORY

### EVOLUTION

Evolution explains how the **structure and function** of cells, tissues, organs, and organ systems have **adapted and changed over millions of years**.

Over time, **natural selection favoured traits** that improved survival and reproductive success, which led to the **specialised** cellular and physiological **adaptations** we see in living organisms today.



Together, evolution and cell theory **form the foundation of human biology** by explaining how living organisms are **organised**, how physiological processes **occur**, and how specialised structures and functions **evolved**.

### CELL THEORY

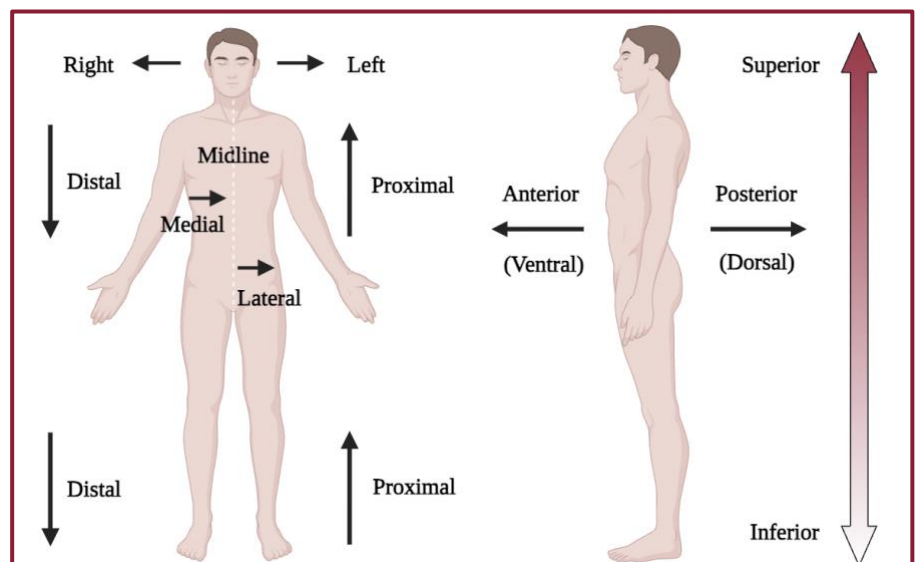
Cell theory describes the **core properties** of living organisms:

1. All living organisms are made of cells.
2. Cells are the basic structural and functional units of life.
3. Cells come from pre-existing cells.

## 1.2 ANATOMICAL POSITION

The anatomical position is a **reference position** used to describe the body.

This terminology provides a **standardised** way to communicate body structures consistently and accurately.



### 1.3

## BODY FLUID COMPARTMENTS

### Extracellular

The fluid located **outside** cells, including:

- ◆ **Interstitial fluid:** This is the fluid between cells that surrounds and bathes tissues.
- ◆ **Plasma:** This is the fluid component of blood. It transports nutrients, hormones, gases and waste.

The body is divided into **fluid compartments** that help maintain balance by regulating the movement of water, nutrients, ions, and waste products.

### Intracellular

The fluid located **inside** cells:

- ◆ Makes up ~2/3 of the total body fluid
- ◆ Rich in potassium (K<sup>+</sup>)

### 1.4

## LEVELS OF BIOLOGICAL ORGANISATION

The human body is organised into **increasingly complex** levels of structure, allowing specialised functions to work together to maintain life.



**Complexity** refers to the intricate interactions between various systems and levels of organisation that ensure that the body functions cohesively.

### CELLS

Basic and **functional units of life** (e.g. muscle cells, neurons).

### TISSUES

**Groups of similar cells** working together to perform specific functions.

- ◆ **Epithelial** → **cover** surfaces, **line** cavities & **form** glands (e.g., skin, glands)
- ◆ **Connective** → **supports, binds & protects** structures (e.g., bone, blood, fat)
- ◆ **Muscle** → contracts & relaxes to **create movement** (skeletal, cardiac, smooth)
- ◆ **Nervous** → receives stimuli and transmits **signals** (e.g., brain, nerves)

### ORGANS

Structures that are made up of **combined tissues** to perform specialised functions (e.g., stomach, heart, lungs).

### ORGAN SYSTEMS

Groups of **organs working together** to perform **major body functions** (e.g., digestive, circulatory, respiratory). These systems **interact continuously** to maintain homeostasis and support survival.

# CELL STRUCTURE AND FUNCTION

2.1

## INTRODUCTION TO CELLS



**Cells are the basic units of life** (~37 trillion cells in the human body) and represent the smallest structures that are capable of carrying out all essential life processes.

The two major classes of cells are **prokaryotes** and **eukaryotes**.

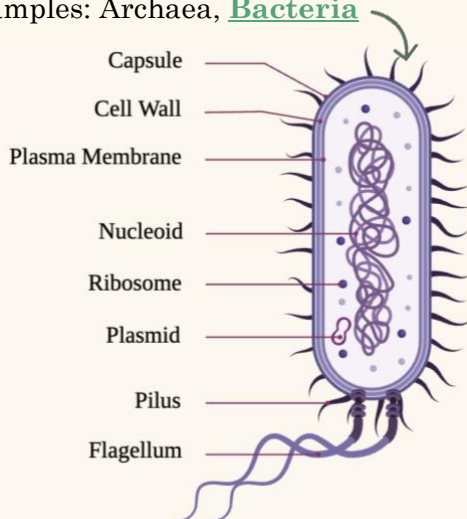
### PROKARYOTES & EUKARYOTES

The key distinction is that **eukaryotic cells compartmentalise functions within organelles**, which allows for more **complexity**, whereas prokaryotic cells lack this internal organisation.

#### PROKARYOTIC CELLS

- ◆ No true nucleus
- ◆ 1-10um (**smaller**)
- ◆ No membrane-bound organelles
- ◆ Circular DNA with a single chromosome
- ◆ Smaller (70S) ribosomes
- ◆ Cell wall is usually present
- ◆ **Simpler**

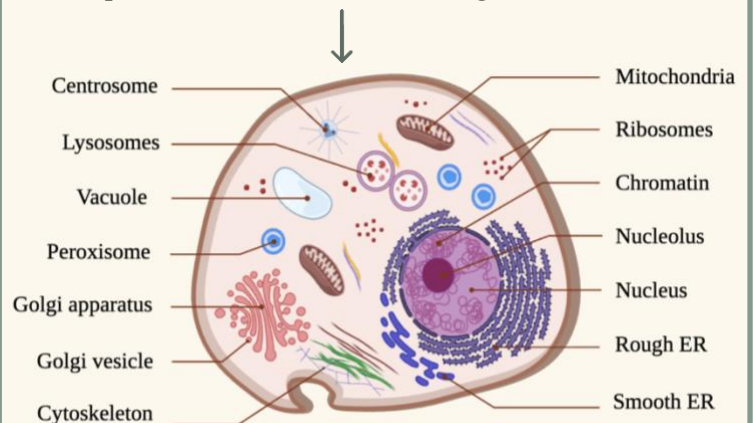
Examples: Archaea, **Bacteria**



#### EUKARYOTIC CELLS

- ◆ True nucleus
- ◆ 10-100um (**bigger**)
- ◆ **Membrane-bound organelles** present
- ◆ Linear DNA with multiple chromosomes
- ◆ Larger (80S) ribosomes
- ◆ Cell wall is absent in animals, but present in plants (cellulose)
- ◆ **More complex**

Examples: Plants, **Animals**, Fungi, Protists



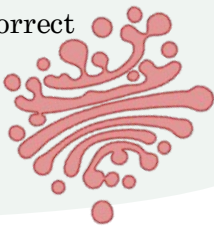


The membrane-bound organelles found inside eukaryotic cells each **carry out specialised cellular functions**. The organelles below are especially important for energy production, transport, support, and genetic control.

### GOLGI APPARATUS

**Structure:** Consists of flattened membranous sacs called **cisternae**.

**Function:** **Processes, sorts, and packages proteins and lipids** that have been synthesised in the ER. It directs them to their correct destinations inside or outside the cell.



### MITOCHONDRIA

**Structure:** Mitochondria have a **double membrane**, with the inner membrane folded into cristae to **increase surface area**.

**Function:** As the “**powerhouse of the cell**”, mitochondria **produce ATP** through cellular respiration, providing energy for the cell. They also play roles in **apoptosis** (programmed cell death) and cellular **metabolism**.



Mitochondria have their **own DNA** and replicate by fission.



### ENDOPLASMIC RETICULUM (ER)

**Structure:** The ER is a network of **membranous tubules** and **sacs**. It comes in two forms: rough ER (with ribosomes) and smooth ER (without ribosomes).

**Function:**

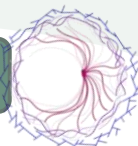
- **Rough ER:** Involved in **protein synthesis** and **folding**.
- **Smooth ER:** Involved in the **production of lipids** and **steroid hormones**.



### CYTOSKELETON

**Structure:** Made up of **microfilaments, intermediate filaments, and microtubules**.

**Function:** The network of filaments and tubules provides **structural support**, facilitates **intracellular transport**, and enables **cell movement**.



### NUCLEUS

**Structure:** Surrounded by a double membrane called the **nuclear envelope**, which contains nuclear pores.

**Function:** Acts as the **control centre of the cell**, containing the genetic material (DNA) and regulating all cellular activities, including growth, metabolism, and reproduction.

**The nucleolus:** The site of **RNA transcription** and **ribosome biogenesis**.

