

RAD 223

Radiography physiology

Lecture Notes

First lecture: Cell and Tissue

Physiology: the word physiology derived from a Greek word for study of nature. It is the study of how the body and its part work or function.

Homeostasis

When structure and function are coordinated the body achieves a relative stability of its internal environment called homeostasis / staying the same. Although the external environmental changes constantly, the internal environment of a healthy body remains the same within normal limits.

Under normal conditions, homeostasis is maintained by adaptive mechanisms ranging from control center in the brain to chemical substances called hormones that are secreted by various organs directly into the blood streams. Some of the functions controlled by homeostasis mechanisms are blood pressure, body temperature, breathing and heart rate.

Cell

Cells are the smallest independent units of life. All life depends on the many chemical activities of cells. Some of the basic functions of cell are: growth, metabolism, irritability and reproduction.

Cell is the basic living structural and functional unit of the body.

Cytology: - It is a branch of science concerned with a study of cells

Cell Theory explains about

- a) All living organisms are composed of cell and cell products.
- b) Cell is the basic unit of structure & function of all living organisms.
- c) All cells come from the division of pre existing cell.
- d) An organism as a whole can be understood through the collective activities & interactions of its cells.

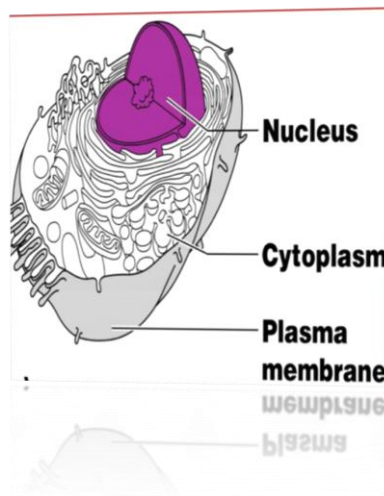
To know more about cell, we can divide the cell in to three principal parts: -

Plasma (cell) membrane: it is the outer lining, limiting membrane separating the cell internal parts from extra cellular materials & external environment.

Cytoplasm: cytoplasm is the substance that surrounds organelles and is located between the nucleus and plasma membrane

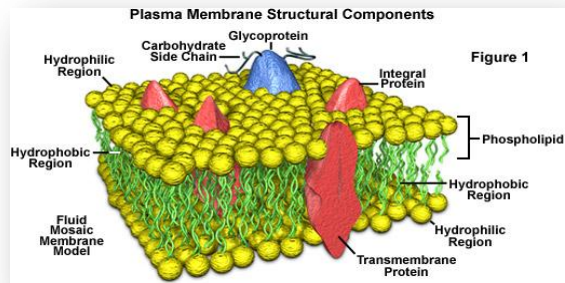
Organelles: these are permanent structures with characteristic morphology that are highly specialized in specific cellular activity.

Extra cellular materials are also referred to as the matrix, which are substances external to the cell surface.



Plasma Membrane

Plasma membrane is a thin outer membrane, which maintains the integrity of the cell. It keeps the cell and its contents separate and distinct from the surrounding. It is a double layered measuring about 4.5 nm and made of phospholipids, cholesterol, glyco-lipid, & carbohydrate (oligosaccharides). The bi-layer is self-sealing. If a needle is injected and pulled out, it automatically seals.



Functions: -

1. Separate the cytoplasm inside a cell from extra cellular fluid.
2. Separate cell from one another
3. Provide an abundant surface on which chemical reaction can occur.
4. Regulate the passage of materials in to and out of cells. It also let some things in and keeps others out. The quality selective permeability

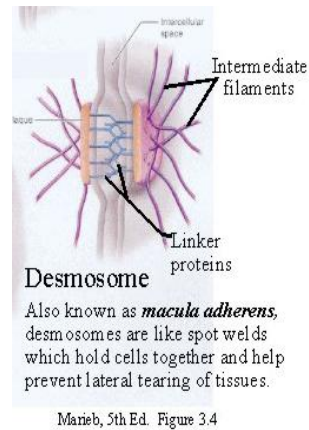
Membrane junctions

- Membrane junctions are divided into:

1. Tight junction

- Impermeable junctions which binds cells together acting as a leak proof sheet
- prevents passage of substances through the extracellular space
- E.x tight junctions in the small intestine prevents digestive enzymes from leaking into the blood

1. Desmosomes:



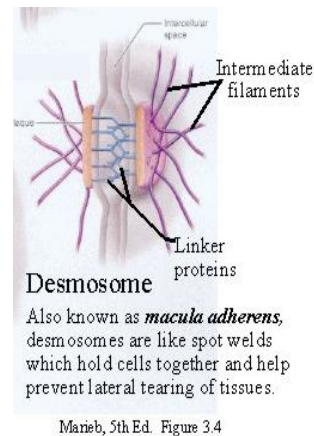
1. Gap junction:

- Allows communication between cells
- Chemicals (nutrients, ions..) can pass from one cell to the other
- Found in:
 - Between heart cells
 - Between embryonic cells

Cytoplasm

Cytoplasm is a matrix or ground substance in which various cellular components are found. It is thick semi transparent, elastic fluid containing suspended particles and a series of minute tubules and filaments that form cytoskeleton. Water constitutes 75-90% of the cytoplasm. It also contains solid components, proteins, carbohydrates, lipids and inorganic substances. The inorganic components exist as solutions because they are soluble in water. The majority of organic substances however are found as colloids. Colloids are particles that remain suspended in the surrounding medium.

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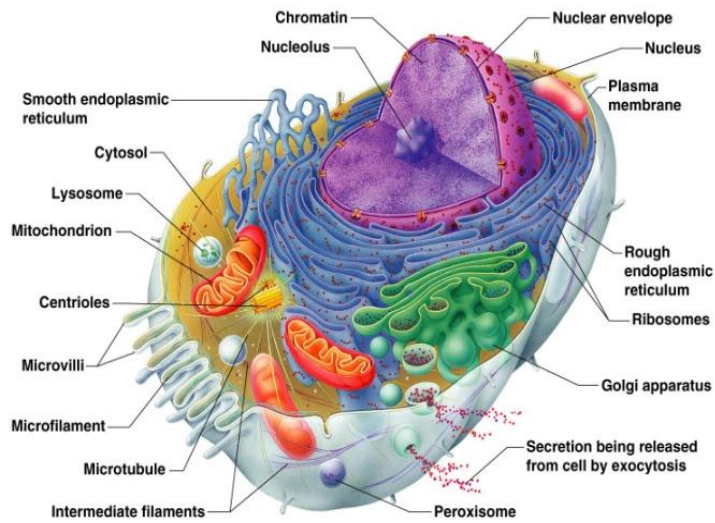
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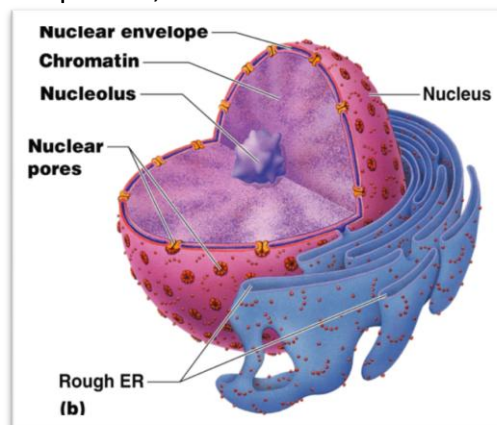
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Organelles



Organelles are specialized portion of the cell with a characteristic shape that assume specific role in growth, maintenance, repair and control.

- a) Nucleus, Oval in shape and is the largest structure in the cell. Contain the hereditary factor in the cell. Hence it controls cell activity & structure. Most cell contain single nucleus but some like matured Red Blood cell do not contain. However Muscle cell contain several nucleuses. The nucleus separated from other cell structure by double membrane called nuclear membrane. Pores over the nuclear membrane allow the nucleus to communicate with the cytoplasm. In the nucleus a jelly like fluid that fills the nucleus is karylymph (neucleoplasm), which contain the genetic material called chromosome. Nucleus also contain dark, somewhat spherical, non-membrane bound mass called nucleolus. It contains DNA, RNA and protein, which assist in the construction of ribosome.



- b) Ribosome, tiny granules, composed of Ribosomal RNA (rRNA). They are site of protein synthesis.
- c) Endoplasmic reticulum is a double membrane channel. It is continuous with the nuclear membrane. It involved in intracellular exchange of material with the cytoplasm. Various products are transported from one portion of the cell to another via the endoplasmic reticulum. So it is considered as intracellular transportation. It is also storage for synthesized molecules. Together with the Golgi complex it serves as synthesis & packaging center. Endoplasmic reticulum (ER) is divided in to two. These are, granular E.R. Containing granule and involving in synthesis of protein and agranular E.R. that synthesize lipid & involves in detoxification.
- d) Golgi Complex, near to the nucleus. It consist 4-8 membranous sacs. It process, sort, pack & deliver protein to various parts of the cell.
- e) Mitochondria, a small, spherical, rod shaped or filamentous structure. It generates energy. Each mitochondria posses two membrane, one is smooth (upper) membrane and the other is arranged with series of folds called cristae. The central cavity of a mitochondrion enclosed by the inner membrane is the matrix.
- f) Lysosomes appear as membrane enclosed spheres. They are formed from Golgi complexes & have single membrane. They contain powerful digestive (hydrolytic enzyme capable of breaking down many kinds of molecules. The lysosomal enzyme believed to be synthesized in the granular endoplasmic reticulum and Golgi complex.

- g) The cyto-skeleton, the cytoplasm has a complex internal structure consisting of a series of exceedingly small microfilaments, microtubule & intermediate filaments together referred to as the cyto-skeleton.



(b) Microfilament



(c) Intermediate filament



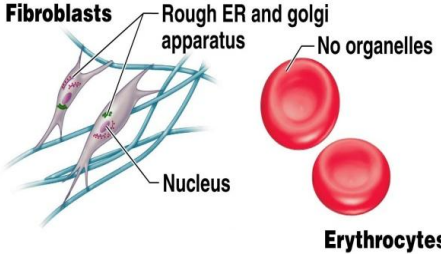
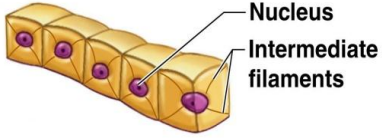
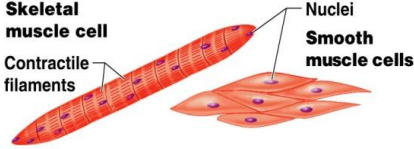
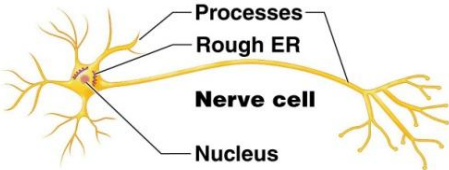
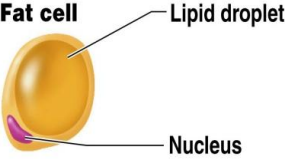
(d) Microtubule

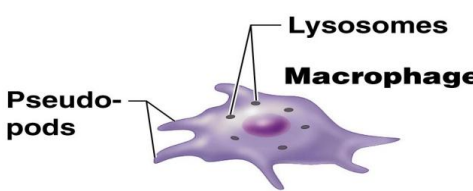
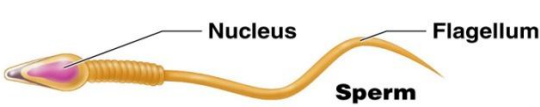
- h) Centrosome, a dense area of cytoplasm generally spherical and located near the nucleus it contains centrioles. It also contains DNA that controls their replication. Centrosomes are made of microtubules, which seem drinking straws. They are involved in the movement of chromosome during cell division.
- i) Cilia/flagella, thread-like appendages, which are made of microtubules. When they are beating forms rhythmic movement. They are found in female reproductive organ and upper respiratory tube.

Tissue and Cell Diversity

Cells are highly organized units. But in multicellular organisms, they do not function in isolation. They work together in a group of similar cells called tissue. Tissue is a group of similar cells and their intercellular substance that have a similar embryological origin and function together to perform a specialized activity. A science that deals with the study of a tissue is Histology. The various tissues of the body are classified into four principal parts according to their function & structure. These are epithelial, connective, muscular, and Nervous tissue.

Cell diversity

<ul style="list-style-type: none"> • Fibroblasts secrete fibers • Has abundant rough ER and large Golgi apparatus to make the proteins required for building fibers • Erythrocytes (RBC) has concave shape to provide more surface, are for O₂ uptake 	 <p>(a) Cells that connect body parts</p>
<ul style="list-style-type: none"> • The shape of epithelial cells allow it to pack in sheets • Filled with intermediate filament helps it resist tear 	 <p>(b) Cells that cover and line body organs</p>
<ul style="list-style-type: none"> • Muscle cells are filled with contractile filaments which makes it shorten forcibly and move bones 	 <p>(c) Cells that move organs and body parts</p>
<ul style="list-style-type: none"> • Has long processes for receiving and transmitting messages to other body parts • Covered with a wide plasma membrane • rich in rough ER to synthesize membrane components 	 <p>(f) Cell that gathers information and controls body functions</p>
<ul style="list-style-type: none"> • Huge shape for fat storage 	 <p>(d) Cell that stores nutrients</p>

<ul style="list-style-type: none"> • Has pseudopods to move to infection sites • Rich in lysosomes which digest infectious microorganisms 	 <p>The diagram shows a purple, irregularly shaped cell with several small, dark purple circular structures inside. Labels with leader lines point to 'Lysosomes' (one of the dark circles) and 'Pseudo-pods' (one of the cell's extensions). The word 'Macrophage' is written in bold. Below the cell, the text '(e) Cell that fights disease' is written in bold.</p>
<ul style="list-style-type: none"> • Has flagellum to help propel (push) it toward the egg 	 <p>The diagram shows a yellow, elongated cell with a rounded head and a long, wavy tail. Labels with leader lines point to 'Nucleus' (inside the head) and 'Flagellum' (the tail). The word 'Sperm' is written in bold. Below the cell, the text '(g) Cell of reproduction' is written in bold.</p>

References:

Marieb, E. N. (2002), Essential of human anatomy and physiology, Seventh Edition.

Tortora, G.J. (1995), Principles of human Anatomy and Physiology., Harper Collins, New York, 7th ed