Lec. 1 # Cells & Basic Tissues

Aim

To explain the human body at a microscopic level, including the structure and function of cells, tissues and membranes.

THE CELL

All living matter is composed of functional units called cells. At one end of the scale in the animal kingdom, there are unicellular organisms composed of a single cell (eg. Protozoa or Amoeba). In an amoeba all the vital processes of the animal take place inside a single cell.

Cells are capable of digesting food, growing, respiring, excreting, secreting, reproducing and responding to stimuli. All these things happen in a single-celled animal.

At the other end of the scale, there are the multi-cellular organisms such as the higher animals and humans. In these organisms, the cells become specialized, and one or more of these different functions may be lost.

Parts of the Human Cell

The various parts of the human cell and their functions are:

1. Cell Membrane

Phospholipid bilayer containing cholesterol and proteins (integral and peripheral) and some carbohydrates (externally); forms a selectively permeable boundary of the cell. Function: Acts as a physical barrier to enclose cell contents; regulates material movement into and out of the cell; establishes and maintains an electrical charge difference across the plasma membrane; functions in cell communication.

2. **Nucleus**
   Large structure enclosed within a double membrane; contains chromatin, nucleolus, and nucleoplasm. Houses the DNA that serves as the genetic material for directing protein synthesis.
3. **Nucleolus**
   A spherical body inside a nucleus. Function: The nucleolus is involved in the synthesis and storage of ribosomal RNA.

4. **Cytoplasm**
   This is the fluid inside the cell which contains salts and sugars in solution.

5. **Golgi apparatus**
   The dynamic organelle stores food inside the cell. Also note the fat droplets which float about in the cytoplasm and are also a means of storing food in the form of fats. Also called Golgi complex. Function: Modifies, packages, and sorts materials that arrive from the ER in transport vesicles; forms secretory vesicles and lysosomes.

6. **Lysosomes**
   Spherical-shaped membrane bound organelles formed from the Golgi apparatus; contain digestive enzymes. Function: Digest microbes or materials (eg, ingested by the cell, worn-out cellular components, or the entire cell)
7. **Centrosome**
   Amorphous region adjacent to nucleus; contains a pair of centrioles. Function: Organizes microtubules; participates in mitotic spindle formation during cell division.
8. **Mitochondria**
   Double membrane-bound organelles containing a circular strand of DNA (genes for producing mitochondrial proteins). Function: Synthesize most ATP during aerobic cellular respiration by digestion of fuel molecules (eg, glucose) in the presence of oxygen.

9. Rough Endoplasmic Reticulum (RER)

Extensive interconnected membrane network that varies in shape (eg, cisternae, tubules); ribosomes attached on cytoplasmic surface. Function: Modifies, transports, and stores proteins produced by attached ribosomes; these proteins are secreted, become components of the plasma membrane, or serve as enzymes of lysosomes.

10. Smooth Endoplasmic Reticulum (SER)

Extensive interconnected membrane network lacking ribosomes. Function: Synthesizes, transports, and stores lipids (eg, steroids); metabolizes carbohydrates; detoxifies drugs, alcohol, and poisons; forms vesicles and peroxisomes.

11. Microtubule

Hollow cylinders composed of tubulin protein. Function: Maintain cell shape and rigidity; organize and move organelles; support cilia and flagella; participate in vesicular transport; separate chromosomes during the process of cell division.

12. Microvilli

Numerous thin membrane folds projecting from the free cell surface; supported by microfilaments. Function: Increase membrane surface area for greater absorption.

13. Cilia

Short, numerous membrane extensions supported by microtubules, which occur on exposed membrane surfaces of some cells. Function: Move substances (eg, mucus, and dissolved materials) over the cell surface.

14. Nuclear Envelope

Double membrane boundary between cytoplasm and nuclear contents; continuous with rough endoplasmic reticulum. Function: Separates nucleus from cytoplasm.

15. Peroxisome

Smaller, spherical-shaped membrane-bound organelles formed from the ER or through fission; contain oxidative enzymes. Function: Detoxify specific harmful substances either produced by the cell or taken into the cell; engage in beta oxidation of fatty acids to acetyl CoA.

16. Microfilament

Actin protein monomers organized into two thin, intertwined protein filaments (actin filaments). Function: Maintain cell shape; support microvilli; separate two cells during cytokinesis (a process of cell division); facilitate change in cell shape; participate in muscle contraction.

17. Free Ribosomes

An organelle suspended in cytoplasm that synthesizes proteins. Contains ribosomal RNA and ribosomal proteins. Function: Engage in protein synthesis: Bound ribosomes produce proteins that are secreted, incorporated into plasma membrane, and within lysosomes; free ribosomes produce proteins used within the cell

18. Inclusions

Aggregates of specific types of molecules (eg, melanin protein, glycogen, or lipid). Function: Serve as temporary storage of melanin protein, glycogen, or lipid.

FROM CELLS TO BODIES

Humans are multi-cellular organisms. The single cells, many of which are specialized so that they can perform a particular function, are grouped together to form **tissues**. These tissues in turn form special groups called **organs**. The groups of organs make up a **system**, and the systems join together to form a **living body**.

HUMAN TISSUES

There are five basic types of tissue found in humans:

1. Epithelial tissues

2. Connective tissues
3. Fluid tissues
4. Muscle tissues
5. Nervous tissues

1. Epithelial tissues

These are formed from cells which join together to form covering layers, for example, the skin covering the body. This type of tissue also forms the covering layers of various organs in the body; the lining of the body cavities and the active parts of the glands of the body. Epithelial tissues are made up of specialized cells of various shapes.

2. Connective tissues

This is the tissue which joins other tissues together. Connective tissues give form and strength to many organs, and often serve for protection and leverage. Examples of connective tissue are: bones; tendons; ligaments; cartilage and fat.

3. Fluid tissues

These tissues transport food nutrients and waste products around the body. Blood is a good example of a fluid tissue.

4. Muscle tissues

There are three types of muscle tissues:

1. **Striated or voluntary muscle tissue** which is the type found in your arms and legs and which you can rest as you wish. Skeletal muscle is made up of striated muscle fibers supported by connective tissues attached to bone by tendons or an aponeurosis, and stimulated by nerves;
2. **Smooth or involuntary muscle tissue** works automatically and cannot be controlled by you. Involuntary muscle tissue would be found in the muscle in the intestine which moves food along though the gut.
3. **Cardiac muscle tissue** is also involuntary and cannot be

controlled by you. This type of muscle tissue is found in the heart. Muscle tissue is made so that it can **expand and contract**. You contract (shorten) the muscles of your arm when you pick up a brick and expand (lengthen) them when you stretch out your arm. The involuntary muscles of the body expand and contract on their own (think how your heart beats without your control).

5. Nervous tissue

The nerve cells which make up this tissue are sensitive to stimuli, such as heat and touch. They can link up charges and transmit impulses through the nervous system.

These are the different types of tissues, but remember that, although they are different from each other because they perform different functions, **they are all made up of cells.** These cells are the basic units of life. They take in food or nutrients, utilize the nutrients and produce energy and waste products. That is the basic process of living - the breakdown of food into energy and waste products. This process goes on in plants and animals (including humans).

CELL DIVISION

Cell growth occurs by a single cell dividing to reproduce two cells. This process can occur by either of two different methods; either mitosis or meiosis.

Mitosis is a process involving one parent cell, where the new cells are identical copies of the cell which they came from (ie. the parent cell). This process is involved in normal growth processes of an organism such as: An organism growing bigger throughout its life.

- An organism replacing dead or discarded cells (rejuvenation).

Meiosis is a process that occurs only during sexual reproduction.

It involves two parents, and two successive divisions or two phases, resulting in new cells which are NOT identical to the parents.