Ministry of Higher Education and Scientific Research

Al- Mamoun University

Department of Biology

علم الحيوان ZOOLOGY

المرحلة الأولى للعام الدراسي 2024-2023

الفصل الدراسي الأول

تدريسي المادة :

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Lecture one: Introduction-Understanding the Animal World

What is Biology? and what is Zoology?

Biology is a natural science that studies life and living organisms, including their physical structure, chemical processes, molecular interactions, physiological mechanisms, development and evolution.

Zoology is the scientific study of animals. It is a branch of biology that studies the members of the animal kingdom and animal life in general. Zoology is one of the broadest fields in all of science because of the immense variety of animals and the complexity of the processes occurring within animals.

They may study particular functional, structural, or ecological aspects of one or more animal groups (table 1), or they may choose to specialize in a particular group of animals (table 2).

Table 1: Examples of specializations in zoology

Sub -discipline	Description
Anatomy	Study the structure of entire organisms and their parts
Cytology	Study of the structure and function of cells
Comparative Genomics and Bioinformatics	Study of the structure, function, and evolution of the genetic composition of groups of animals using computer-based computational methods
Ecology	Study of the interaction of organisms with their environment
Embryology	Study of the development of an animal from the fertilized egg to birth or hatching
Genetics	Study of the mechanisms of transmission of traits from parents to offspring
Histology	Study of tissues
Molecular biology	Study of subcellular details of structure and function

Parasitology	**Study of animals that live in or on other organisms at the expense of the host**
Physiology	**Study of the function of organisms and their parts**
Systematics	**Study of the classification of, and the evolutionary interrelationships among, animal group**

Table 2: Examples of specialization in Zoology by taxonomic categories

Entomology	**Study of insects**
Herpetology	**Study of amphibians and reptiles**
Ichthyology	**Study of fishes**
Mammalogy	**Study of mammals**
Ornithology	**Study of birds**
Protozoology	**Study of protozoa**

Characteristics of living organisms:

An individual living thing, such as an animal or a plant, is called an organism.

The term (living organism) is usually used to describe something which displays all the characteristics of living things (The Vital Functions). There are seven activities which make organisms different from non-living things, they are:

1- Nutrition: Living things take in materials from their surroundings that they use for growth or to provide energy. Nutrition is a process by which organisms obtain energy and raw materials from nutrients such as proteins, carbohydrates and fats.

2- Respiration: Respiration is the release of energy from break down food substances in all living cells to carry out the following processes.

3- Movement: All living things move, even plants move in various different ways, The movement may be so slow that it is very difficult to see.

4-Excretion: Excretion is defined as the removal of toxic materials, the waste products of metabolism and substances in excess from the body of an organism.

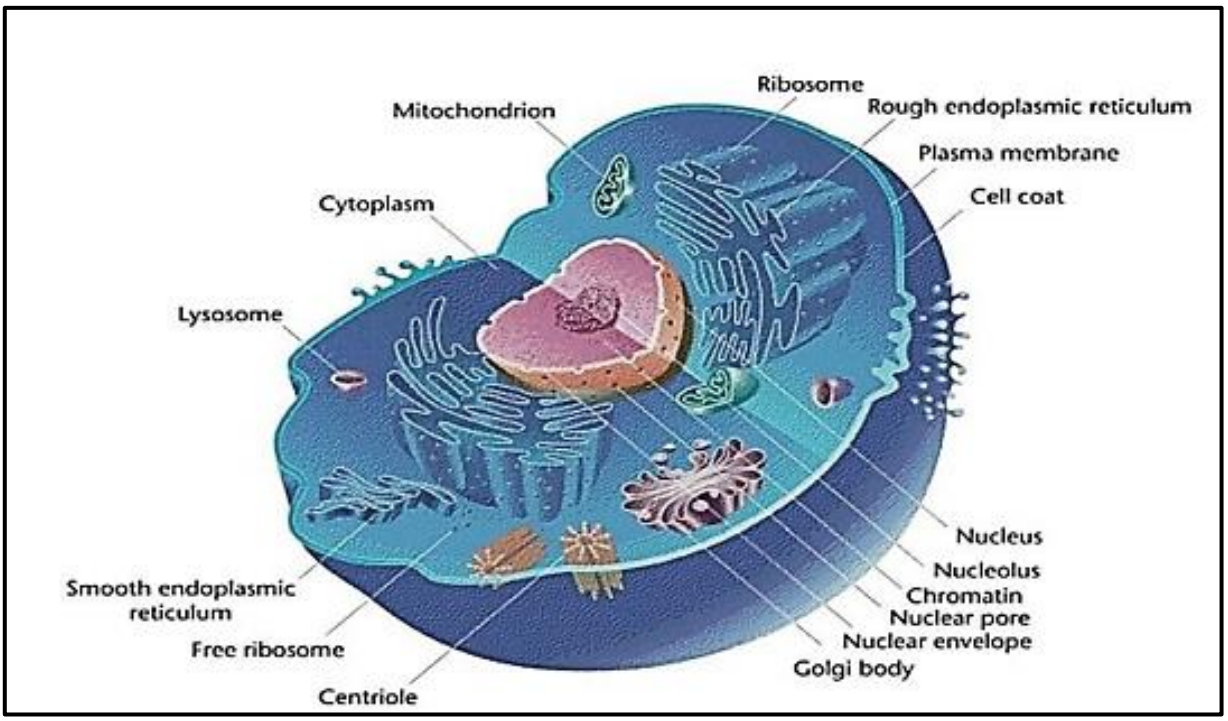
5- Growth: The permanent increase in cell number and size is called growth. It is seen in all living things. It involves using food to produce new cells.

6– Reproduction: All living organisms have the ability to produce offspring.

7- Sensitivity: All living things are able to sense and respond to stimuli around them such as light, temperature, water, gravity and chemical substances.

Lecture Two : The Animal Cell

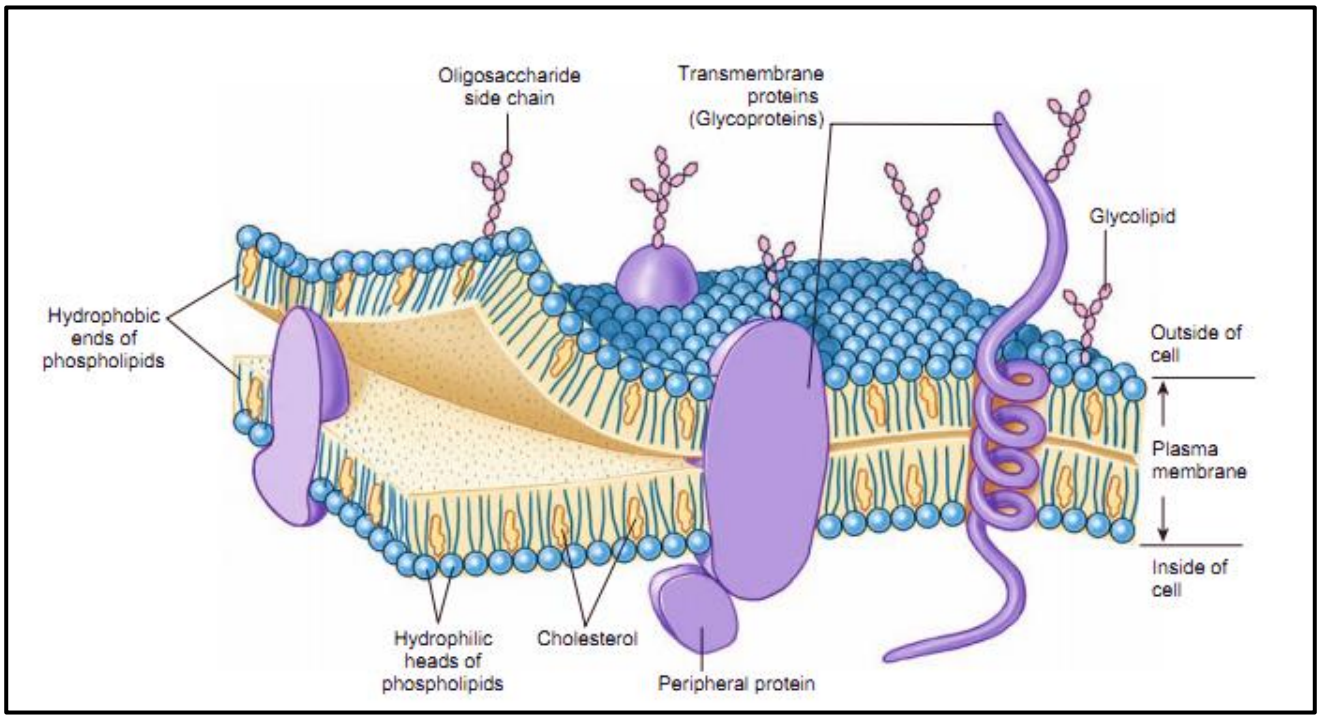
The cell is the basis structural and functional unit of living organisms. It can be considered as an organism on its own? It is the smallest independently functioning unit in the structure of an organism, usually consisting of one or more nuclei surrounded by cytoplasm and enclosed by a membrane. Cells also contain organelles such as mitochondria, lysosomes, and ribosomes.



Cell Membrane

Cell membrane is composed of lipids that are arranged in a bilayer. Also, the lipids are arranged within the membrane with the polar head towards the outer sides and the hydrophobic tails towards the inner part. This ensures that the nonpolar tail of saturated hydrocarbons is protected from the aqueous environment.

Later, biochemical investigation clearly revealed that the cell membranes also possess protein and carbohydrate. Depending on the ease of extraction, membrane proteins can be classified as integral or peripheral. Peripheral proteins lie on the surface of membrane while the integral proteins are partially or totally buried in the membrane.

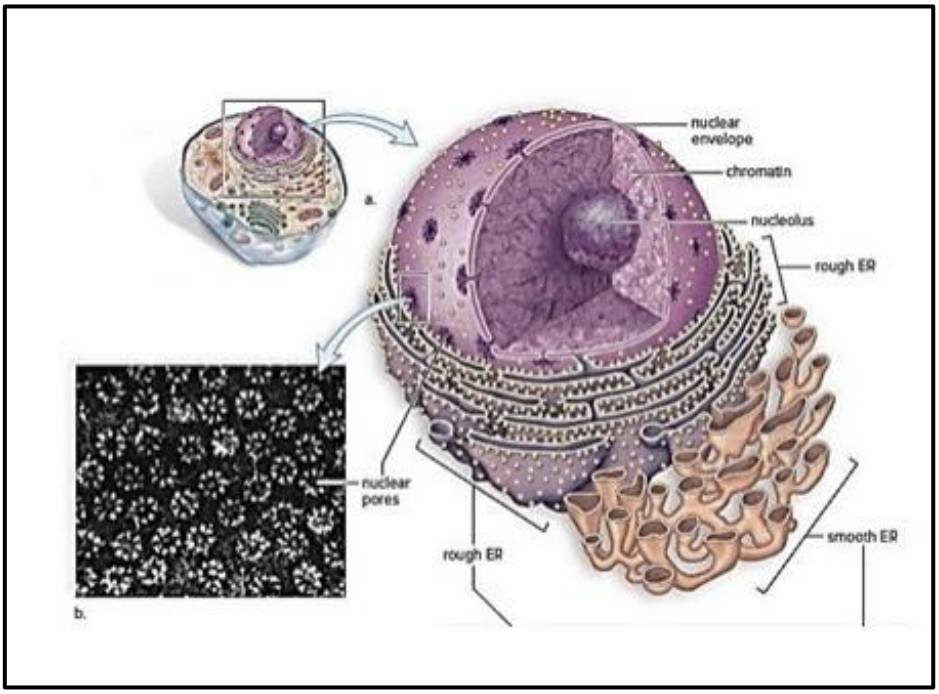


Nucleus

The interphase nucleus (nucleus of a cell when it is not dividing) has highly extended and elaborate nucleoprotein fibers called chromatin, nuclear

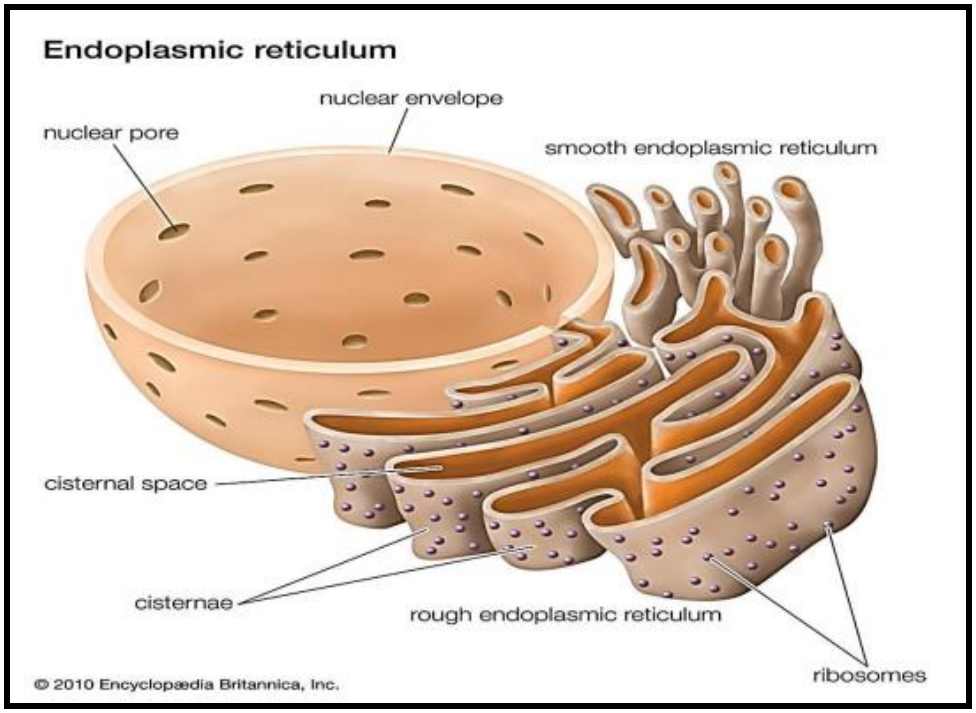
matrix and one or more spherical bodies called nucleoli. Electron microscopy has revealed that the nuclear envelope, which consists of two parallel membranes with a space between (10 to 50 nm) called the perinuclear space, forms a barrier between the materials present inside the nucleus and that of the cytoplasm. The outer membrane usually remains continuous with the endoplasmic reticulum and also bears ribosomes on it.

Normally, there is only one nucleus per cell, variations in the number of nuclei are also frequently observed. Some mature cells even lack nucleus, e.g., erythrocytes of many mammals. The nuclear matrix or the nucleoplasm contains nucleolus and chromatin. The nucleoli are spherical structures present in the nucleoplasm. The content of nucleolus is continuous with the rest of the nucleoplasm as it is not a membrane bound structure. It is a site for active ribosomal RNA synthesis. Larger and more numerous nucleoli are present in cells actively carrying out protein synthesis.



The Endoplasmic Reticulum (ER)

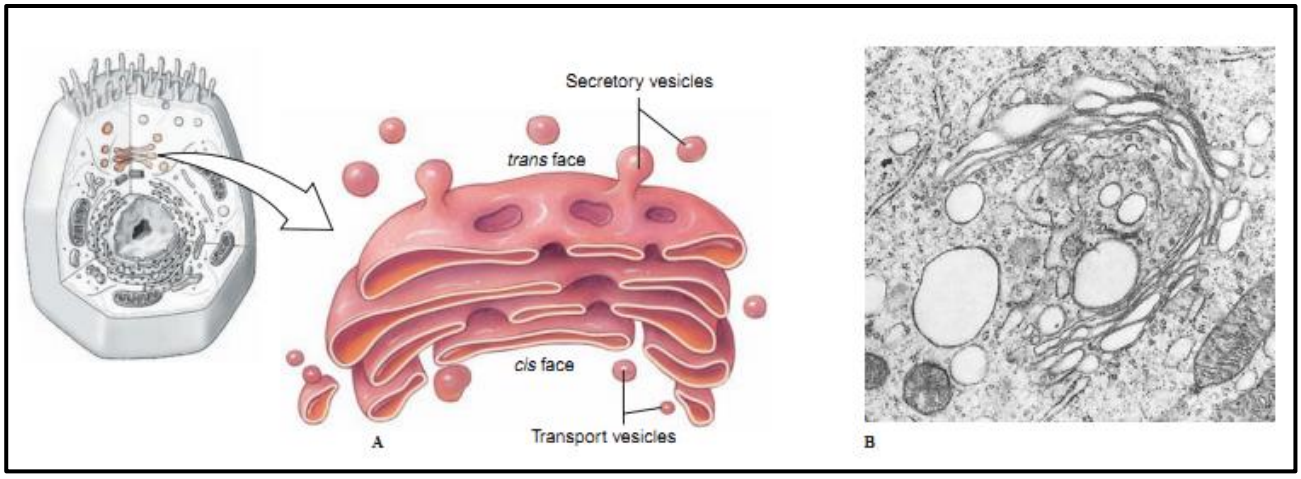
Electron microscopic studies of eukaryotic cells reveal the presence of a network or reticulum of tiny tubular structures scattered in the cytoplasm that is called the endoplasmic reticulum (ER).The ER often shows ribosomes attached to their outer surface. The endoplasmic reticulum bearing ribosomes on their surface is called rough endoplasmic reticulum (RER). In the absence of ribosomes they appear smooth and are called smooth endoplasmic reticulum (SER). RER is frequently observed in the cells actively involved in protein synthesis and secretion. They are extensive and continuous with the outer membrane of the nucleus. The smooth endoplasmic reticulum is the major site for synthesis of lipid.



Golgi apparatus

Camillo Golgi (1898) first observed densely stained reticular structures near the nucleus. They consist of many flat, disc-shaped sacs or cisternae of0.5µm to 1.0µm diameter. These are stacked parallel to each other. The Golgi apparatus

principally performs the function of packaging materials, to be delivered either to the intra-cellular targets or secreted outside the cell.



Lecture Three:

Lysosomes

These are membrane bound vesicular structures formed by the process of packaging in the golgi apparatus. The isolated lysosomal vesicles have been found to be very rich in almost all types of hydrolytic enzymes (hydrolases – lipases, proteases, carbohydrases) optimally active at the acidic pH. These enzymes are capable of digesting carbohydrates, proteins, lipids and nucleic acids.

Vacuoles

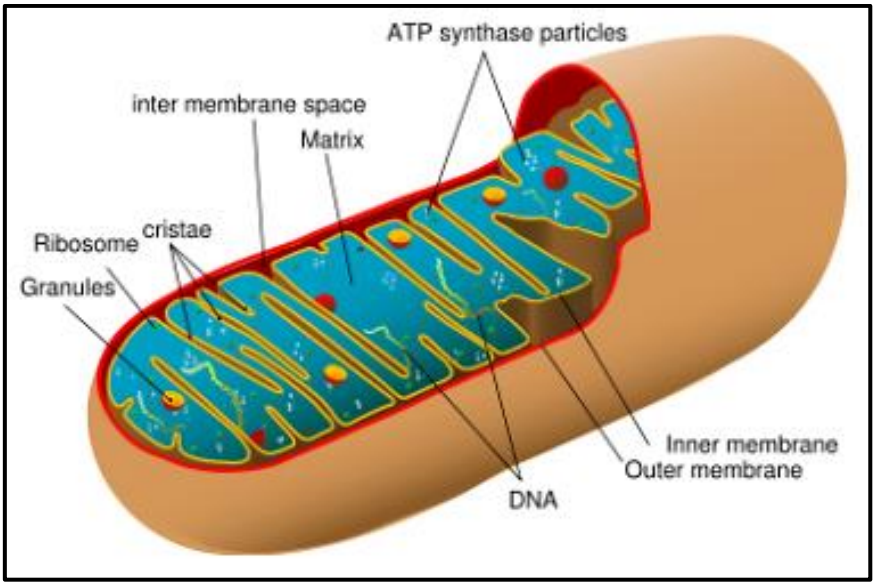
The vacuole is the membrane-bound space found in the cytoplasm. It contains water, sap, excretory product and other materials not useful for the cell. The vacuole is bound by a single membrane called tonoplast. In Amoeba the contractile vacuole is important for excretion. In many cells, as in protists, food vacuoles are formed by engulfing the food particles.

Mitochondria

Mitochondria, unless specifically stained, are not easily visible under the microscope. The number of mitochondria per cell is variable depending on the physiological activity of the cells. Each mitochondrion is a double membrane-bound structure with the outer membrane and the inner membrane dividing its lumen distinctly into two aqueous compartments, i.e., the outer compartment and the inner compartment. The inner compartment is called the matrix.

The outer membrane forms the continuous limiting boundary of the organelle, while The inner membrane forms a number of in folding called the cristae. towards the matrix. The cristae increase the surface area. The two membranes have their own specific enzymes associated with the mitochondrial function.

Mitochondria are the sites of aerobic respiration. They produce cellular energy in the form of ATP, hence they are called _power houses‘ of the cell. The matrix also possesses single circular DNA molecule, a few RNA molecules, ribosomes and the components required for the synthesis of proteins. The mitochondria divide by fission.



Ribosomes

Ribosomes are the granular structures first observed under the electron microscope as dense particles by George Palade (1953). They are composed of ribonucleic acid (RNA) and proteins and are not surrounded by any membrane.

Lecture Four

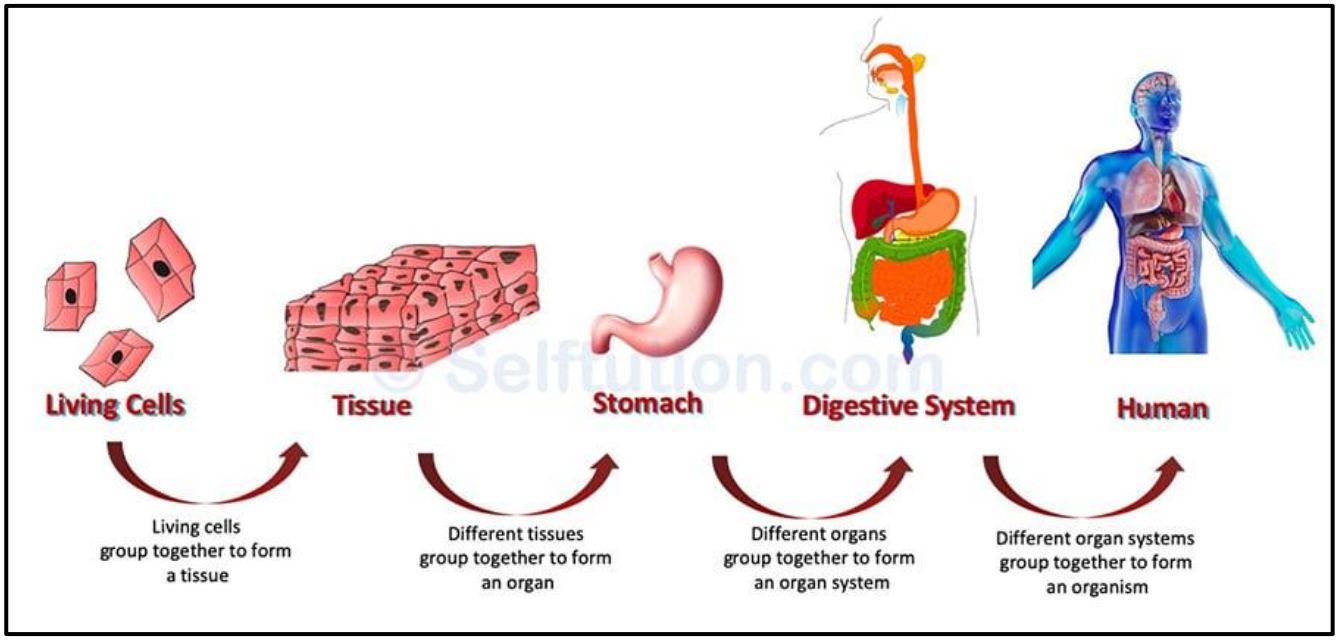
Animal Tissues

Tissue Level of Organization

The tissues of multicellular, complex animals are four primary types: epithelial, connective, muscle, and nervous. Recall that tissues are groups of similar cells

group of similar cells carrying out related functions. These tissues combine to form organs—like the skin or kidney—that have specific, specialized functions within the

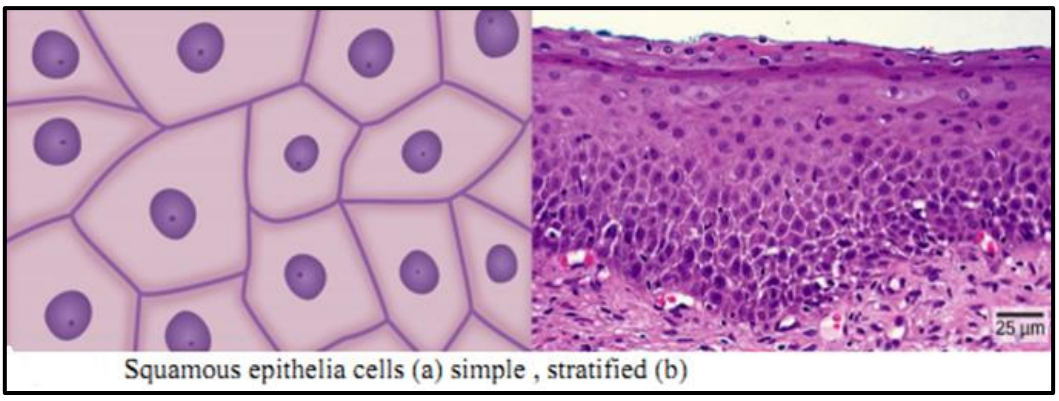
body. Organs are organized into organ systems to perform functions; examples include the circulatory system, which consists of the heart and blood vessels, and the digestive system, consisting of several organs, including the stomach, intestines, liver, and pancreas. Organ systems come together to create an entire organism.



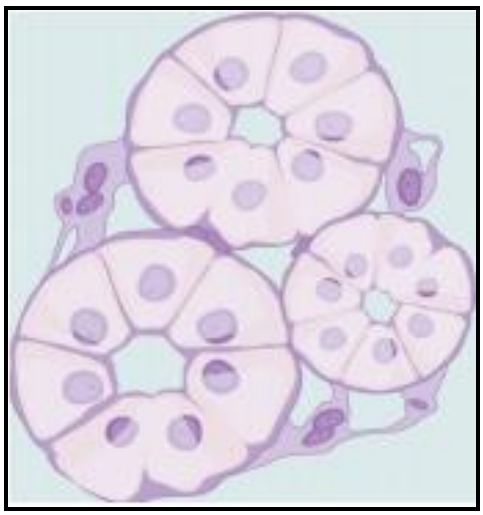
1st Epithelial Tissues:

Epithelial tissues cover the outside of organs and structures in the body and line the lumens of organs in a single layer or multiple layers of cells. The types of epithelia are classified by the shapes of cells present and the number of layers of cells.

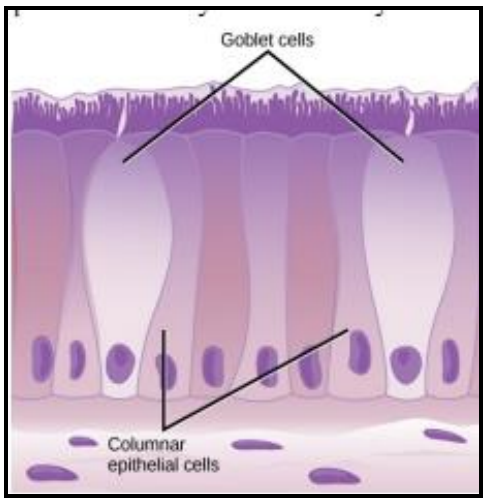
Cell shape	Description	location
squamous	flat, irregular round shape	**simple:** lung alveoli, capillaries **stratified**: skin, mouth, vagina
cuboidal	cube shaped, central nucleus	glands, renal tubules
columnar	tall, narrow, nucleus toward base tall, narrow, nucleus along cell	simple: digestive tract pseudostratified: respiratory tract
transitional	round, simple but appear stratified	urinary bladder



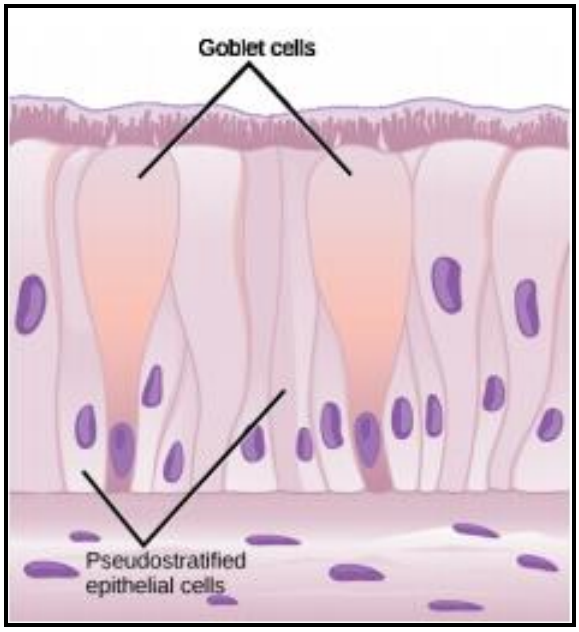
Squamous epithelia cells (a) simple , stratified (b)



Simple cuboidal epithelial

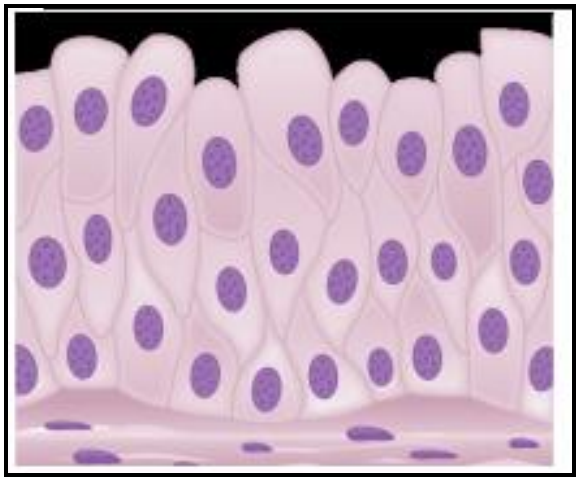


Simple columnar epithelial



Pseudostratified columnar epithelia

line the respiratory tract. They exist in one layer, but the arrangement of nuclei at different levels makes it appear that there is more than one layer. Goblet cells interspersed between the columnar epithelial cells secrete mucous into the respiratory tract.

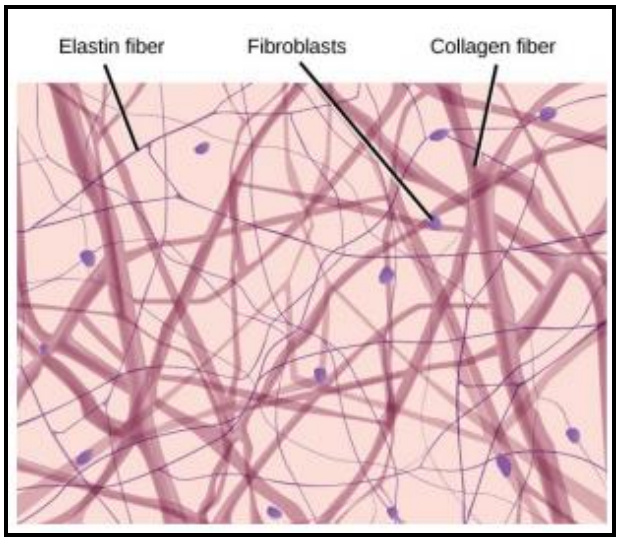


Transitional epithelia of the urinary bladder undergo changes in thickness depending on how full the bladder is.

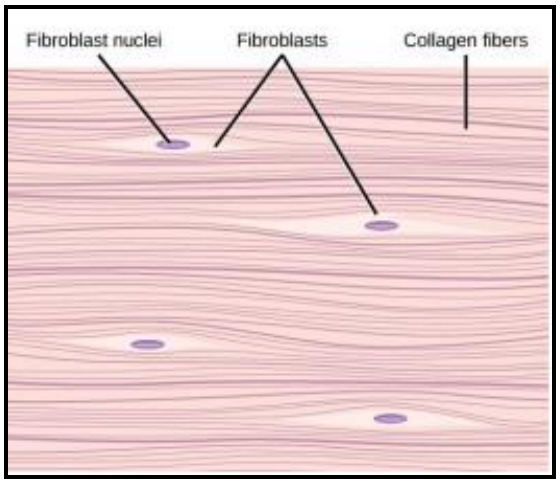
2 nd Connective Tissues

Connective tissues are made up of a matrix consisting of living cells and a non-living substance, called the ground substance. The ground substance is made of an organic substance (usually a protein) and an inorganic substance (usually a mineral or water).

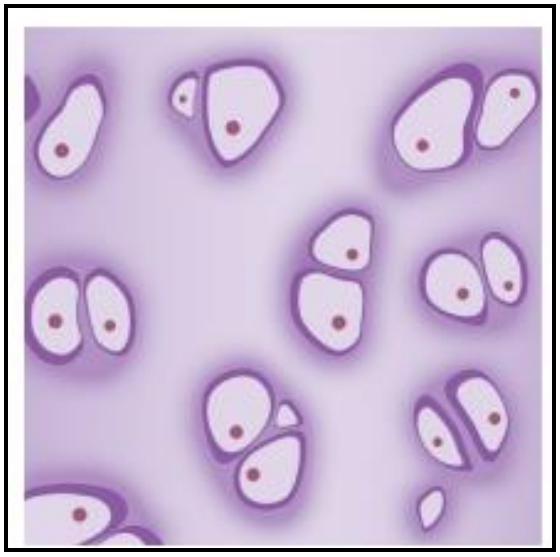
Tissue	Cells	Fibers	Location
Loose/areolar	fibroblasts, macrophages, some lymphocytes/ neutrophils	few: collagen, elastic, reticular	around blood vessels; anchors epithelia
Dense, fibrous connective tissue	fibroblasts, macrophages,	mostly collagen	irregular: skin regular: tendons, ligaments
Cartilage	chondrocytes, chondroblasts	hyaline: few collagen fibrocartilage: large amount of collagen	shark skeleton, fetal bones, human ears, intervertebral discs
Bone	osteoblasts, osteocytes, osteoclasts	some: collagen, elastic	vertebrate skeletons
Adipose	adipocytes	few	adipose (fat)
Blood	red blood cells, white blood cells	none	blood



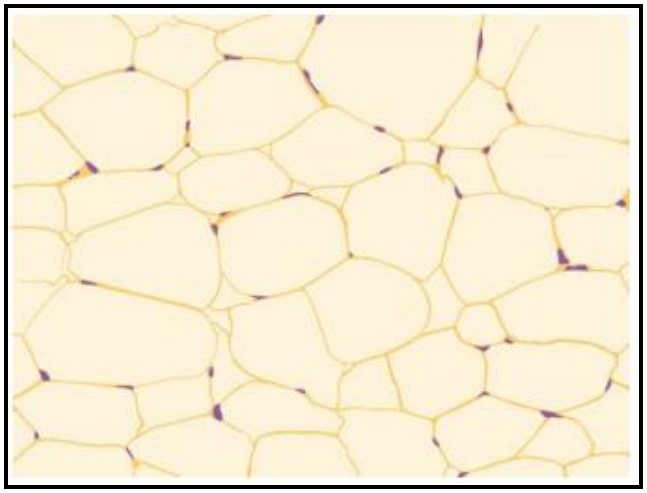
Loose connective tissue is composed of loosely woven collagen and elastic fibers. The fibers and other components of the connective tissue matrix are secreted by fibroblasts.



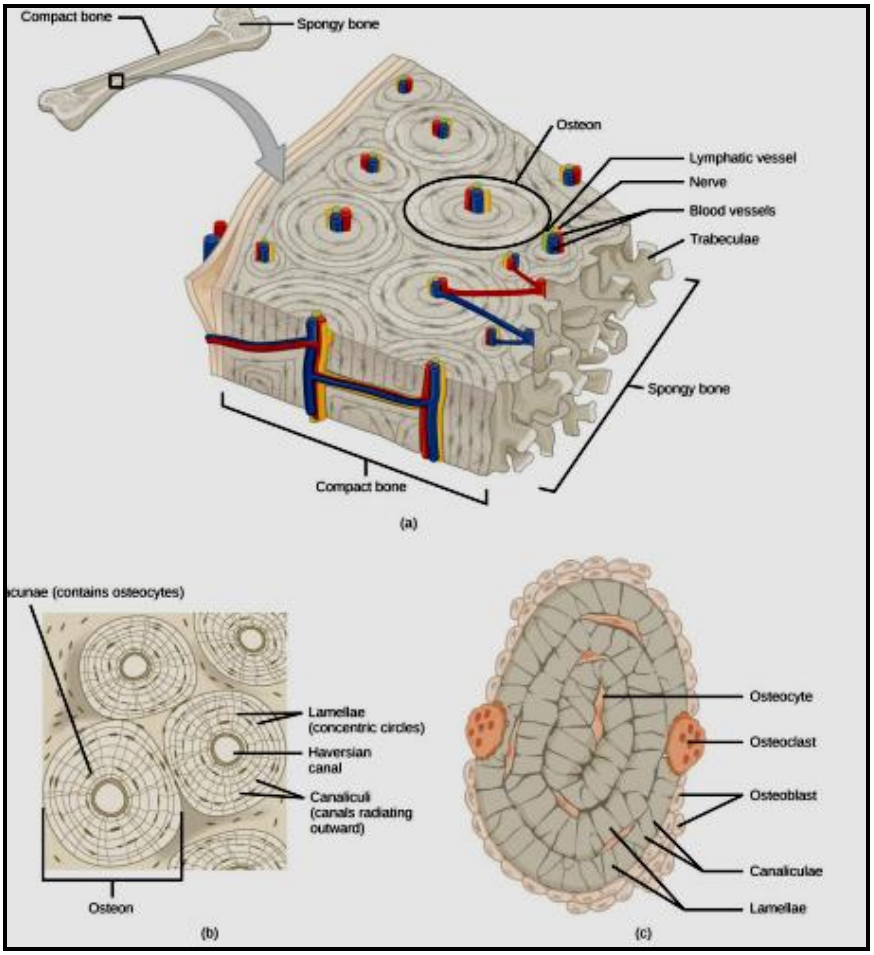
Fibrous connective tissue from the tendon has strands of collagen fibers lined up in parallel.



Hyaline cartilage consists of a matrix with cells called chondrocytes embedded in it. The chondrocytes exist in cavities in the matrix called lacunae.



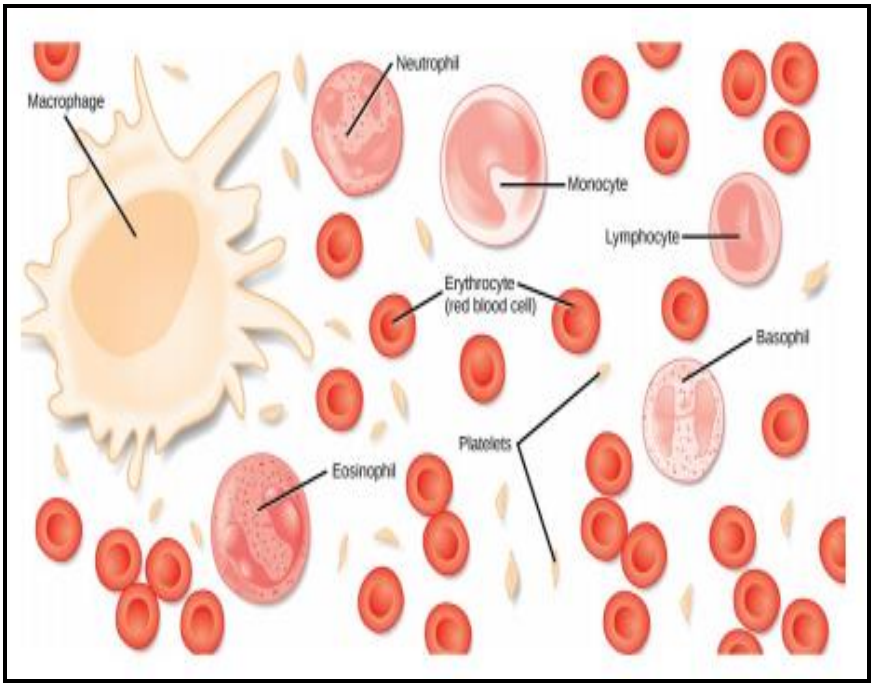
Adipose is a connective tissue is made up of cells called adipocytes. Adipocytes have small nuclei localized at the cell edge.



(a) Compact bone is a dense matrix on the outer surface of bone. Spongy bone, inside the compact bone, is porous with web-like trabeculae.

(b) Compact bone is organized into rings called osteons. Blood vessels, nerves, and lymphatic vessels are found in the central Haversian canal. Rings of lamellae surround the Haversian canal. Between the lamellae are cavities called lacunae. Canaliculi are micro channels connecting the lacunae together.

(c) Osteoblasts surround the exterior of the bone. Osteoclasts bore tunnels into the bone and osteocytes are found in the lacunae.



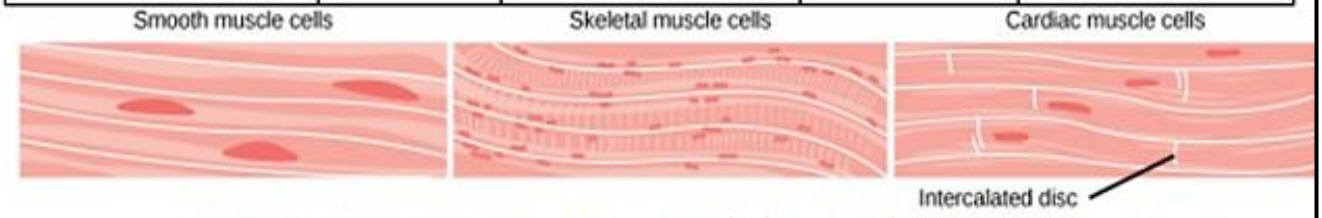
Blood is a connective tissue that has a fluid matrix, called plasma, and no fibers. Erythrocytes (red blood cells), the predominant cell type, are involved in the transport of oxygen and carbon dioxide. Also present are various leukocytes (white blood cells) involved in immune response.

Lecture Five:

3 rd Muscle Tissues

There are three types of muscle in animal bodies: smooth, skeletal, and cardiac. They differ by the presence or absence of striations or bands, the number and location of nuclei, whether they are voluntarily or involuntarily controlled, and their location within the body. The table below summarizes these differences.

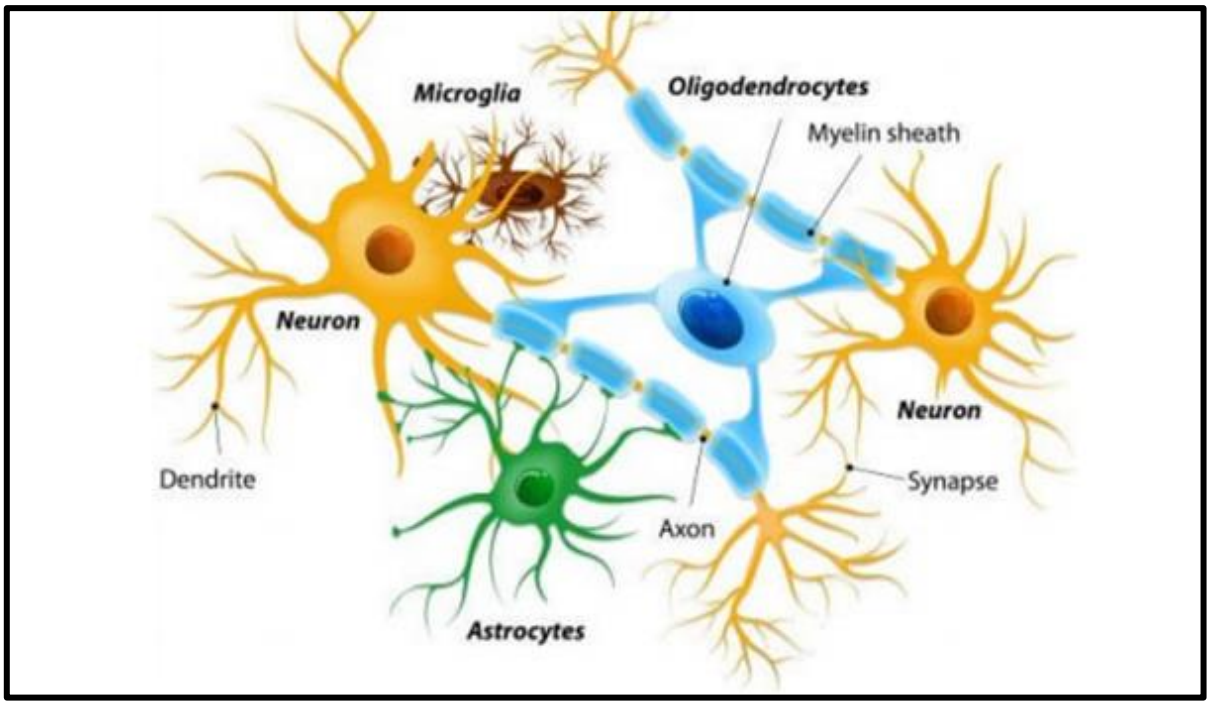
Type of Muscle	Striations	Nuclei	Control	Location
smooth	no	single, in center	involuntary	visceral organs
skeletal	yes	many, at periphery	voluntary	skeletal muscles
cardiac	yes	single, in center	involuntary	heart



Smooth muscle cells do not have striations, while skeletal muscle cells do. Cardiac muscle cells have striations, but, unlike the multinucleate skeletal cells, they have only one nucleus. Cardiac muscle tissue also has **intercalated discs**, specialized regions running along the plasma membrane that join adjacent cardiac muscle cells and assist in passing an electrical impulse from cell to cell.

4 th Nervous Tissues

Nervous tissues are made of cells specialized to receive and transmit electrical impulses from specific areas of the body and to send them to specific locations in the body.



The neuron has projections called dendrites that receive signals and projections called axons that send signals. Also shown are two types of glial cells: astrocytes regulate the chemical environment of the nerve cell, and oligodendrocytes insulate the axon so the electrical nerve impulse is transferred more efficiently. Glia, also called glial cells or neuroglia, are non-neuronal cells in the central nervous system and the peripheral nervous system that do not produce electrical impulses.

Lecture six

Animal Kingdom

Every single animal, from the smallest of insects to the blue whale (largest animal on earth) is classified into various phylum and classes. This classification is the basis of the Animal Kingdom or Kingdom Animalia.

All the members of the animal kingdom are called Metazoa. An animal must have several characteristics to be an animal:

1. They are made of cells, which form tissues, which form organs which form organ

systems.

2. They obtain food by eating other organisms (herbivores, carnivores or omnivores).

3. Most animals reproduce sexually but some can reproduce asexually.

4. All animals move in order to satisfy of their basic needs (food, water, shelter, escaping danger)

5. Animals are divided in to vertebrates (animal with backbones) and invertebrates (animal without backbone).

How is Organisms Classified?

There are eight classification groups of living things:

Domain

Kingdom

Phylum

Class

Order

Family

Genus

Species

- There are several classification which are put by scientists like **John Ray**, **Carolus Linnaeus who is called "The father of Taxonomy" and others,** and depend on several principles

- One of the most modern Taxonomy which divide the organisms in Two main groups and five Kingdoms:

1. **Prokaryotes** (Kingdom Monera): meaning literally "before the nucleus." They contain a single, large molecule of DNA not located in a membrane-bound nucleus, but found in a nuclear region, or nucleoid.
    - bacteria
    - Mycoplasma
    - blue-green algae
2. **Eukaryotes:** ("true nucleus") have cells with mem-brane bound nuclei containing chromosomes composed of chromatin. Constituents of eukaryotic chromatin include proteins called histones and RNA, in addition to DNA. Some non-histone proteins are found associated with both prokaryotic DNA and eukaryotic chromosomes. Eukaryotes are generally larger than prokaryotes and contain much more DNA.
    - Kingdom Protista
    - Kingdom Fungi
    - Kingdom Plantae
    - Kingdom Animalia

Comparison of Prokaryotic and Eukaryotic Cells

Characteristic	Prokaryotic Cell	Eukaryotic Cell
Cell size	Mostly small (1–10 µm)	Mostly large (10–100 µm)
Genetic system	DNA with some DNA-binding protein; simple, circular DNA molecule in nucleoid; nucleoid is not membrane bound	DNA complexed with DNA-binding proteins in complex linear chromosomes within nucleus with membranous envelope; circular mitochondrial and chloroplast DNA
Cell division	Direct by binary fission or budding; no mitosis	Some form of mitosis; centrioles in many; mitotic spindle present
Sexual system	Absent in most; highly modified if present	Present in most; male and female partners; gametes that fuse to form zygote
Nutrition	Absorption by most; photosynthesis by some	Absorption, ingestion, photosynthesis by some
Energy metabolism	No mitochondria; oxidative enzymes bound to cell membrane, not packaged separately; great variation in metabolic pattern	Mitochondria present; oxidative enzymes packaged therein; more unified pattern of oxidative metabolism
Intracellular movement	None	Cytoplasmic streaming, phagocytosis, pinocytosis
Flagella/cilia	If present, not with "9 + 2" microtubular pattern	With "9 + 2" microtubular pattern
Cell wall	Contains disaccharide chains cross-linked with peptides	If present, not with disaccharide polymers linked with peptides

Lecture seven

What are the Characteristics of all Animals?

- Animals cannot make their own food (consumers).
- Animals digest their food.
- Many animals move from place to place.
- Animals have many cells.
- Animal cells have nuclei and organelles (eukaryotic cells).

What are the nine Different Phyla in Kingdom Animalia?

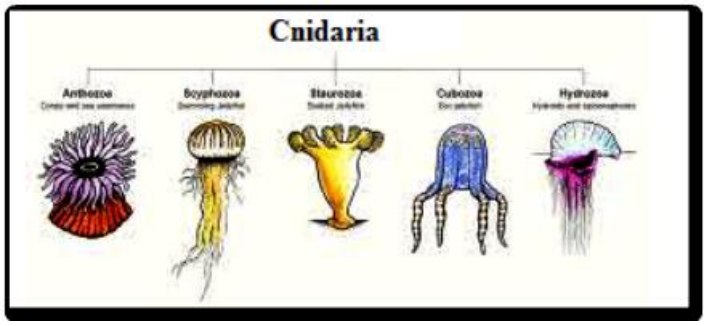
1. Phylum Porifera
2. Phylum Cnidaria
3. Phylum Platyhelminthes
4. Phylum Nematoda
5. Phylum Mollusca
6. Phylum Annelida
7. Phylum Arthropoda
8. Phylum Echinodermata
9. Phylum Chordata

1- Phylum Porifera

Aquatic organisms lack tissues and organs asymmetrical, mostly sessile (do not move) Example: sponges. This is a ―real‖ sponge are Aquatic organisms, lack tissues and organs Asymmetrical, mostly sessile (do not move).

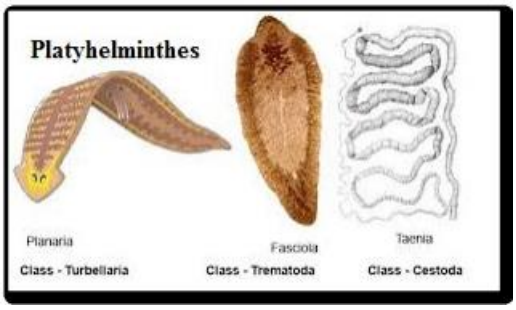
2- Phylum Cnidaria

Aquatic organisms, radial symmetry, digestive cavity with one opening, tentacles with stinging cells; Examples: jellyfish, corals, hydra, sea anemones.



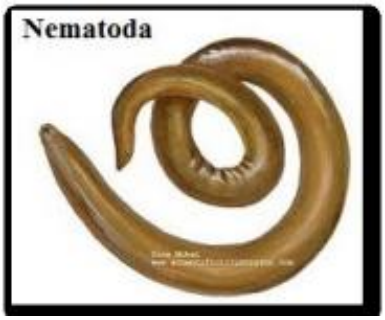
3- Phylum Platyhelminthes

Bilaterally symmetrical worms, flat bodies, digestive system with one opening; Examples: parasitic and free-living species Examples: Flat worms.



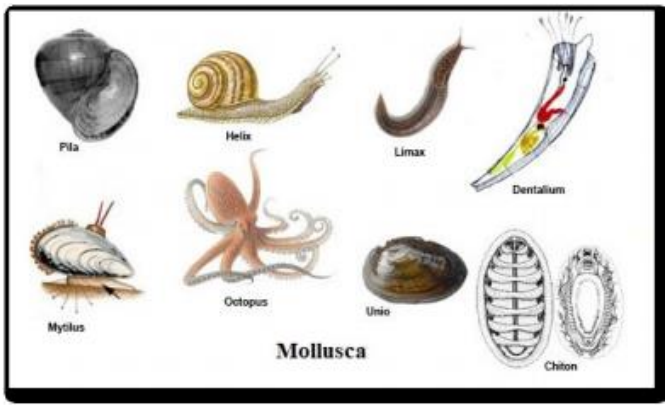
4- Phylum Nematoda

Round, smooth worms, Bilateral symmetry Digestive system with two openings free living and parasitic forms Examples: roundworms.



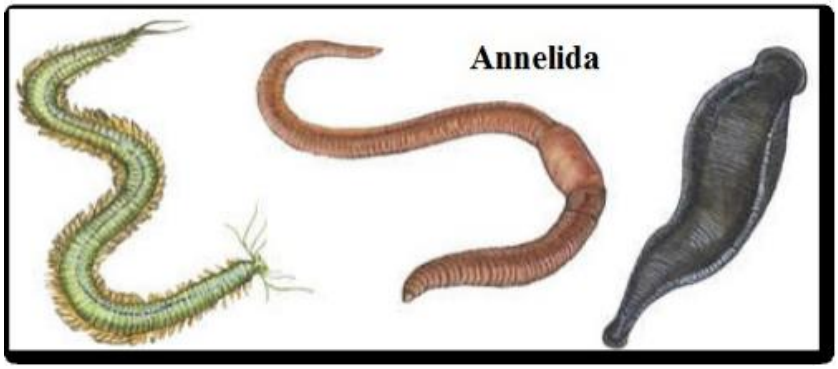
5- Phylum Mollusca

Soft-bodies, many with a hard shell or foot-like appendage, aquatic or terrestrial; Examples: clams, snails, squid, octopuses.



6- Phylum Annelida

Round worms with segmented bodies, bilateral symmetry, Terrestrial and aquatic: Examples: earthworms, leeches, and marine polychaetes.



7- Phylum Arthropoda

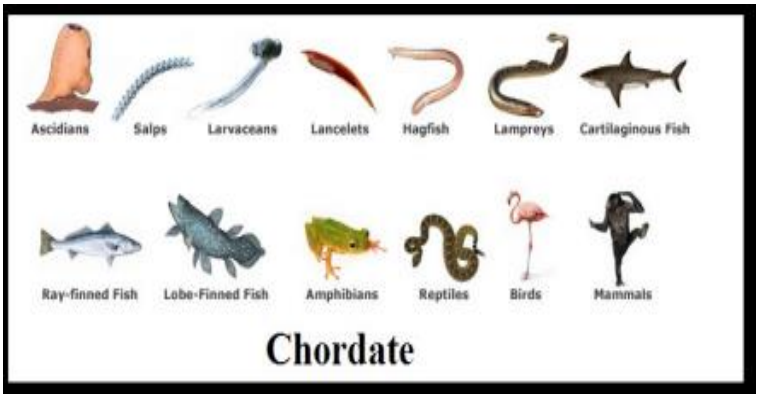
Largest animal group, bilateral symmetry, Have an exoskeleton, segmented bodies, and pairs of jointed appendages, Land and aquatic; Examples: insects, crustaceans, and spiders.

8- Phylum Echinodermata

Marine organisms, Radial symmetry Spiny/leathery skin, Water-vascular system with tube feet; Examples: sea stars, sand dollars, sea urchins.

9- Phylum Chordata

Organisms with internal skeletons and specialized body systems, At some point all have a backbone (or notochord), gill slits, and a tail; Examples: fish, amphibians, reptiles, birds, and mammals.



Lecture eight

Classification of organisms interactions

With the development of organisms communities, the demand for nutrients and space also increases. As a result, there has been a development of different strategies to enable organisms to persist in an environment. Cell–cell interactions may produce cooperative effects ,where one or more individuals benefit, or competition between the cells may occur with an adverse effect on one or more species in the environment. The nature and magnitude of interaction will depend on the types of organism present as well as the abundance of the organisms and types of sensory systems of the individual organisms.

Thus, There are several interactions that occurs between organisms, some of them are beneficial to both of them, while other interaction may be harmful to one of them. However, the most important interaction that occurs between organisms are:

1. Commensalisms

The commensalistic relationship involves two organisms where one partner (the commensal) benefits while the other species (the host) is not harmed or helped.

There are several situations under which commensalisms may occur between organisms:

- Commensalistic relationships between organisms include situations in which the waste product of one organism is the substrate for another species.
- Commensalistic associations also occur when one microbial group modifies the environment to make it more suited for another organism.

For example, in the intestine the common, nonpathogenic strain of Escherichia coli lives in the human colon, but also grows quite well outside the host, and thus is a typical commensal. When oxygen is used up by the facultatively anaerobic E. coli, obligate anaerobes such as Bacteroides are able to grow in the colon.

- One species releasing vitamins, amino acids and other growth factors that are needed by a second species

2. Mutualism

Mutualism defines as an obligatory association that provides some reciprocal benefit to both partners. This is an obligatory relationship in which the mutualist and the host are metabolically dependent on each other.

Lichen is an excellent example of microbe-microbe mutualism interaction. Lichen is the association between specific ascomycetes (the fungus) and certain genera of either green algae or cyanobacteria.

The fungi benefit for the carbohydrates produced by the algae or cyanobacteria via photosynthesis, While The fungus provides space for algae or cyanobacteria by creating a firm substratum within which the phycobiont can grow.

3. parasitism

Parasitism occurs when one species obtains nutrients from another for the purpose of cell growth. Parasites display two types: (1) direct lifecycle that does not require an intermediate host and (2) indirect lifecycle that requires an intermediate host.

In parasitism, one organism (parasite) benefits from another (host); there is a degree of coexistence between the host and parasite that can shift to a pathogenic relationship (a type of predation). The host may be microbes, plants or animals.

For example: The fungal genus, Trichoderma produces enzymes such as chitinases which degrade the cell walls of other fungi

phylum Protozoa

This phylum refers to **Kingdom Protista**, they are Unicellular which could do all the vital function of the body independently , by organelles in it which develop to specializes cells in the sophisticated. The body of the protozoa is a mass of protoplasm surrounded by a membrane.

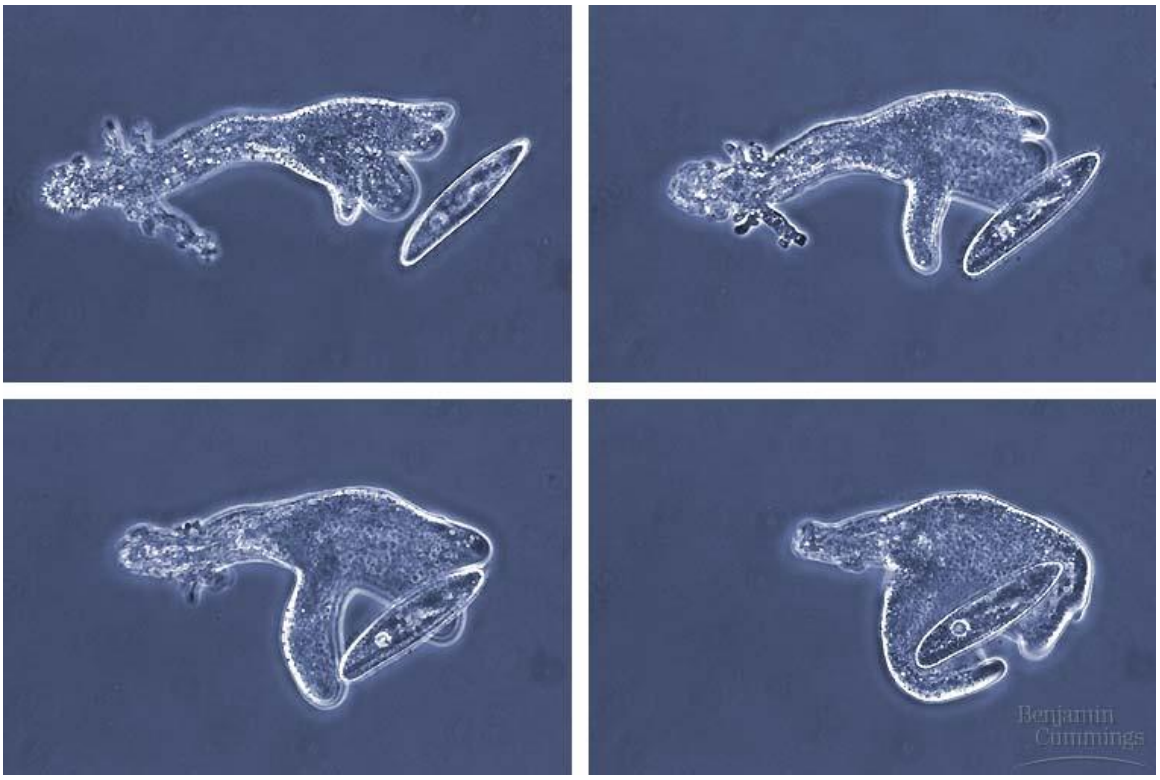
This Phylum is classified into 4 subphylum due to the moving method:

1. subphylum Sarcodina : moves by Pseudopodia
2. subphylum Mastigophora
3. subphylum Ciloiophora
4. subphylum Sporozoa

Subphylum Sarcodina: Amoeba

Consists of nucleus which contains one nucleolus, moves by Pseudopodia, the cytoplasm is differ into endoplasm and ectoplasm.

The Amoeboid movement is a slow and patchy movement, which the gel state of the cytoplasm convert into sol state, this procedure is used to a method of moving or feeding. When Amoeba contact to an organism, a Pseudopodia is formed towards the creature and a Food cup begins to form around it, then a food vacuole is formed around it, finally lysosomes are secreted and digest the creature.



Ministry of Higher Education and Scientific Research

Al- Mamoun University

Department of Biology

قسم علوم الحياة

علم الحيوان ZOOLOGY

Practical Lecture

المرحلة الأولى للعام الدراسي 2024-2023

الفصل الدراسي الأول

تدريسي المادة :

م. د. ريم شولك الصباغ

Practical Lecture 1

	Microscopes are devices that allow the observer to an exceedingly close view of minute particles. Different types of microscopes are used for visual observation of morphology, motility, staining and fluorescent reactions of bacteria.
pH Meter	
	A pH meter is an instrument for determining the pH of liquid media, liquid samples and buffers. It is a device used in laboratories to measure the H-ion concentration in water-based solution in order to determine the acidity or alkalinity of the solution.
Water Bath	
	Water Bath is a conventional device that is used for chemical reactions that required a controlled environment at a constant temperature. It is used to incubate samples in water at a constant temperature over a long period of time.

Analytical Balance	
	An analytical balance is a type of balance that is commonly used in laboratories to weigh small quantities of chemicals and samples precisely and quickly.
Autoclave	
	An autoclave is a pressurized chamber used for the process of sterilization and disinfection by combining three factors: time, pressure and steam. Autoclaves are mostly used for the sterilization of medical or laboratory equipment with the capacity of sterilizing a large number of materials at once and for the preparation of culture media during laboratory applications.
Centrifuge	
	A centrifuge is a device that allows the rotation of an object about a single axis, where an outward force is applied perpendicularly to the axis. The primary application of a centrifuge is the separation of particles suspended in a suspension. It can be used for the separation of cell organelles, nucleic acid, blood components, and separation of isotopes.

	A deep freezer can be used for the preservation of different things used in the laboratories for a very long period of time. Deep freezers are used in laboratories to store and preserve medical equipment, food items, blood samples, medicines, and injections, etc. for a more extended period of time.
Homogenizer	
	Homogenizer is a device used in laboratories for the mixing of various liquids and materials like tissue, plant, food, soil, and many others. A homogenizer is primarily used to disrupt cells to acquire cell organelles for different microbiological processes. It is used in the preparation step before the extraction and purification of different macromolecules like proteins, nucleic acids, and lipids.
Hot plate	
	A hot plate is a stand-alone appliance used in microbiology laboratories as a tabletop heating system. In a laboratory, hot plates are used to heat glassware and their components. They are used over water baths as in water baths might be hazardous in case of any spills or overheat.
Incubator	
	An incubator is a device that is used in the laboratories for the growth and maintenance of microorganisms and cultures. Laboratory incubators provide a controlled, contaminant-free environment for safe, reliable work with cell and tissue cultures by regulating conditions such as temperature, humidity, and CO2. Microbiological incubators are used for the growth and storage of bacterial cultures.

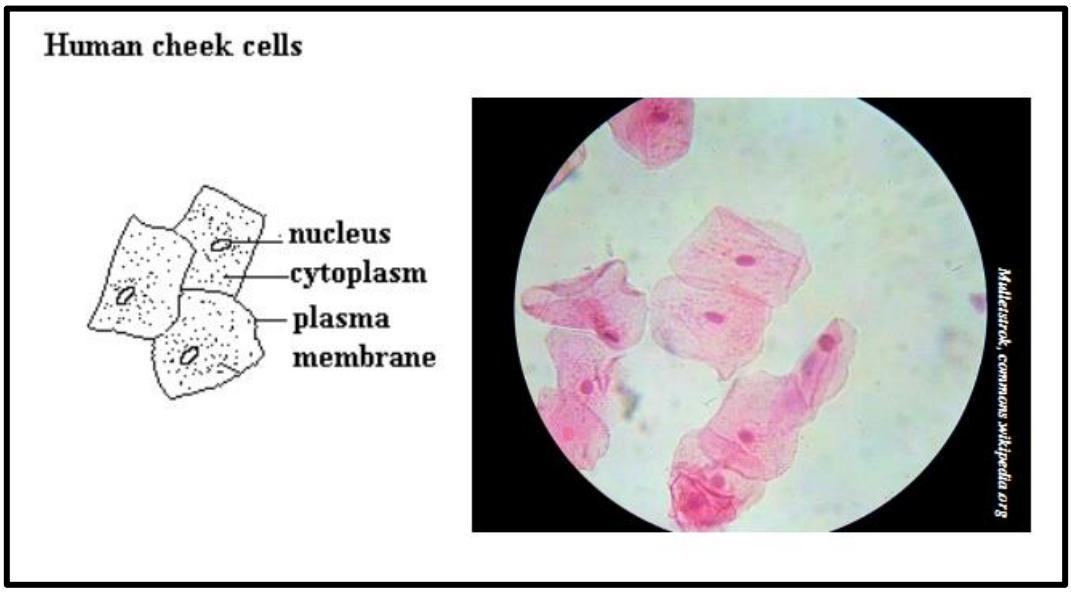
VACUTAINER TUBES

Color	Anticoagulant	Uses
	No anticoagulant	Serological examination in biochemistry
	**Sodium Fluoride**	Glucose estimation
	**EDTA**	Hematological examination like complete hemogram, ESR
	**3.2% sodium citrate**	Coagulation studies like PT, APTT
	**Heparin**	Bone marrow studies
	**Citrate**	Blood culture
	**(K2)EDTA**	Blood Bank tests. Blood typing. ABO grouping etc

Practical Lecture 2

Human Cheek Cell Test

1. **To view cheek cells, gently scrape the inside lining of your cheek with a**
1. **toothpick. DO NOT GOUGE THE INSIDE OF YOUR CHEEK!**
2. **Gently roll & tap the toothpick onto the center of a glass slide with a single drop of water. Some of the cheek cells will fall onto the slide.**
3. **Cover with a cover slip using proper procedure.**
4. **Observe the cheek cells under scanning, low and high power of your microscope.**
5. **Add a drop of methylene blue stain or iodine. This is done by placing a drop on the side of the cover slip and placing a paper towel on the opposite edge of the coverslip. This should draw the stain through and color the cells.**
6. **Observe the cheek cells under low and high power of your microscope (at the minimum you should observe the cell membrane, nucleus, and cytoplasm).**



Practical Lecture 3

Determination of Hematocrit (Hct)

(Packed Cell Volume; PCV)

Hematocrit is defined The percentage by volume of packed red blood cells in a given sample of blood after centrifugation.

•The hematocrit may also be referred to as Packed Cell Volume (PCV) or erythrocyte volume fraction (EVF.(

Objective

•To pack the RBC using the centrifuge force .

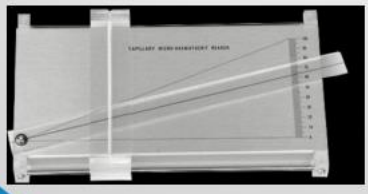
•Forcing all red cell below and plasma above, by centrifugal force .

Relevance

•Measurement of hematocrit (Hct) or packed cell volume (PCV) is the most accurate and simplest of all tests in clinical hematology for detecting the presence and degree of anemia or polycythemia. In comparison ,hemoglobin estimation is less accurate, and RBC count far less accurate .

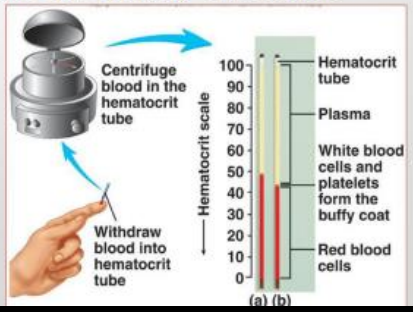
Material and instruments

- Microhaematocrit tube (capillary tube) 75mm in length and 1mm in diameter which contains heparin and show a red ring at the end of the tube.
- Microhaematocrit centrifuge device.
- Plastic seal to seal one end of Microhaematocrit capillary tube.
- Microhaematocrit reader.



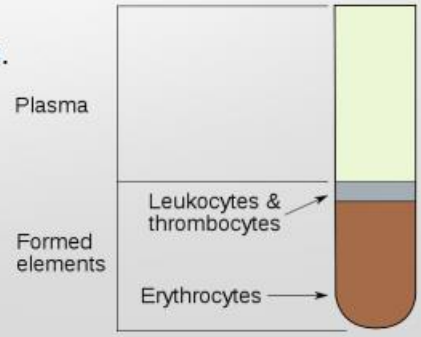
Procedure:

1. Clean your finger with 70% alcohol and let dry.
2. Prick finger with lancet, near the tip but not too close to the nail. Prick so that blood flows freely. Try squeezing up from your wrist if blood does not flow after pricking finger.
3. Place the tip of a capillary tube onto a drop of blood on your finger.
4. Call your instructor to seal the tube.
5. The instructor will spin the tubes in a centrifuge (5 minutes at 10000 rpm),.
7. Using a special reading device(since the capilary tube is not graduated),



Observations and Results:

- Note that the blood has been separated into 3 layers:
- i. A tall upper layer of clear plasma—amber slightly yellow-colored. It should not be pink or red which would indicate hemolysis of red cells in the sample or within the body in hemolytic diseases.
- ii. A greyish-white, thin layer (about 1 mm thick) the so-called "buffy layer", consisting of platelets (thrombocytes) above and leukocytes below it.
- iii. A tall bottom layer of red cells.



Results

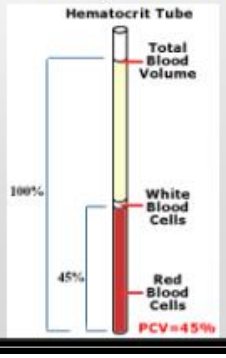
The percentage of the volume of blood occupied by the red cells constitutes hematocrit or packed cell volume.

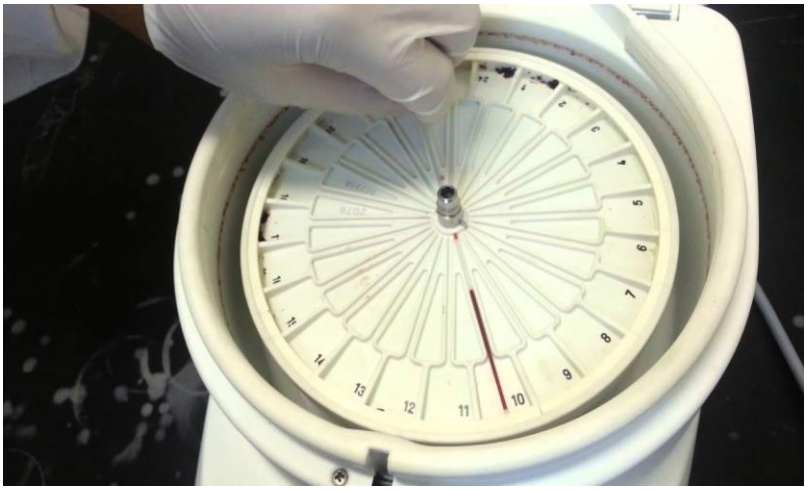
Hct % = {Height of RBCs (mm) / Height of RBCs and plasma (mm)} × 100

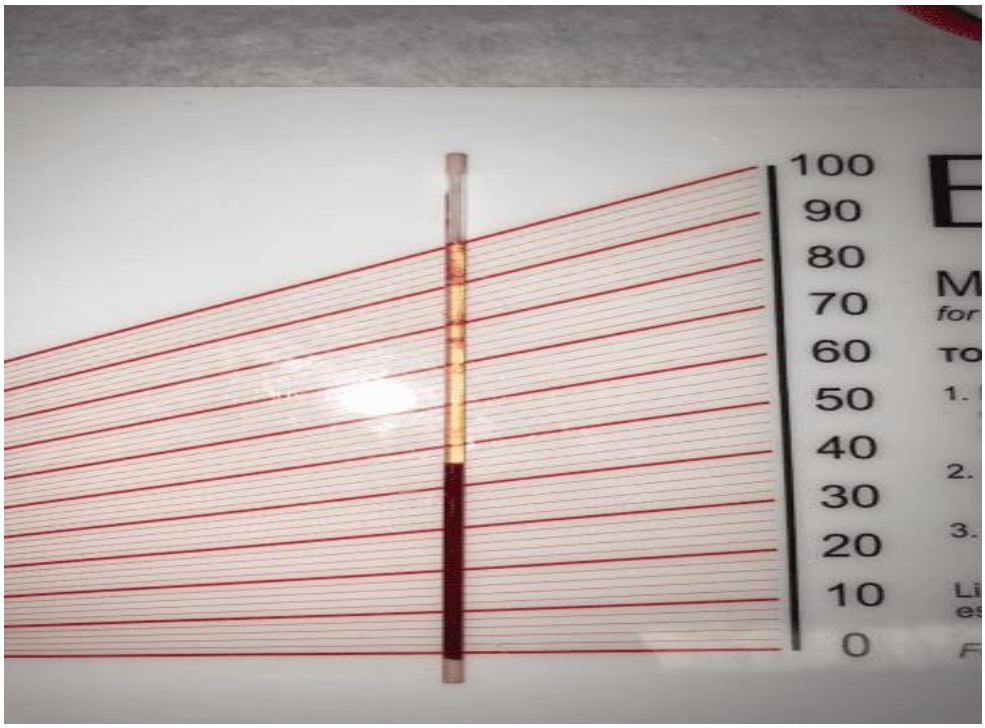
For example, if the height of packed red cells is 45 mm, then

= 45/ 100 × 100 = 45 percent.

- It also means that out of 100 volumes (or parts) of blood 45 volumes (or parts) are red cells and 55 volumes (or parts) are plasma. Thus, out of 1 liter of blood, 450 ml are red cells and 550 ml are plasma.






100
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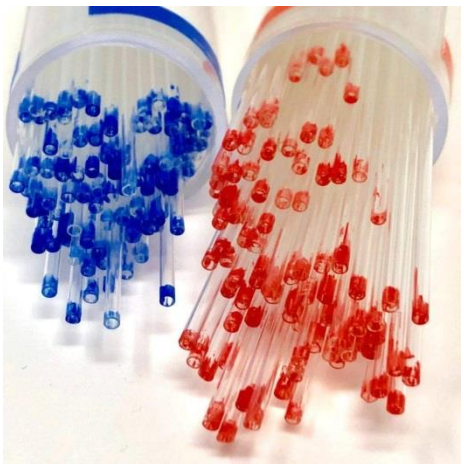



TS
100 tubes per
Capillary tubes
For Micro-hem
Sodium-heparin
75mm Length
I.D.1.1-1.2mm
O.D 1.5-1.6mm
ISO9001
100 tubes per
Capillary tubes
For Micro-hema
Sodium-heparin
75mm Length
I.D.1.1-1.2mm
O.D 1.5-1.6mm
ISO9001

1- Ultra Centrifuge is used to separate very small particles such as DNA

يستخدم جهاز الطرد المركزي عالي السرعة في فصل الدقائق الصغيرة جدا مثل DNA

2- Ultra Refrigerated Centrifuge is used to separate small particles sensitive to heat such as RNA

يستخدم جهاز الطرد المركزي عالي السرعة في فصل الدقائق الصغيرة الحساسة للحرارة مثل RNA

3- spectrophotometer is used to measure absorption

جهاز مطياف الضوء المرئي يستخدم لقياس الامتصاصية

4- Water bath is used to incubate samples at fixed temperature T and time t

يستخدم الحمام المائي لتحضين العينات على درجة حرارة ثابتة ولزمن محدد

5- Nucleus contains Genetic information stored in DNA

تحتوي النواة على المعلومات الوراثية المخزنة في DNA

6- Mitochondria is the power production in the cell

المايتوكوندريا هي عضو إنتاج الطاقة في الخلية

7- Four types of tissues : Epithelial tissues, connective tissues, muscular tissues, nervous tissues

أربعة أنواع من الأنسجة: الأنسجة الظهارية، الأنسجة الضامة، الأنسجة العضلية، الأنسجة العصبي

8- PCV (Packed Cell Volume حجم الخلايا المتجمعة)

9- haematocrit هيماتوكريت

10- blood is collected from a finger by capillary tube contains Heparin

يجمع الدم من الإصبع بواسطة أنبوب شعري يحتوي على الهيبارين

11- PCV or Haematocrit is read by the use of haematocrit reader (Haussky scale)

تقرأ حجم الخلايا المتجمعة أو الهيماتوكريت بواسطة مقراء الراسب الدموي (مقياس هاوسكلي)

12- Incubator is used to incubate microorganisms and cells at fixed temperature T and time t

تستخدم الحاضنة في تحضين الكائنات الحية الدقيقة والخلايا على درجة حرارة ثابتة ولزمن محدد

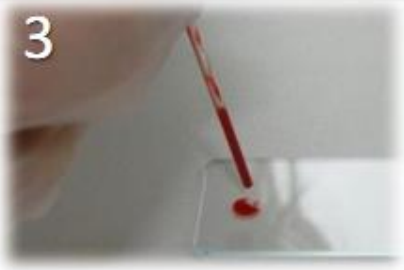
Practical Lecture 4

Blood Film Test

Gently invert the tube to mix the sample.

Hold the tube at an angle and introduce the capillary tube. Allow blood to move up the capillary tube.

Put your index finger over the top of the capillary tube before removing it or blood will leak (run back down into the sample).



Place a drop of blood onto one end of a clean slide. Discard the capillary tube into a sharps bin.

There are 2 different ways to make a smear: the 'push' technique (4a & 4b) and the 'pull' technique (6a & 6b)– either technique is acceptable and both are shown below.

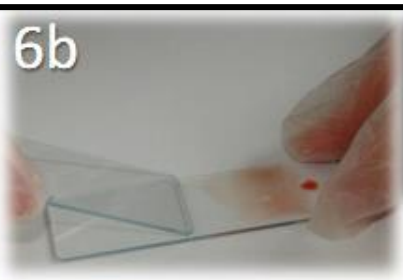
The PUSH technique: Take a second slide and lie the edge flat on the smear slide. Pull the second slide back until it contacts the drop of blood. Allow the blood to spread along the edge of the slide.

Once blood has spread along the edge of the second slide then **push** it away from the drop of blood firmly and swiftly. This can take some practice!

Air dry the slide by wafting it.

The smear should be fully contained on the slide (i.e. not off the edge). It should not be too thick or so thin that there are scratch marks. If held up to the light, the tail (feathered edge) of the smear should contain a rainbow effect.

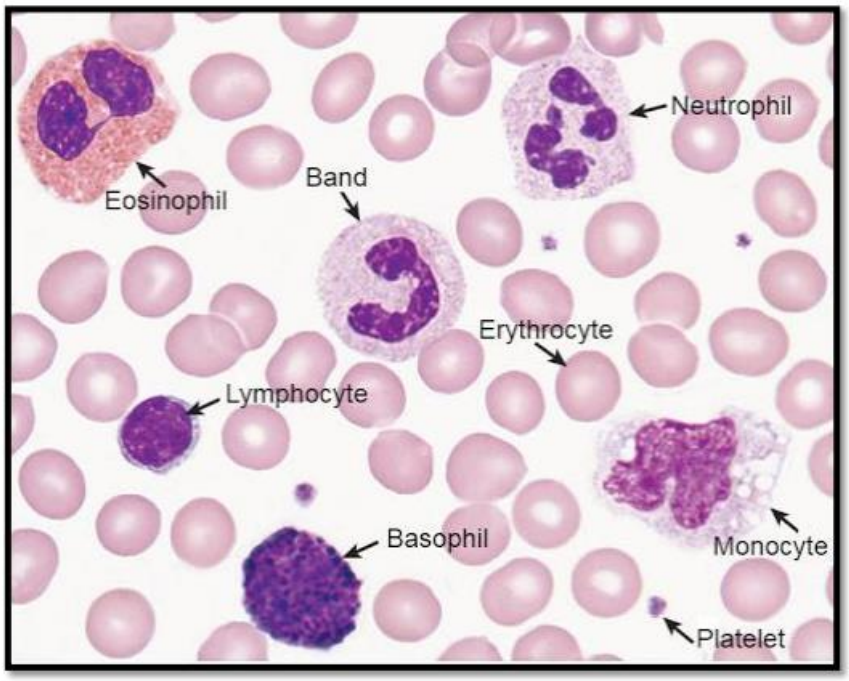
The PULL technique: Take a second slide and lie the edge flat on the smear slide. Push the second slide back until it contacts the drop of blood. Allow the blood to spread along the edge of the slide.



Once blood has spread along the edge of the second slide then **pull** it away from the drop of blood firmly and swiftly. This can take some practice!

Air dry the slide by wafting it.

The smear should be fully contained on the slide (i.e. not off the edge). It should not be too thick or so thin that there are scratch marks. If held up to the light, the tail (feathered edge) of the smear should contain a rainbow effect.



Blood Film Test

Differential Leukocyte Count (DLC)

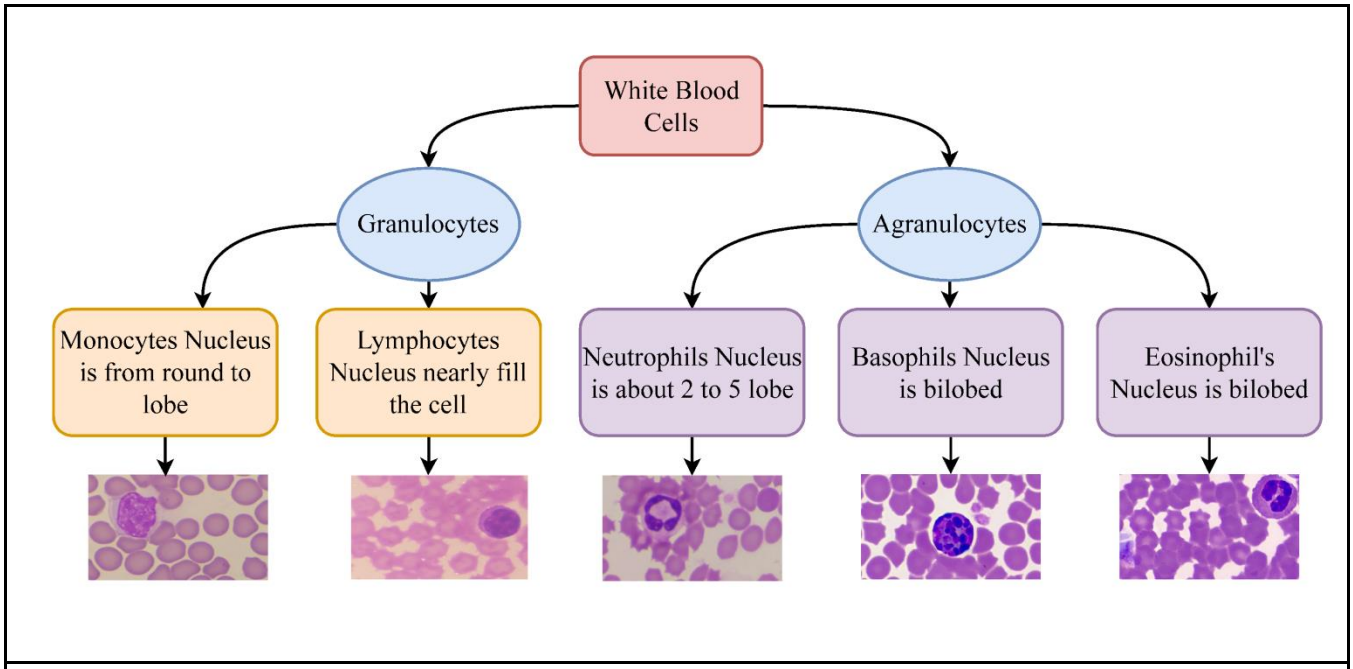
- **There are three main cells in the blood that the test focuses on:**
  - **red cells RCB: (which carry oxygen)**
  - **white cells WBC: (the body's immune system)**
  - **Platelets: (important for blood clotting)**
- **WBC are 2 types:**

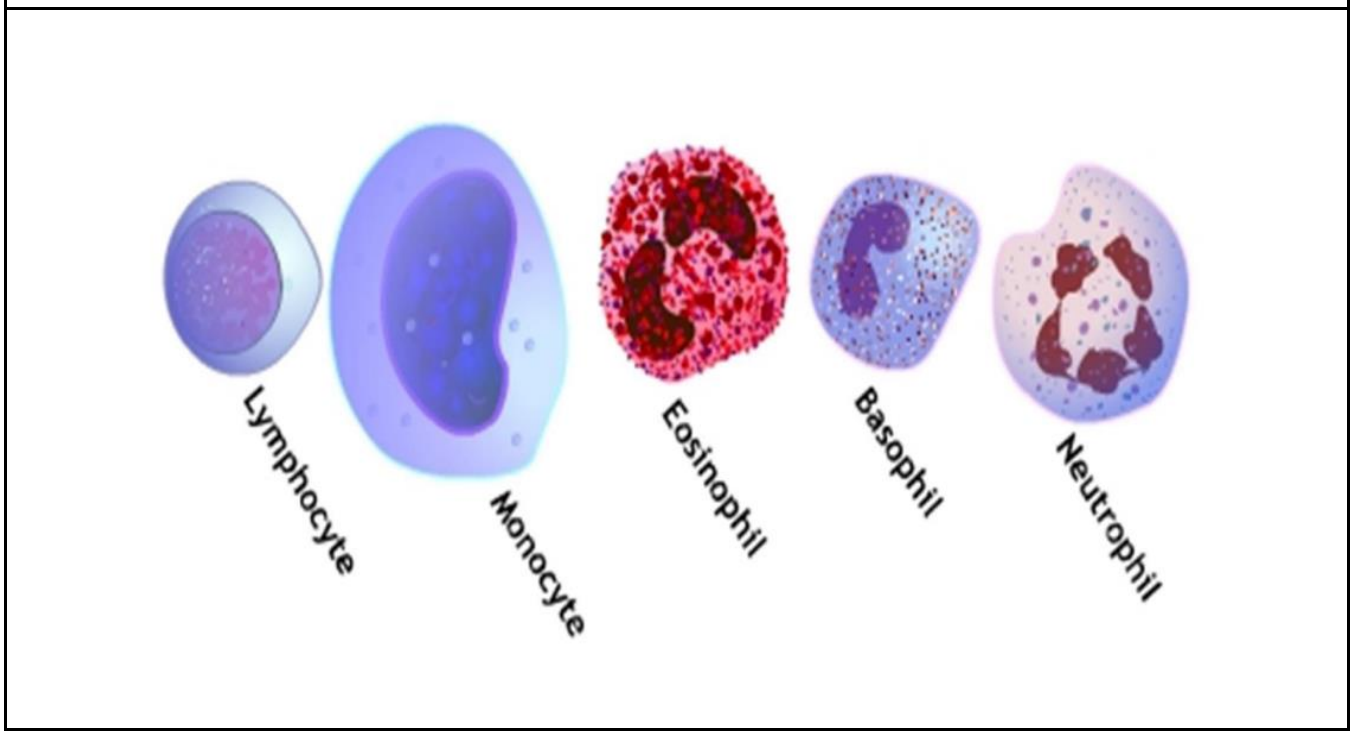
Granulocytes (محببة): 1-Neutrophils(متعادلة), 2-Eosinophils (حامضية), 3-Basophils (قاعدية)

Agranulocytes (غير محببة): 1-Lymphocytes (اللمفاوية), 2-Monocytes (الأحادية البالعة)

- **The main difference between RBCs and WBCs is that WBCs contain (تحتوي) nucleus.**
- **The differences between WBCs types is the shape of nucleus , function , coloring.**
- **Normal WBC count range from 4000 - 11000 cells/ mL this count varies with age**
- **Why do we use WBC test: سبب إجراء اختبار عدد كريات الدم البيضاء**
  - ✓ **to detect infection or inflammation تحديد وجود عدوى أو التهاب**
  - ✓ **detect the effects of possible poisoning تحديد آثار وجود سمية محتملة**
  - ✓ **monitor blood diseases like leukemia مراقبة أمراض الدم مثل اللوكيميا**
- **Leishman stain is used to dye and count WBC تستخدم صبغة ليشمان لصبغ وعد كريات الدم البيضاء**

- **Blood Film Test is a test used to count WBC**
- **Blood is a connective tissue**





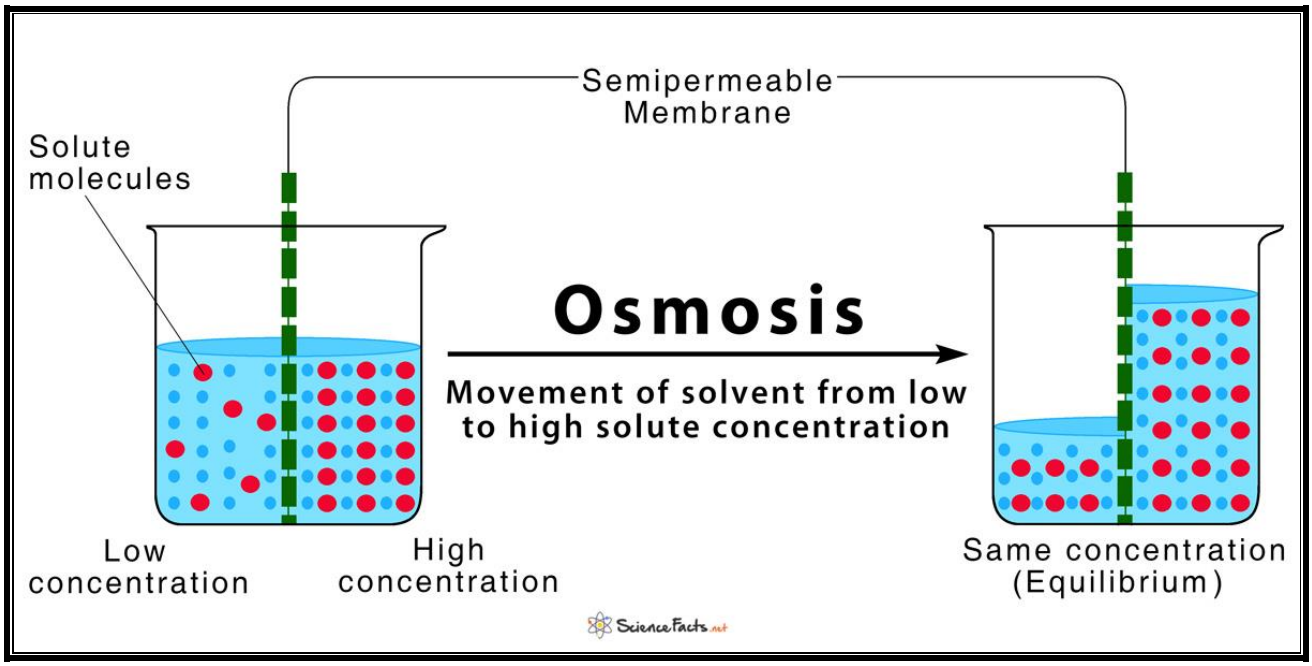
Practical Lecture 5

Osmotic Fragility Test

تناضحية خلايا الدم الحمراء

Osmosis is the natural movement of solvent from low to high solute concentration, to equalize the solute concentrations

هي حركة المادة المذيبة (السائل) من المكان الأقل تركيزا إلى الأعلى تركيزا، وذلك لجعل التركيزين متساويين.

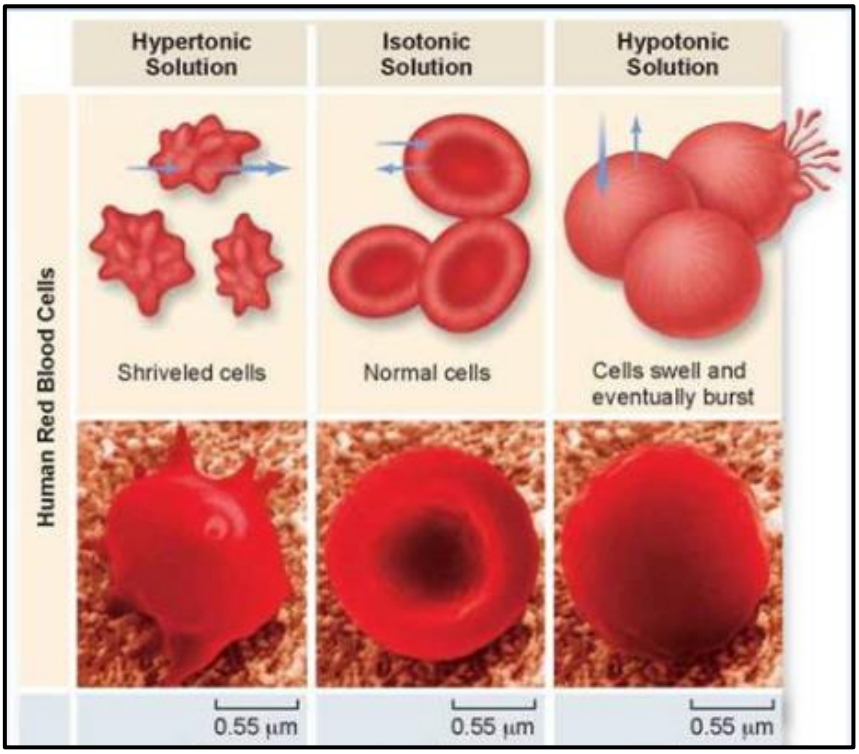


Fragility (هشاشية) of red blood cells refers to the tendency of RBC to hemolyze (انحلال الدم) under stress (saline solutions). The sooner hemolysis occurs, the greater the osmotic fragility of the cells

Hemolysis:- This term refers to the breaking down (bursting) of red cells resulting in release of Hb into the surrounding fluid.

isotonic solution: A solution that has the same salt concentration as cells and blood.

- **When cells are in isotonic solution, movement of water out of the cell is exactly balanced by movement of water into the cell. A 0.9% solution of NaCl (saline) is isotonic to animal cells.**
- **In a hypertonic solution (محلول عالي التركيز) the total concentration of all dissolved solute is greater than the concentration in a cell.**
- **In a hypertonic solution: the concentration of water outside is surely lower , so, water inside the cell will flow outside to attain equilibrium, causing the cell to shrink.**
- **In a hypotonic solution (محلول منخفض التركيز) the total concentration of all dissolved solute is less than that of a cell.**
- **In a hypotonic solution: the concentration of water outside is surely greater, so , the water will flow inside to the cell, so the cell will burst.**



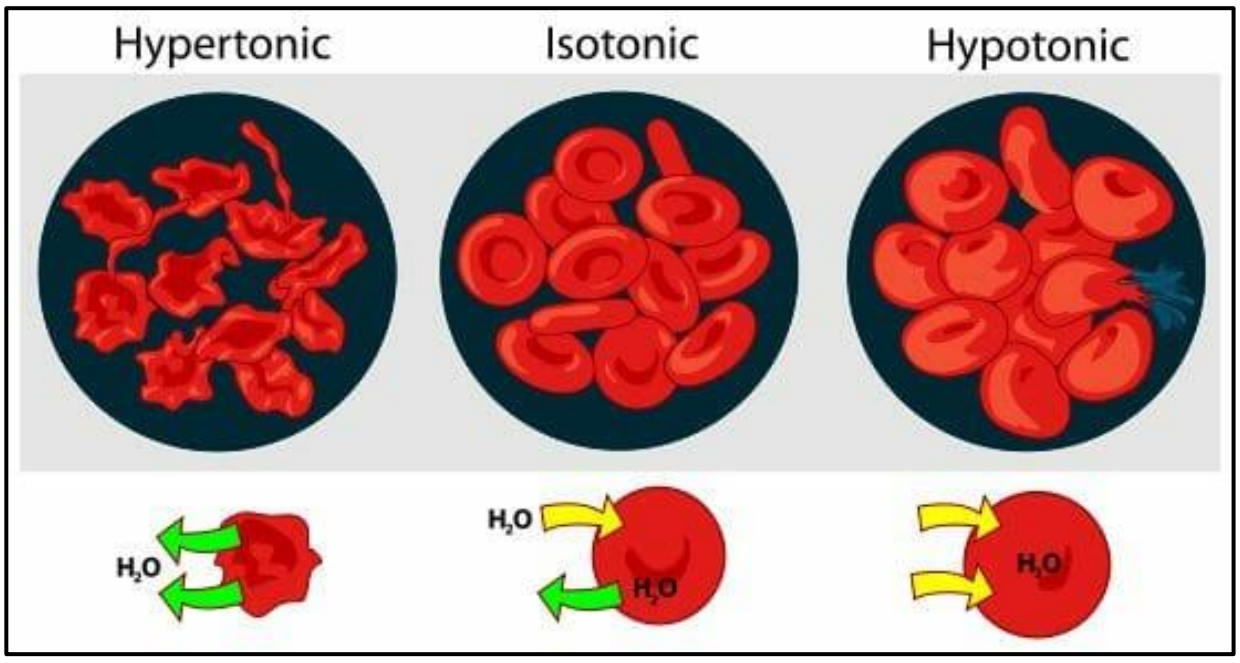
PRINCIPLES

The normal red cells can remain suspended in normal saline (0.9% NaCl solution) for hours without bursting or any change in their size or shape.

But when they are placed in decreasing strengths of hypotonic saline سائل منخفض الملوحة, they absorb water (due to osmosis) and finally burst. The ability of RBCs to resist this type of hemolysis can be determined quantitatively

Notes:

- **When RBC's are placed in distilled water (0% NaCL) Hypotonic solution, they will burst & the hemoglobin will be released and the hemoglobin will color the plasma hemolysis**
- **If the RBC's are placed in 0.9%NaCl nothing happens to them because it is isotonic with the cells**
- **If we put the RBC's in a hypertonic solution they will shrink.**



Factors affect the osmotic fragility:

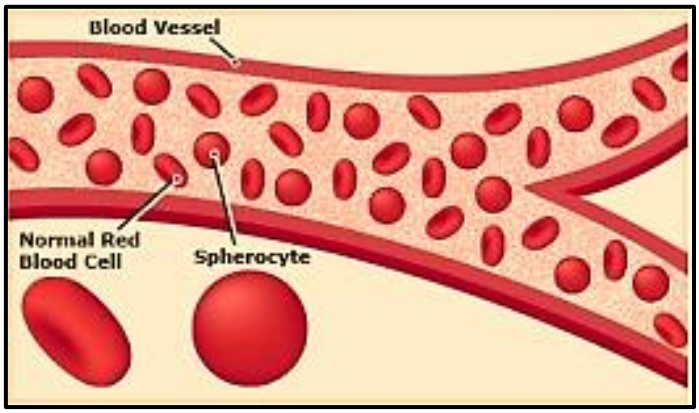
The main factors affecting the osmotic fragility test is the shape of the RBC's which is due to:

1- Cell membrane permeability (نفاذية).

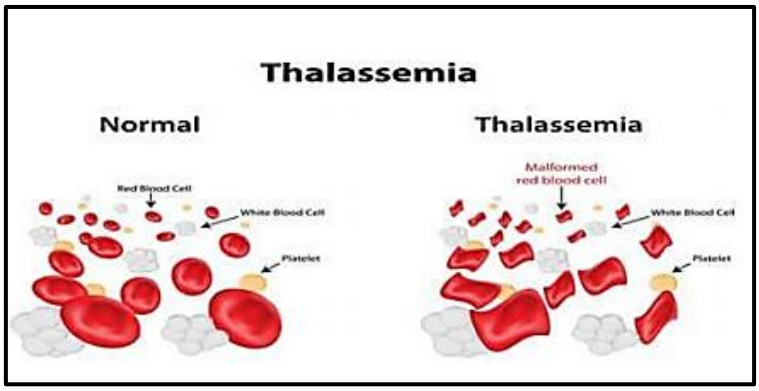
2- Surface-to –volume ratio

Why the Test is performed? To detect thalassemia (تلاسيميا) and hereditary spherocytosis (اضطراب زيادة كريات الدم الوراثي).

- **Hereditary spherocytosis is a disorder in which red blood cells are imperfect because of their round, ball-like shape. These cells are more fragile than normal because they are less likely to expand**



- **Thalassemia is an inherited condition that affects the portion of blood (hemoglobin) that carries oxygen**



Purpose:

To aid diagnosis of hereditary spherocytosis & Thalassemia.

Material &instruments

1. Test tubes

2. NaCl with different concentrations

3. Heparinized venous blood

4. Distilled water

Procedure

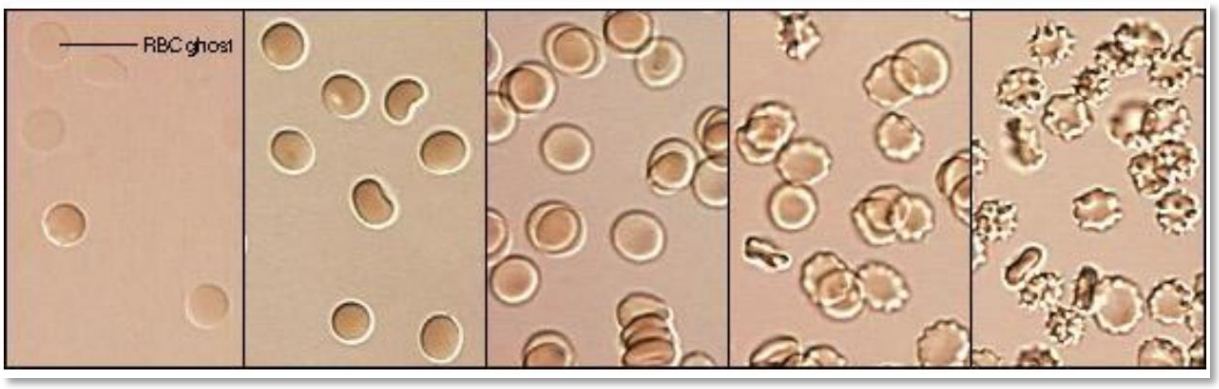
1- Prepare different concentrations of NaCl start with 0 concentration, then put in the rest of the test tubes the following concentrations of NaCl 0.3, 0.35 0.4, 0.45, 0.5, 0.9%

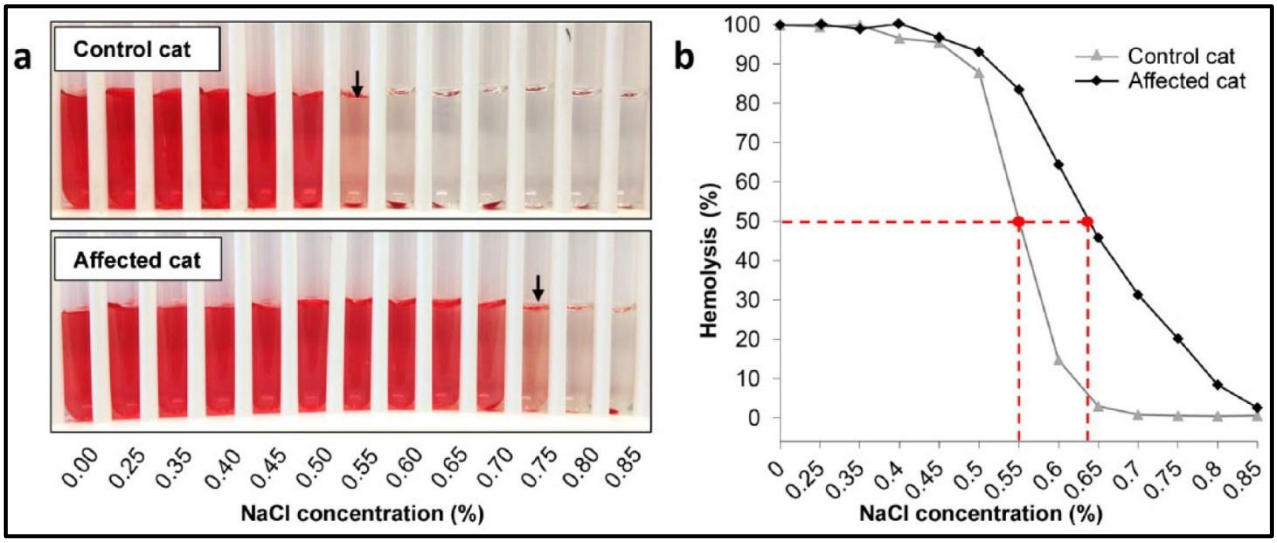
2- Put a few drops of heparinized blood in each test tube and read the results visually.

3- Carefully observe each tube for depth of red color of the supernatant الطافية and the mass of red cells at the bottom المترسبة.

4 - Place a small drop of each of the following solutions on a separate, clean microscope slides: 5% NaCl, 0.9% NaCl, 0.4% NaCl, and distilled water.

5- Observe each slide and note the appearance of the blood cells on the microscope.


RBC ghost


a
Control cat
Affected cat
0.00
0.25
0.35
0.40
0.45
0.50
0.55
0.60
0.65
0.70
0.75
0.80
0.85
NaCl concentration (%)
b
Control cat
Affected cat
Hemolysis (%)
100
90
80
70
60
50
40
30
20
10
0
0
0.25
0.35
0.4
0.45
0.5
0.55
0.6
0.65
0.7
0.75
0.8
0.85
NaCl concentration (%)