

Chapter 5 - Tissues, Organs, and Organ Systems

5.1. The Levels of Organisation:

The levels of organisation in biological systems explain how smaller structural units combine to form larger and more complex structures. For example, heart cells make up cardiac muscle, which groups up to form the heart, which groups to form the cardiovascular system.

All kinds of cells in different systems are specialised in performing functions specific to their system and structure. For example, the cells in the nervous system (neurons) are specialised for their function and not for the cells present in the gastrointestinal system.

- **Atomic Level:** The smallest unit of an element (Carbon, Hydrogen, etc.)
- **Molecular Level:** atoms combine to make molecules, which contain different properties (DNA, water)
- **Organelle Level:** biomolecules assemble in a way to form organelles, i.e., nucleus, ribosome, etc.
- **Cellular Level:** the smallest unit of life in an organism, which has certain actions to perform. E.g., muscle cells, neurons, etc.
- **Tissue Level:** groups of cells with similar functions (connective tissue, muscle tissue)
- **Organ Level:** Two or more types of tissue grouping together to form an organ (heart, lungs)
- **Organ System Level:** A Group of multiple organs that perform related functions (nervous system, cardiovascular system)
- **Organism Level:** When all organ systems and functions come together, they form an organism- human, animal or plant

5.1.1. Organs:

They are made of two or more types of tissues organised to serve a particular function. Examples:

- **Heart:** Pumps blood.
- **Lungs:** Bring in oxygen and eliminate carbon dioxide.
- **Stomach:** Digests food.
- **Skin:** Protects internal structures from the environment.

Most organs contain all four tissue types:

- **Epithelial tissue:** Lines organs.
- **Connective tissue:** Supports and binds.
- **Muscle tissue:** Facilitates movement.
- **Nervous tissue:** Controls communication.

Example: In the case of the stomach, all four tissues are present. Epithelial tissue lines the inner lining of the stomach. Connective tissue is found in the walls of the stomach, which provides strength by containing blood vessels. Muscle tissue is also in the layering of walls, smooth muscle. Nervous tissue controls the secretion of digestive substances in different circumstances.

5.1.2. Organ Systems:

Organs work together in systems to perform specific functions. Examples:

- **Cardiovascular system:** Heart and blood vessels circulate blood and transport oxygen and nutrients

Organ Systems Work Together: Multiple organ systems also work together in harmony to continue bodily functions. Example: Respiratory System + Circulatory System:

- The respiratory system supplies oxygen to the blood and removes carbon dioxide.
- The circulatory system transports oxygenated blood to cells and removes carbon dioxide from tissues.

5.2. Homeostasis

To maintain optimum conditions- 37°C The ability to maintain a stable internal environment despite external changes. Key factors include body temperature, pH, and ion concentration (glucose levels) Importance: Deviations from set levels can lead to illness.

5.2.1. Maintenance of Homeostasis

Biological systems use feedback loops to maintain balance. Examples:

- During exercise, muscles increase heat production, raising body temperature. Homeostasis brings it back to normal.
- Drinking sugary drinks raises glucose levels, which are regulated to maintain balance.

5.2.2. Temperature Regulation

If the temperature rises above the set point, the body starts its defence mechanism (homeostasis) to bring it down to normal. The main factors are sweating and heavy breathing. Example of a negative feedback loop:

- **Stimulus:** Body temperature exceeds 37°C.
- **Sensors:** Nerve cells detect temperature rise.
- **Control:** The brain (hypothalamus) processes this information.
- **Effectors:** Sweat glands cool the body through evaporation.

5.3. Plant Tissues

Plant tissues are composed of similar cells performing a specific function, similar to animal tissues. Types of plant tissues:

- **Dermal Tissue:** Covers and protects the plant.
- **Ground Tissue:** Photosynthesis and nutrient storage.
- **Vascular Tissue:** Transports water and nutrients.

5.3.1. Plant Organs and Organ Systems

Plant organs include leaves, stems or roots. They perform a specific function related to their structure. Vascular plants are plants with specialised tissues (xylem and phloem) for transporting water and food nutrients. Organ systems of vascular plants:

- **Root System:** Absorbs water and nutrients from underground soil to absorb water and nutrients.
- It also serves as a storage site for food
- **Shoot System:** This includes the vegetative site—leaves and stems for photosynthesis and transport—and the reproductive site, which includes flowers and fruits.

Example:

- Leaves capture sunlight for photosynthesis.

5.3.2. Structure and Function of a Leaf

Leaves are the site responsible for photosynthesis, where each of the cells is specialised for a specific function. Develop laterally at nodes and are part of the shoot system. Involved in two key processes: 1) food synthesis for plants, and 2) water and gas exchange. Components:

- **Epidermis:** a single layer of cells forming the outermost layer and covering the leaf, coated with cutin
- **Cutin:** Outer layer of epidermis with a waxy cuticle to prevent water loss. It covers the upper epidermis.
- **Stomata:** present on the lower epidermis, enclosed by two guard cells
- **Guard Cells:** Control opening and closing of stomata for gas exchange (oxygen, carbon dioxide)
- **Palisade mesophyll:** cylindrical cells rich in chloroplasts
- **Spongy mesophyll:** loosely arranged cells with large intercellular spaces, facilitating gaseous exchange
- **Xylem:** transports water from roots to leaves, present in dead cells/wood cells.
- **Phloem:** transports food from leaves to other parts of the plant for nutrients
- Xylem and phloem together make the vascular bundle