Unit 2

Unit 2: Organization in the Living World

This unit focuses on the basic structure of living organisms, starting from the cellular level, and covers the concept of tissues and organ systems. Here's a detailed breakdown of key concepts that will help you prepare thoroughly.

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1. The Cell – Basic Unit of Life

A **cell** is the smallest structural and functional unit of life. All living organisms are made up of cells, which can either be **unicellular** (composed of a single cell, e.g., bacteria) or **multicellular** (composed of many cells, e.g., humans).

Types of Cells:

- **Prokaryotic Cells**:
  - These cells do not have a well-defined nucleus.
  - Example: Bacteria.
- **Eukaryotic Cells**:
  - These cells have a well-defined nucleus and other membrane-bound organelles.
  - Example: Plant and animal cells.

Components of a Cell:

1. **Cell Membrane**:
   - Thin, flexible barrier around the cell.
   - Controls the movement of substances in and out of the cell.
2. **Nucleus**:
   - The control center of the cell.
   - Contains genetic material (DNA) which regulates cell activities.
3. **Cytoplasm**:
   - Jelly-like substance inside the cell where organelles are suspended.
4. **Mitochondria**:
   - Known as the "powerhouse" of the cell.
   - Produces energy in the form of ATP (Adenosine Triphosphate).
5. **Ribosomes**:
   - Responsible for protein synthesis.
6. **Endoplasmic Reticulum (ER)**:
   - **Smooth ER**: Synthesizes lipids.
   - **Rough ER**: Has ribosomes attached and is involved in protein synthesis.
7. **Golgi Apparatus**:
   - Modifies, sorts, and packages proteins for secretion.
8. **Chloroplast** (only in plant cells):
   - Site of photosynthesis, containing chlorophyll.
9. **Vacuole**:
   - Stores water, nutrients, and waste products.
   - Larger in plant cells than in animal cells.
10. **Lysosomes**:

- Contains digestive enzymes to break down waste materials.

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2. Tissues

Tissues are groups of similar cells that perform a specific function. In multicellular organisms, tissues organize into organs and organ systems.

Types of Animal Tissues:

1. **Epithelial Tissue**:
   - Forms the outer covering of organs and the body.
   - **Types**: Squamous, Cuboidal, Columnar, Ciliated.
   - Functions: Protection, absorption, secretion.
2. **Connective Tissue**:
   - Binds different tissues and supports the body.
   - Types: Blood, Bone, Cartilage, Areolar, Adipose (fat tissue).
3. **Muscle Tissue**:
   - Responsible for movement.
   - Types: **Skeletal muscle** (voluntary control), **Smooth muscle** (involuntary control), **Cardiac muscle** (found in the heart).
4. **Nervous Tissue**:
   - Conducts electrical impulses.
   - Composed of neurons that transmit signals between the brain and other body parts.

Types of Plant Tissues:

1. **Meristematic Tissue**:
   - Actively dividing tissue found in the growing regions of plants (tips of roots and shoots).
2. **Permanent Tissue**:
   - Tissues that no longer divide. They are specialized to perform specific functions.
   - **Types**:
     - **Simple Permanent Tissue**: Composed of one type of cell (e.g., Parenchyma, Collenchyma, Sclerenchyma).
     - **Complex Permanent Tissue**: Composed of more than one type of cell (e.g., Xylem, Phloem for conduction of water and nutrients).

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3. Organs and Organ Systems

An **organ** is a structure composed of different types of tissues that work together to perform a specific function. Multiple organs form **organ systems** to carry out complex functions.

Major Organ Systems:

1. **Digestive System**:
   - Function: Breakdown of food into nutrients.
   - Main Organs: Mouth, esophagus, stomach, intestines, liver.
2. **Respiratory System**:
   - Function: Exchange of gases (oxygen and carbon dioxide) between the body and the environment.
   - Main Organs: Nose, trachea, lungs.
3. **Circulatory System**:
   - Function: Transports nutrients, gases, and wastes throughout the body.

- Main Organs: Heart, blood vessels, blood.

4. **Excretory System**:
   - Function: Removal of waste products from the body.
   - Main Organs: Kidneys, ureters, urinary bladder, urethra.
5. **Nervous System**:
   - Function: Controls and coordinates body functions.
   - Main Organs: Brain, spinal cord, nerves.

Key Processes

Diffusion and Osmosis:

- **Diffusion**: The movement of particles from an area of high concentration to an area of low concentration.
  - Example: The spread of oxygen from the lungs into the bloodstream.
- **Osmosis**: A special type of diffusion where water moves across a semi-permeable membrane from a region of lower solute concentration to higher solute concentration.
  - Example: Absorption of water by plant roots.

Photosynthesis:

- The process by which green plants make their food using sunlight, carbon dioxide, and water. Occurs in the **chloroplasts** of plant cells.

$$6CO_2 + 6H_2O \xrightarrow{\text{Sunlight}} C_6H_{12}O_6 + 6O_2$$

- **Products**: Glucose (stored as starch) and Oxygen.

Important Terms

- **Cytoplasm**: Gel-like substance within the cell membrane containing organelles.
- **Endoplasmic Reticulum**: Network of membranes involved in protein and lipid synthesis.
- **Chlorophyll**: The green pigment in plants that captures sunlight for photosynthesis.
- **Neuron**: A nerve cell responsible for transmitting electrical signals.