Pharmacy Exam Guide Step I ANATOMY & HISTOLOGY

-1st Edition (P1C5)

PHARMACY EXAM
GUIDE
STEP I
ANATOMY &
HISTOLOGY

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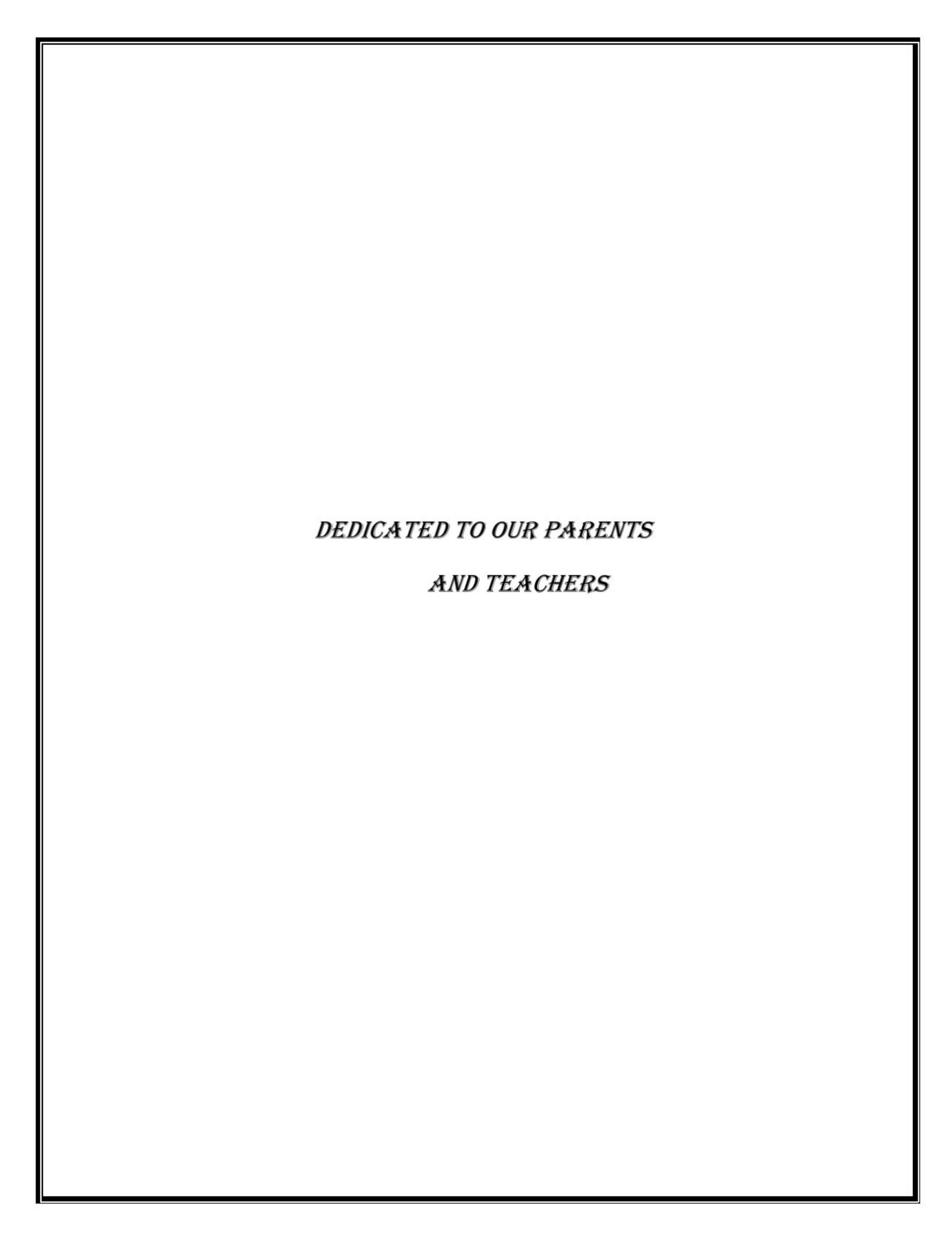
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ACKNOWLEDGEMENT

The future belongs to those who believe in the beauty of their dreams.

The preparation of this book "Pharmacy Exam Guide" was just a dream of some students of Doctor of Pharmacy, University of Central Punjab, which could not be fulfill without the help and support of our teachers and parents.

We appreciate the tireless efforts of *Our Teachers* who encouraged us always to achieve our endeavor, no matter, how hard they can be.

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Chapter 1 ANATOMICAL TERMINOLOGY

1.1 ANATOMY

"Anatomy is the study of structures or body parts and their relationships to on another" ANATOMY: Gross anatomy -macroscopic. HISTOLOGY -microscopic.

1.2 DIRECTIONAL TERMS

 SUPERIOR: means the part is above another or closer to head (cranial).

Vs.

INFERIOR: means the part is below another or towards the feet (caudal).

ANTERIOR: means towards the front (the eyes are anterior to the brain) -[ventral].

Vs.

POSTERIOR: means toward the back (the pharynx is posterior to the oral cavity) - [dorsal].

 MEDIAL: relates to the imaginary midline dividing the body into equal right and left halves (the nose is medial to the eyes).

Vs.

LATERAL: means towards the side with respect to the imaginary midline (the ears are lateral to the eyes).

 IPSILATERAL: the same side (the spleen and descending colon are ipsilateral).

Vs.

CONTRA LATERAL: Refers to the opposite side (the spleen and gallbladder are contralateral).

5.PROXIMAL: is used to describe a part that is

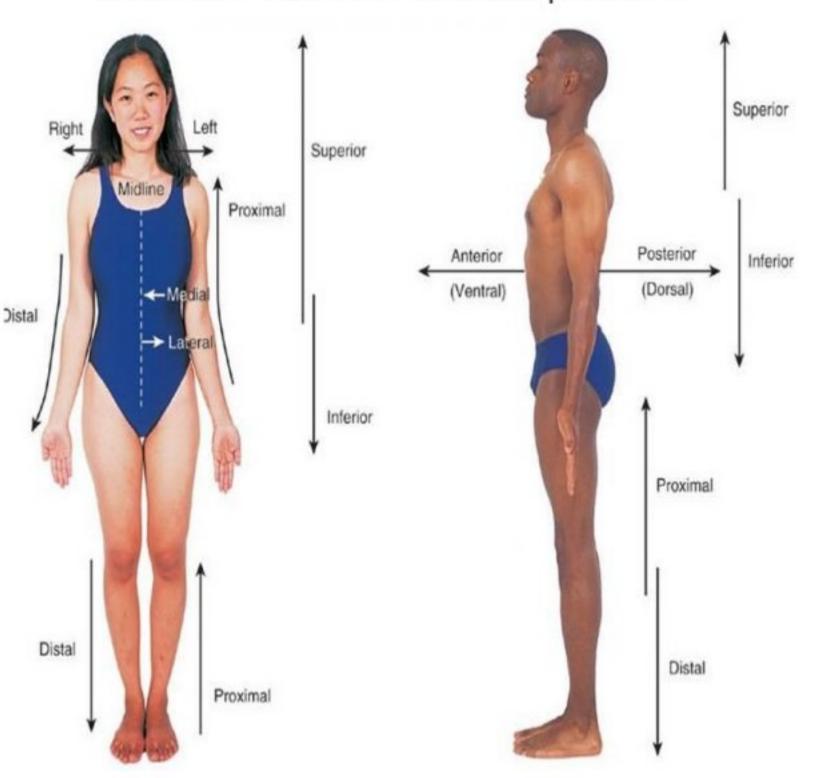


FIGURE 1 ANATOMICAL TERMINOLOGIES

closer to the trunk of the body or closer to another specified point of reference than another part (the elbow is proximal to the wrist).

Vs.

DISTAl: it means that a particular body part is farther from the trunk or farther from another specified point of reference than another part (fingers are distal to the wrist).

 SUPERFICIAL: means situated near the surface.
 Peripheral also means outward or near the surface.

Vs.

DEEP: is used to describe parts that are more internal.

Term	Definition	Illustration	Example
Superior (cranial or cephalad)	Toward the head end or upper part of a structure or the body; above		The forehead is superior to the nose.
Inferior (caudal) [†]	Away from the head end or toward the lower part of a structure or the body; below		The navel is inferior to the breastbone.
Anterior (ventral)*	Toward or at the front of the body; in front of	- B	The breastbone is anterior to the spine.
Posterior (dorsal)*	Toward or at the backside of the body; behind	8	The heart is posterior to the breastbone.

Term	Definition	Illustration	Example
Medial	Toward or at the midline of the body; on the inner side of		The heart is medial to the arm.
Lateral	Away from the midline of the body; on the outer side of	-	The arms are lateral to the chest.
Intermediate	Between a more medial and a more lateral structure	3	The armpit is intermediate between the breastbone and shoulder.
Proximal	Close to the origin of the body part or the point of attachment of a limb to the body trunk		The elbow is proximal to the wrist (meaning that the elbow is closer to the shoulder or attachment point of the arm than the wrist is).

1.3 REGIONAL TERMS:

- AXIAL PART: includes the head, neck, and trunk.
- APPENDICULAR PART: Includes the limbs which are attached to the body's axis.



Chapter 2 ANATOMICAL POSITIONS

2.1 PRONE:

If the body is lying face down, it is prone position.

2.2 SUPINE:

If the body is lying face up, it is supine position.

2.3 LEVELS OF ORGANIZATION

Particles → atom → molecule → macromolecule → organelle → cell → tissue → organ → organ system → organism.

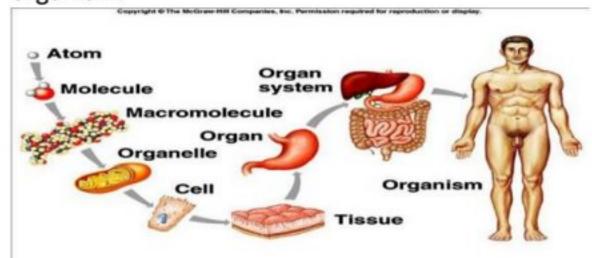


FIGURE 2 LEVEL OF ORGANIZATION

2.4 BODY ORGANIZATION

- BODY CAVITIES hollow spaces within the human body that contain Internal organs.
- a) THE DORSAL CAVITY: located toward the back of the body, is divided into the cranial cavity (which holds the brain) and vertebral or spinal cavity (which holds the spinal cord).
- b) THE VENTRAL CAVITY: located toward the front of the body, is divided into abdominopelvic cavity and thoracic cavity by the diaphragm.

The abdominopelvic cavity is subdivided into ABDOMINAL CAVITY (which holds liver, gallbladder, stomach, pancreas, spleen, kidney, small, and large intestines) and the PELVIC CAVITY (which holds the urinary bladder and reproductive organs).

 The thoracic cavity is subdivided into the PLEURAL CAVITY (which holds the lungs) and pericardial cavity (which holds the heart).

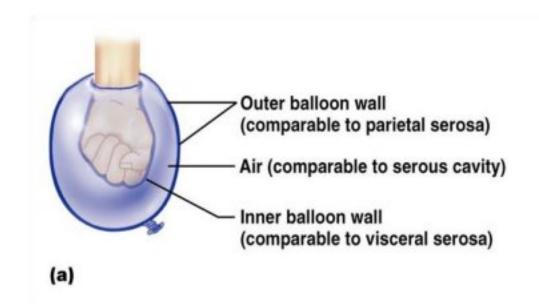
Cavity	Comments
Cranial Cavity	Formed by cranial bones and contains brain.
Vertebral Cavity	Formed by vertebral column and contain spinal cord and the beginings of spinal nerves
Thoracic Cavity	Chest cavity: contains Pleural and pericardial cavities

Pleural Cavity	Each surrounds a lung, , the serous membrane of each pleural cavity is the pleura.			
Pericardial Cavity	Surrounds the heart, the serous membrane of each pericardial cavity is pericardium.			
Mediastinum	Central portion of thoracic cavity between lungs, extends from sternum to vertebral column and from first rib to diaphragm; contains heart, thymus, esophagus, trachea, and several large blood vessels			
Abdominopelvic Cavity	Subdivided into abdominal and pelvic cavities			
Abdominal Cavity	Contains stomach, spleen, liver, gall bladder, small intestine, and most of large intestine, the serous membrane of the abdominal cavity is the peritoneum			
Pelvic Cavity	Contains urinary bladder, portions of large intestine, and internal organs of reproduction.			

2.5 BODY MEMBRANES

Body membranes – tissue linings of body cavities and coverings of internal organs.

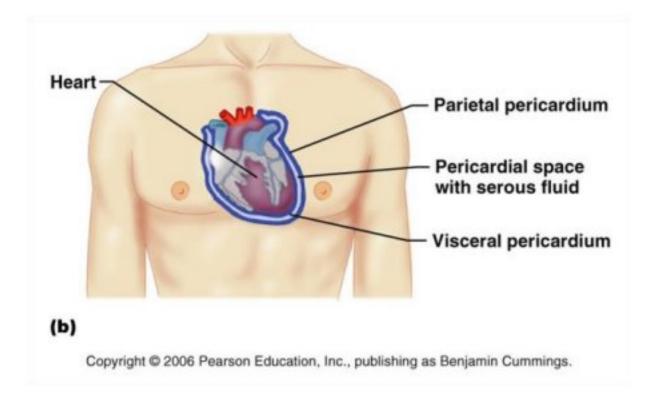
PARIETAL MEMBRANE -



Lining of body cavity (e.g. parietal pleural membrane lines the pleural cavity)

VISCERAL MEMBRANE -

Covering of internal organ (e.g. visceral pleural Membrane lines the surface of the lungs).



2.6 ORGAN SYSTEMS

the remaining 10

- Integumentary, skeletal, muscular, nervous, endocrine, digestive, Respiratory, Circulatory, lymphatic, urinary, and
- reproductive systems.
- The reproductive system is mainly involved in transmitting genetic
 Information From one generation to another, while

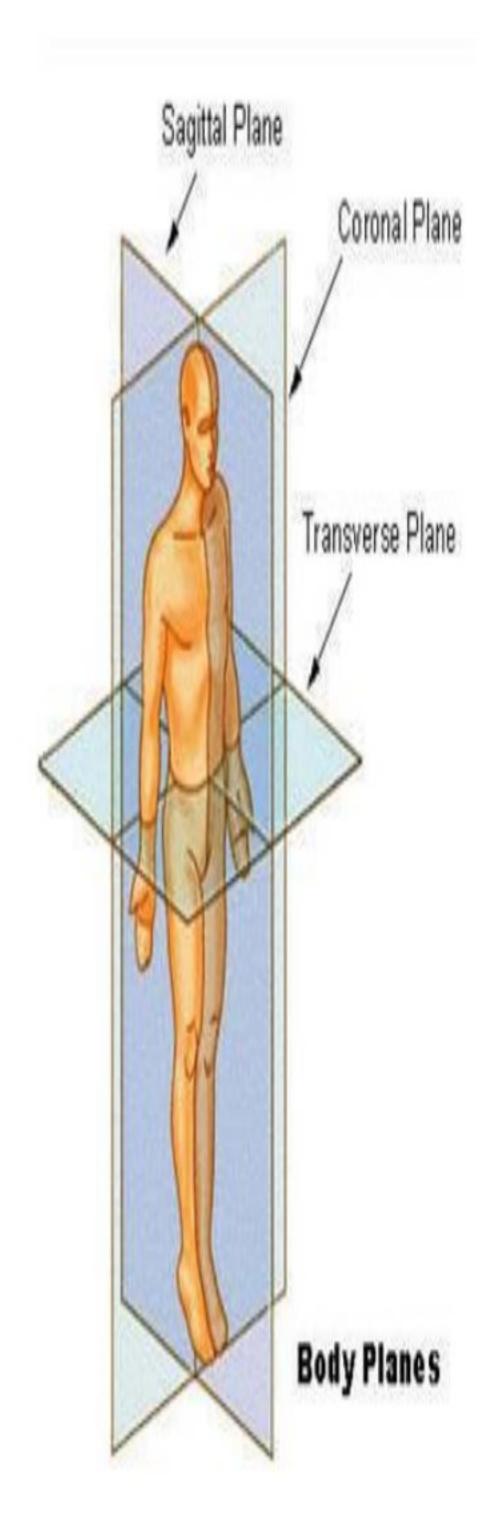
Organ systems are important in maintaining homeostasis.

- 3. These 11 organ systems may be classified by their functions:
- Protection -INTEGUMENTARY SYSTEM.
- Support and movement SKELETAL AND MUSCULAR SYSTEMS.
- Integration and coordination NERVOUS AND ENDOCRINE SYSTEMS.
- Processing and transport DIGESTIVE, RESPIRATORY, CIRCULATORY, LYMPHATIC, AND URINARY SYSTEMS.
- Reproduction and development REPRODUCTIVE SYSTEM.

2.6.1.1

2.7 BODY SECTIONS

- SAGITTAL PLANE divides the body into left and right sections.
- MIDSAGITTAL (MEDIAN) PLANE divides the body into equal halves at midline.
- FRONTAL (CORONAL) PLANE —divides the body into anterior and posterior sections.
- TRANSVERSE (HORIZONTAL) PLANE divides the body into superior and inferior sections.
- PARASAGITTAL PLANE- If sagital plane does not pass through midline but instead divides body into unequal right and left sides



2.8 BODY REGIONS

• The abdominal area is subdivided into 9 REGIONS

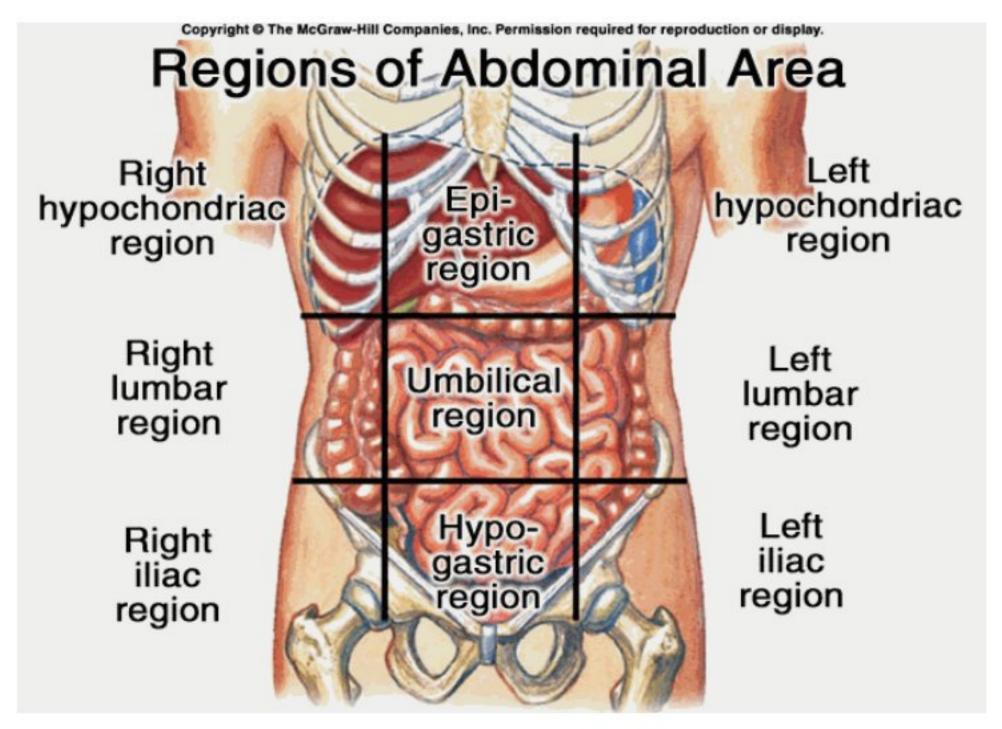


FIGURE 3 BODY REGIONS

The four abdominopelvic quadrants

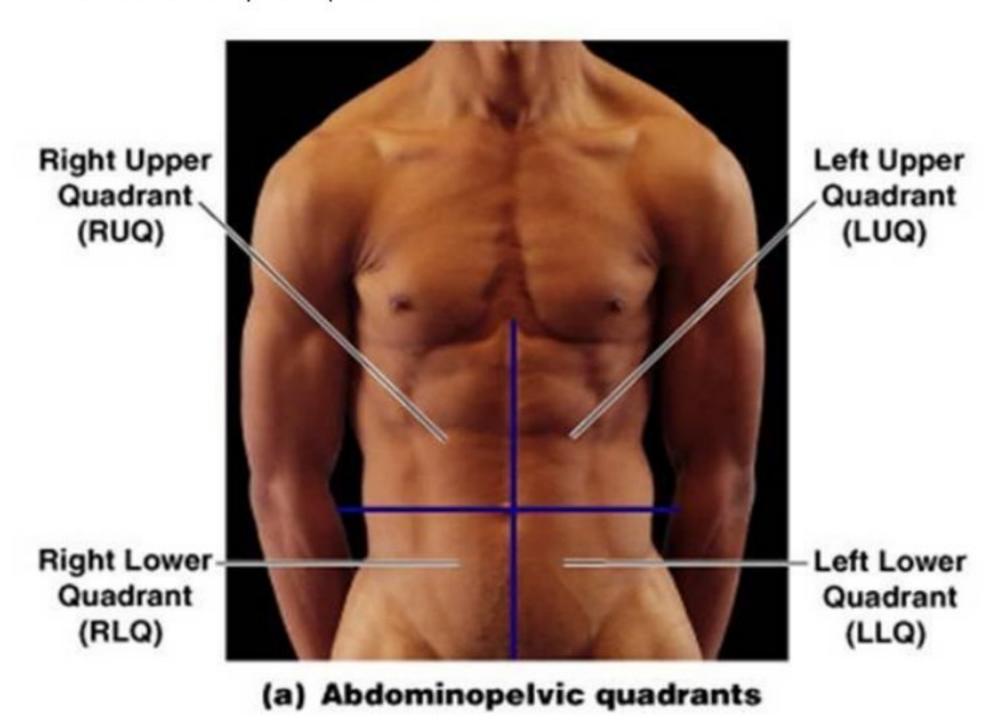


FIGURE 4 ABDOMINOPELVIC QUADRANTS

The nine region division is more widely used for anatomical studies to determine organ location; quadrants are commonly used by clinician for describing the site of abdominal pelvic pain, tumor, injury, or other abnormality.

2.9 COMMON TERMS

- ABDOMINAL = region between thorax and pelvis.
- ANTE BRACHIAL = the forearm.
- ANTECUBITAI = the front of elbow.
- AXILLARY = the armpit.
- BRACHIAL = the upper arm.
- CELIAC = the abdomen.
- CEPHALIC = the head.
- CERVICAL = the neck.
- COSTAL = the ribs.
- CUBITAL = the elbow.
- FEMORAL = the thigh.
- GLUTEAL = the buttock.
- LUMBAR = the lower back.
- ORBITAL/ OPTIC = eyes
- AUDITORY/OTIC = Ears
- HANDS UPPER SURFACE (DORSAL)/
 Hands inner surface (Palmer)
- FOOT UPPER SURFACE (DORSAL)/ Foot inner surface (Plantar)

Chapter 3 CELL

3.1 CELL:

The smallest unit of protoplasm capable of independent existence is called a cell. Cells form structural and functional units of all living organisms.

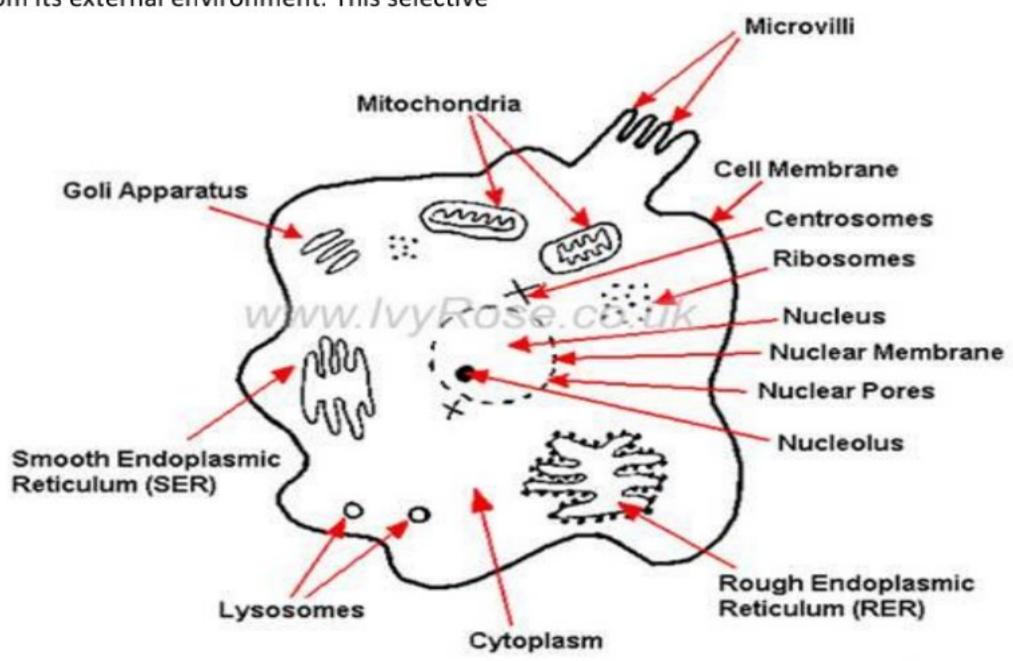
Cell can be divided into three principal parts:

- Plasma membrane
- Cytoplasm
- And Nucleus
- PLASMA MEMBRANE forms the cells flexible outer surface, it separates the cells internal environment (everything inside cell) from its external environment. This selective

barrier regulates the flow of materials into and out of a cell, helping to establish and maintain the appropriate environment for cellular activities.

- > The CYTOPLASM is all of the cellular contents between the plasma membrane and nucleus.
- NUCLEUS is a large organelle that houses most of cells DNA. With in nucleus, each chromosome, a single molecule of DNA associated with several proteins, contains thousand of hereditary units called genes.

The following diagram illustrates a single cell and simple representations of key organelles:



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			7 -	
3.1.1	ORGANELLE	3.1.2 STRUCTURE/FUNC TION		These are the energy producers within the cell.
3.1.3	CELL MEMBRANE	The cell membrane lipid bilayer (phospholipids, glycolipids, and cholesterol) keeps the cell together by containing the organelles within it. Cell membranes are selectively-permeable, allowing materials to move	3.1.10 NUCLEAR MEMBRANE	They generate energy in the form of Adenosine Tri- Phosphate (ATP). Generally, the more energy a cell needs, the more mitochondria it contains. The nuclear membrane separates the nucleus and the nucleolus from the rest
		both into and outside of the cell.		of the contents of the cell.
3.1.4	CENTROSO MES CYTOPLASM	The centrosomes contain the centrioles, which are responsible for cell-division. Cytoplasm is a jelly-like	3.1.11 NUCLEAR PORE	Nuclear pores permit substances (such as nutrients, waste, and cellular information) to pass both into, and out of, the
		substance that is sometimes described as "the cell-matrix". It holds the organelles in place within	3.1.12 NUCLEOLUS	nucleus. The nucleolus is responsible for the cell organelles (e.g. lysosomes, ribosomes, etc.).
3.1.6	GOLGI APPARATUS	is usually connected to an	3.1.13 NUCLEUS	The nucleus is the "Control Center" of the cell, which contains DNA (genetic information) in the form of genes, and also information for the formation of
3.1.7	LYSOSOMES	Lysosomes are tiny sacs filled with enzymes that enable the cell to utilize its nutrients. Lysosomes also destroy the cell after it has died, though there are some circumstances (diseases/conditions) in	3.1.14 RIBOSOMES	Information is carried on chromosomes, which are a form of DNA. Ribosomes interpret cellular information from the nucleus and so synthesize appropriate proteins, as required.
		which lysosomes begin to	3.1.15 ROUGH	"Rough" indicates that there
3.1.8	Microvilli	'break-down' living cells. "Microvilli" is the pural form; "Microvillus" is the singular form. Microvilli are finger-like projections on the outer-surface of the cell. Not all cells have microvilli. Their function is to increase	ENDOPLASM IC RETICULUM (RER)	are ribosomes attached to the surfaces of the endoplasmic reticulum. The endoplasmic reticulum is where proteins and lipids are produced within the cell, and is also concerned with the transport of these materials within the cell.
		the surface area of the cell, which is the area through which diffusion of materials both into, and out of, the cell is possible.	3.1.16 SMOOTH ENDOPLASM IC RETICULUM	"Smooth" indicates that there are no ribosomes attached to the surfaces of the endoplasmic reticulum.
3.1.9	MITOCHON	"Mitochondria" is a plural term; which is appropriate as these are not found alone. The quantity of mitochondria within cells varies with the type of cell.		The endoplasmic reticulum is where proteins and lipids are produced within the cell, and is also concerned with the transport of these materials within the cell.

3.2 TISSUE

3.2.1 DEFINITION:

TISSUE is a cellular organizational level intermediate between cells and a complete organism.

A tissue is an ensemble of cells, not necessarily identical, but from the same origin, that together carry out a specific function. ORGANS are then formed by the functional grouping together of multiple tissues.

3.3 EPITHELIAL TISSUES

It cover the whole body inside and out. They form the skin , and the INNER LINING OF THE BODY CAVITIES such as the stomach and the intestines.

3.3.1 FUNCTIONS:

- Can reproduce quickly in case of damage or injury. That's why your skin heals so quickly when you get a cut.
- · absorption of nutrients from food,
- the secretion of hormones in the glands,
- saliva in the mouth,
- · perspiration in the skin,

Four types of tissue

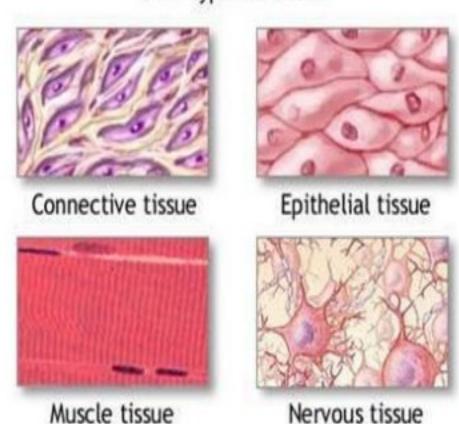


FIGURE 5: TYPES OF TISSUE

M.

· And enzymes indigestion.

3.4 DIFFERENT TYPES OF EPITHELIUM

Epithelial tissue helps to protect organisms from microorganisms, injury, and fluid loss.

Types of Epithelium Simple squamous Simple cuboidal Simple columnar Stratified squamous Stratified cuboidal Stratified cuboidal Pseudostratified columnar

3.5 CONNECTIVE TISSUE

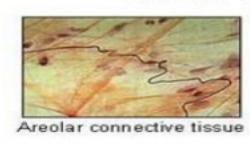
Connective tissues bind structures together.

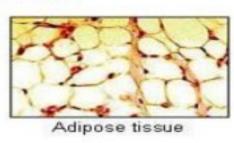
3.5.1 FUNCTIONS:

They also provide support and protection.

3.5.1.1 CONNECTIVE TISSUE INCLUDES TENDONS, LIGAMENTS, BONE AND

CARTILAGE. OTHER TYPES OF THIS TISSUE STORE FAT, PRODUCE BLOOD CELLS AND DESTROY BACTERIA.





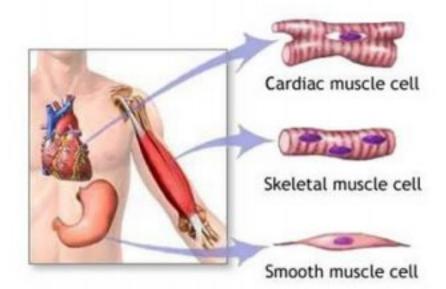




3.6 Muscle tissues

Muscle cells form the active contractile tissue of the body known as muscle tissue.

Muscle tissue functions to produce force and cause motion, either locomotion or movement within internal



*ADAM.

3.6.1 FUNCTION:

is to contract and cause body parts to move.

3.6.2 TYPES:

- skeletal muscle,
- smooth muscle,
- and cardiac muscle.

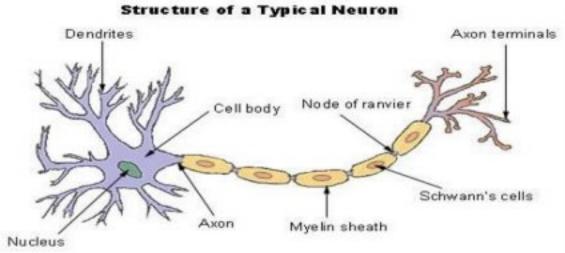
3.7 Nerve Tissue

Nerve tissues are sensitive to changes.

- 3.7.1.1 THEY RECEIVE AND TRANSMIT IMPULSES TO VARIOUS PARTS OF THE BODY.
- 3.7.1.2 THEY ARE LOCATED IN THE BRAIN, SPINAL CORD AND THE NERVES.

In the central nervous system, neural tissue forms the brain and spinal

cord and, in the peripheral nervous system forms the cranial nerves and spinal nerves, inclusive of the motor neurons.



3.7.2 FUNCTIONS:

Transmits communications

3.8 ORGANS

"Organs are the next level of organization in the body."

An ORGAN is a structure that contains at least two different types of tissue functioning together for a common purpose.

There are many different organs in the body:

- the liver,
- kidneys,
- heart,
- · even your skin is an organ.

In fact, the skin is the largest organ in the human body and provides us with an excellent example for explanation purposes

3.8.1 THE SKIN IS COMPOSED OF THREE LAYERS:

- the epidermis,
- dermis and
- subcutaneous layer.

The EPIDERMIS is the outermost layer of skin. It consists of EPITHELIAL TISSUE in which the cells are tightly packed together providing a barrier between the inside of the body and the outside world. Below the epidermis lies a layer OF CONNECTIVE TISSUE called the DERMIS.

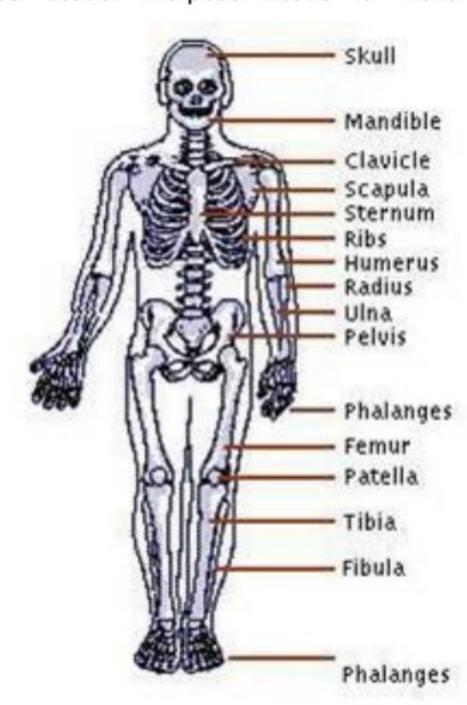
In addition to providing support for the skin, the dermis has many other purposes.

The dermis contains blood vessels that nourish skin cells.

It contains NERVE TISSUE that provides feeling in the skin.

And it contains MUSCLE TISSUE that is responsible for giving you 'goose bumps'when you get cold or frightened.

The SUBCUTANEOUS LAYER is beneath the dermis and consists mainly of a type of CONNECTIVE TISSUE called adipose tissue. Adipose tissue is more



commonly known as fat and it helps cushion the skin and provide protection from cold temperatures.

3.9 ORGAN SYSTEMS

Two or more organs working together in the execution of a specific body function form an organ system, also called a BIOLOGICAL SYSTEM OR BODY SYSTEM.

The functions of organ systems often share significant overlap. For instance, the nervous and endocrine system both operate via a shared organ, the hypothalamus.

For this reason, the two systems are combined and studied as the neuroendocrine system. The same is true for the musculoskeletal system because of the relationship between the muscular and skeletal systems.

3.10 SKELETAL SYSTEM

MAJOR ROLE:

The main role of the skeletal system is to provide support for the body, to protect delicate internal organs and to provide attachment sites for the organs.

MAJOR ORGANS:

Bones, cartilage, tendons and ligaments

3.11 Muscular System

MAJOR ROLE:

The main role of the muscular system is to provide movement. Muscles work in pairs to move limbs and provide the organism with mobility. Muscles also control the movement of materials through some organs, such as the stomach and intestine, and the heart and circulatory system.

MAJOR ORGANS:

Skeletal muscles and smooth muscles throughout the body.

3.12 CIRCULATORY SYSTEM

MAJOR ROLE:

The main role of the circulatory system is to transport nutrients, gases (such as oxygen and CO₂), hormones and wastes through the body.

MAJOR ORGANS:

Heart, blood vessels and blood.

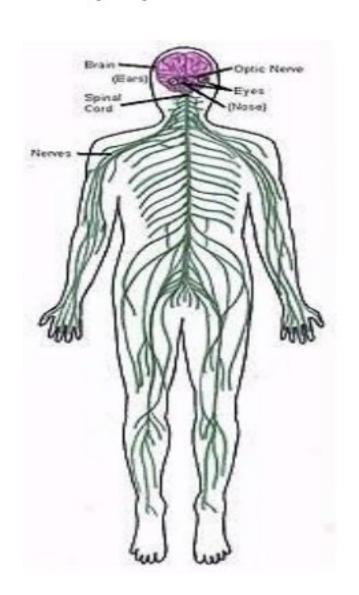
3.13 Nervous System

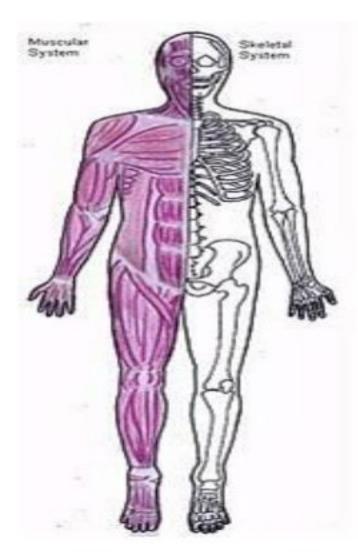
MAJOR ROLE:

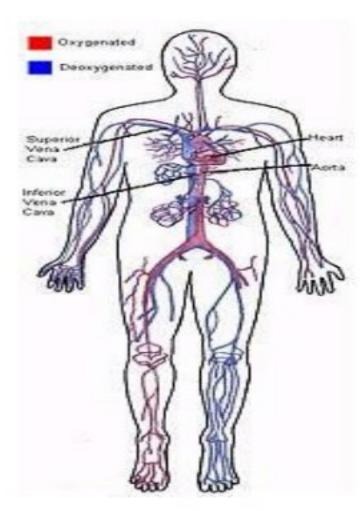
The main role of the nervous system is to relay electrical signals through the body. The nervous system directs behaviour and movement and, along with the endocrine system, controls physiological processes such as digestion, circulation, etc.

MAJOR ORGANS:

Brain, spinal cord and peripheral nerves







3.14 RESPIRATORY SYSTEM

MAJOR ROLE:

The main role of the respiratory system is to provide gas exchange between the blood and the environment. Primarily, oxygen is absorbed from the atmosphere into the body and carbon dioxide is expelled from the body.

MAJOR ORGANS:

Nose, trachea and lungs.

3.15 DIGESTIVE SYSTEM

MAJOR ROLE:

The main role of the digestive system is to breakdown and absorbs nutrients that are necessary for growth and maintenance.

MAJOR ORGANS:

Mouth, esophagus, stomach, small and large intestines.

3.16 EXCRETORY SYSTEM

MAJOR ROLE:

The main role of the excretory system is to filter out cellular wastes, toxins and excess water or nutrients from the circulatory system.

MAJOR ORGANS:

Kidneys, ureters, bladder and urethra.

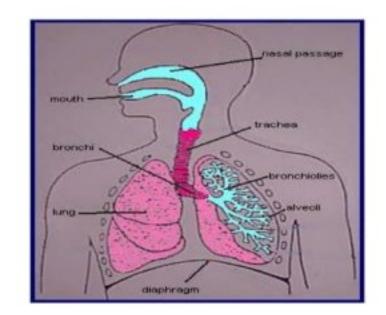
3.17 ENDOCRINE SYSTEM

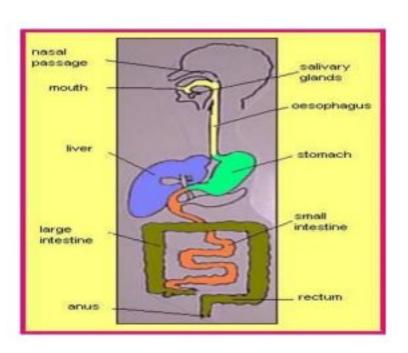
MAJOR ROLE:

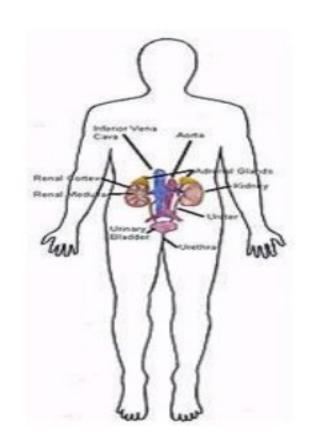
The main role of the endocrine system is to relay chemical messages through the body. In conjunction with the nervous system, these chemical messages help control physiological processes such as nutrient absorption, growth, etc.

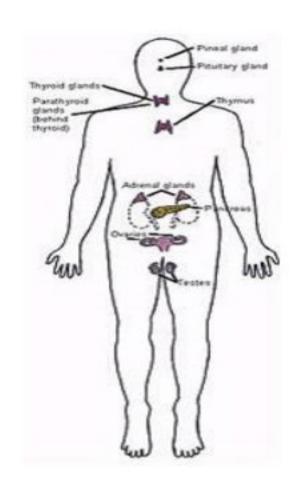
MAJOR ORGANS:

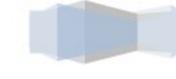
Many glands exist in the body that secretes endocrine hormones. Among these are the hypothalamus, pituitary, thyroid, pancreas and adrenal glands.









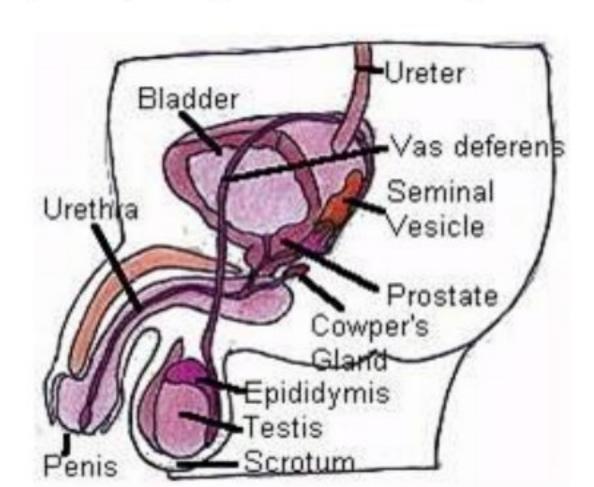


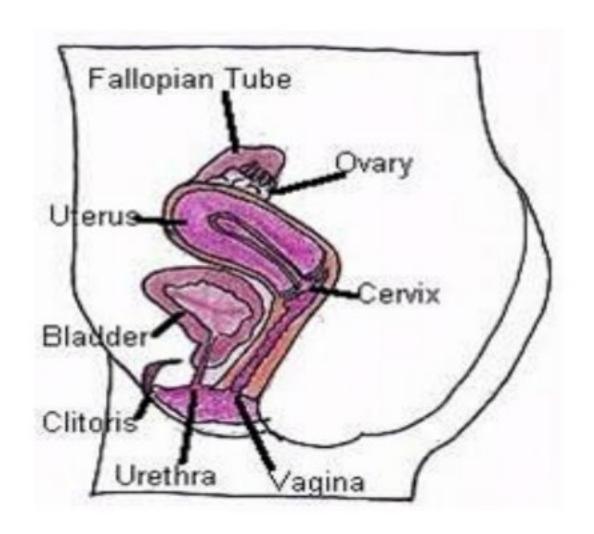
3.18 REPRODUCTIVE SYSTEM

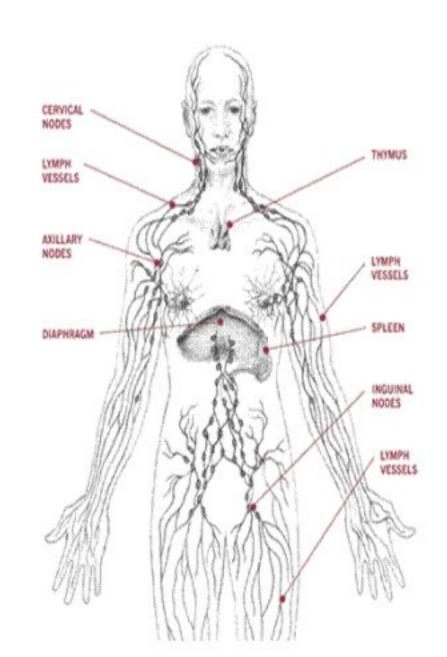
MAJOR ROLE:

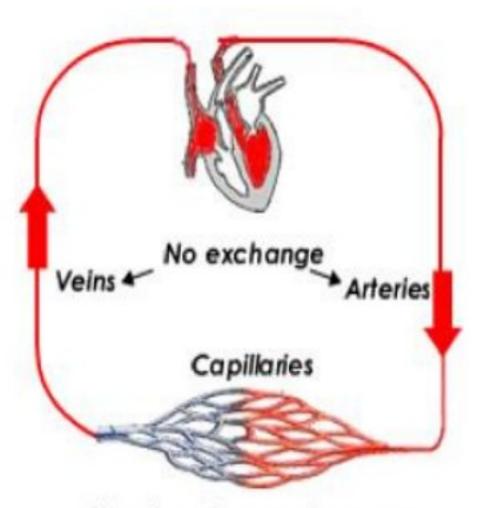
The main role of the reproductive system is to manufacture cells that allow reproduction. In the male, sperm are created to inseminate egg cells produced in the female.

MAJOR ORGANS:
Female (top): ovaries, oviducts, uterus, vagina and mammary glands.
Male (bottom): testes, seminal vesicles and penis.









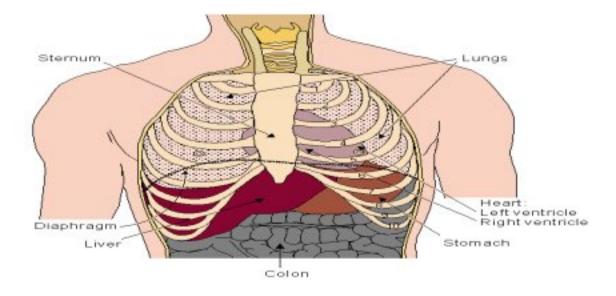
Site of exchange of oxygen, carbon dioxide, nutrients and waste between blood and tissues

LYMPHATIC / IMMUNE SYSTEM

MAJOR ROLE:

The main role of the immune system is to destroy and remove invading microbes and viruses from the body. The lymphatic system also removes fat and excess fluids from the blood.

MAJOR ORGANS: Lymph, lymph nodes and vessels, white blood cells, T- and B- cells.



Chapter 4 CARDIOVASCULAR SYSTEM

4.1 Introduction:

It is a transport system of body through which nutrient are convey to the the tissue for utilization and metabolism or carried to appropriate place to excretion.

Carried medium id liquid, blood flow in blood vessels, central pumping organ, Heart maintains the circulation of blood in tissue.

4.2 CVS COMPONENTS:

4.2.1 HEART:

Heart is a four chamber muscular chamber which pumps blood into tissues of the body.

- Receiving chamber is ATRIUM.
- Pumping chamber is VENTRICLE.

4.2.2 ARTRIES:

- Distributing channel
- · Carry blood away from the heart.
- Branched like tree in the coarse.
- Large arteries rich in Elastic tissue.
- Medium arteries rich in Muscular tissue.
- Arterioles are minute branches, visible to naked eye.

4.2.3 VEINS:

Veins are draining channels. These bring back blood to heart from tissue

 Venules are small veins, join tighter to form large vein.

4.2.4 CAPILLARIES:

- Network of microscopic vessels.
- Connect arterioles with venules.
- Cause free exchange of Nutrition and metabolism across the wall between blood and fluid vessels.

4.3 HEART:

"The scientific study of the normal heart and the diseases associated with it is CARDIOLOGY"

4.3.1 LOCATION OF THE HEART:

The Heart is the hollow muscular pumping organ of somewhat conical form. It lies between the lungs in the mediastainum and is enclosed in pericardium. It is placed obliquely in the chest behind the body of sternum and adjoining part of Rib cartilage and projected farther into the right half of thoracic cavity so that about $1/3^{rd}$ of it is situated into the right and $2/3^{rd}$ on the left of medial plane.

4.3.2 SIZE:

The heart in the adult measures about 12cm in length 8-9cm in breath at the broadest part and 6cm in thickness. Its weight in males varies from 280-

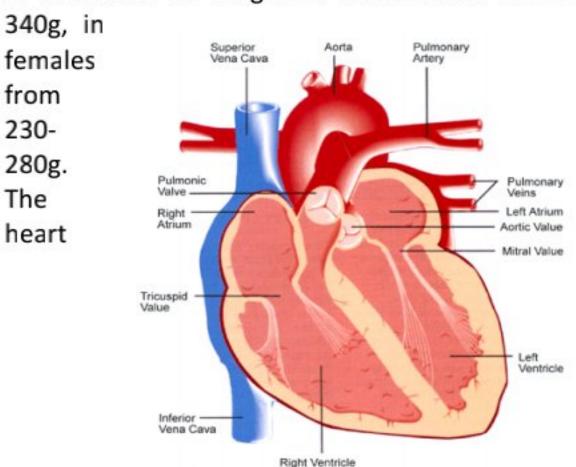


FIGURE 6 HEART

continuous to increase in weight and size up to an advance period of life, this increase is more marked

than women.

base

4.3.3 APEX:

Visualize the Heart as cone lined on its side. The pointed part of its heart is the apex by the tip of left ventricle (a lower chamber of heart) and rest on diaphragm. It is directed anterioraly, inferiorly to the left.

4.3.4 BASE:

The base of heart is posterior surface is formed by atreia (upper channels of heart). The base is formed by left atrium into which pulmonary veins and a portion of right atrium which receives the inferior and superior vena cava.

4.4 SURFACES & BORDER:

4.4.1 ANTERIOR BORDER:

Anterior border of the heart is deep to sternum and ribs.

4.4.2 INFERIOR SURFACE:

Inferior border is the portion of heart that rest mostly on the diaphragm and is formed between apex and the the right border.

- The right border faces the right lung and extends from inferior surface to the base.
- The left border called also called the pulmonary border faces the left lung and extend from the base of apex.

4.5 IMPORTANCE:

Determining of an organ surface projection means outlining its dimension, this practice is useful when conducting diagnostic procedures such as lumbar puncture.

4.6 COVERING & WALLS:

The heart is enclosed by a double wall sac called pericardium the loosely fitted superficial part of this sac is referred to as fibrous pericardium. This fibrous layer helps to protect the heart and anchors it to the surrounding structure such ac diaphragm and sternum. Deep to fibrous pericardium is the slippery two layers serous pericardium, this parietal layer lines the anterior of the fibrous pericardium at the superior aspect of heart. This parietal layer attaches to the large arteries leaving the heart and then makes u-turn and continuous inferiorly over the heart surface as the visceral layer or epicedium which is actually part of the heart wall.

A slippery lubricant fluid (serous fluid) is produced by the serous membrane, this fluid allows the heart to beat easily in a relatively friction less environment as the serous pericardial layers slightly smoothly across each other posterior backbone.

4.7 LAYERS OF HEART:

The heart wall composed of three layers the outer epicedium (visceral pericardium) the myocardium and the inner most endocardium. The myocardium consist of thick bundles of cardiac muscles twisted into ring like arrangements, it is the layer that actually contract, the myocardium is reinforced internally by a dense fibrous connective tissue network called the "skeleton of Heart".

The endocardium is the glancing sheet of endothelium that lining the heart cardium. It is continues to with the lining of blood vessels leaving and entering the heart.

4.8 CHAMBERS OF HEART:

The heart is a dual pump that contains 4 chambers two upper or receiving chamber called atrium and two lower or pumping chamber called ventricle. The paired atria received blood from vessels receiving blood to the heart called veins while the ventricle ejects blood from the heart into the blood vessel called arteries. The right pump consisting of right atrium and right ventricle is a weaker pulmonary pump. This pulmonary pump moves deoxygenated blood thorough the blood vessels to the lungs. The left pump comprise of left atrium and left ventricle is the strong systemic pump. This systemic pump circulated oxygenated blood to all system of the body.

4.8.1 AURICLE:

On the anterior surface of each atrium is wrinkled pouch like structure called an auricle. Each auricle increases the capacity of atrium slightly so that it can hold greater volume of the blood.

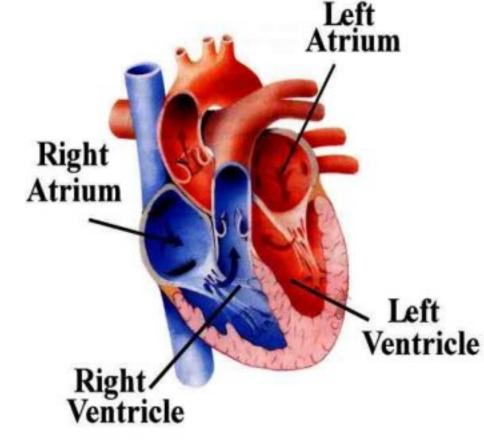
4.8.2 SULCI:

Also on the heart surface there are series of grooves called sulci which contain coronary blood vessel and a variable amount of fat. Each sulcus makes the

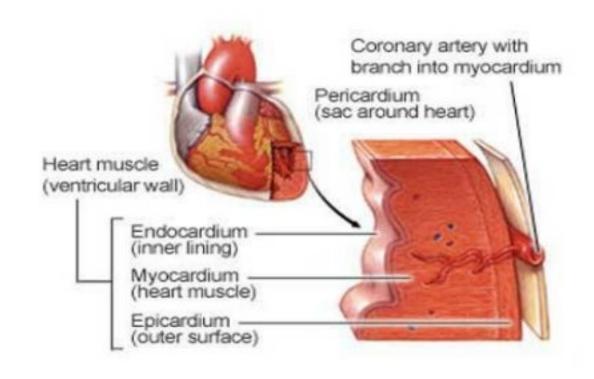
between two chambers of the heart.

4.8.3 1. RIGHT ATRIUM:

The right atrium forms the right border of the heart and it is about2-3mm in average thickness it receives blood from



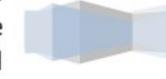
these veins; superior vena cava, inferior vena cava



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FIGURE 7 LAYERS OF HEART

and coronary sinus vein (opening of CVS) always carry blood towards the heart between the right and left atrium is thin partition called interstitial septum, a prominent feature of this septum is oval shaped depression "fossa ovalis". Blood passes from the atrium into the right ventricle through a valve called



suspid valve. It is also called antrioventricular valve TRICUSPID VALVE.

4.8.4 2. RIGHT VENTRICLE:

The right ventricle 4-5cm in average thickness forms the most of the anterior surface of heart. The inside of right ventricle contains a series of ridges form by raised bundles of Cardiac Muscle fiber called TRABECULAE CARNEAE.

4.8.5 TRICUSPID VALVE:

Tricuspid valve guards the atrio ventricular and consists of 3 cusps and formed by the fold of Endocardium with some connective tissue enclosed.

4.8.6 PULMONARY VALVE:

Blood passes from the right ventricle through the pulmonary valves into large vessels called pulmonary trunk. Pulmonary trunk divides into right and left pulmonary arteries, which carries blood to the lungs.

4.8.7 3. LEFT ATRIUM:

Left atrium forms most of the base of the heart. It receives blood from the pulmonary vein, blood passes from the left atrium into left ventricle from the bicapsited valve (mitral valve) which has two caps. It is also called as left atrio ventricular valve.

4.8.8 4. LEFT VENTRICLE:

The left ventricle is the thickest part of the heart averaging 10-15mm thickness forms the apex of the heart like the right ventricle, it also contains Trabuclae carnea. Bloods passes from left ventricle through aortic valve into largest artery of the body (the ascending aorta). Some of the blood in the aorta flows in the coronary arteries which branched from ascending aorta and carry blood to the heart wall braches of arc of the aorta carry the blood throughout the body.

4.9 FUNCTION OF HEART VALVES:

The heart consist of four chambers

- Two arteries (upper chamber)
- Two ventricle (lower chamber)

Blood passes through a valve before passing through each chamber of the heart. The valve prevents the backward flow of blood. Valves are actually flaps that act as one-way inlets for blood coming into ventricle. Each has three flaps except the mitral valve (bicuspid valve) which only has two flaps. The four heart valve includes the following:

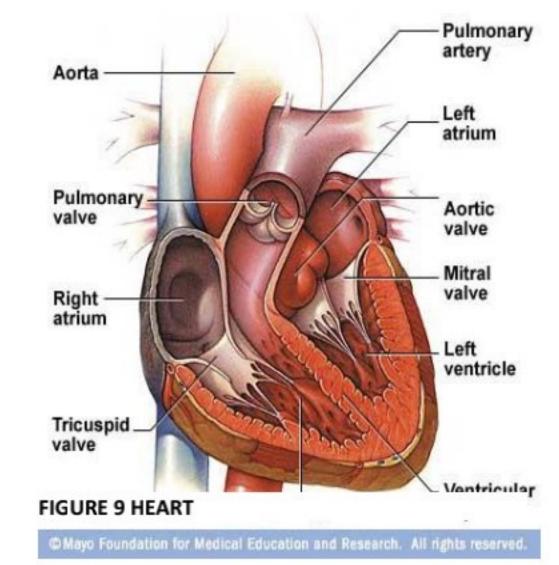
- TRICUSPID VALVE (located between right atrium and right ventricle)
- PULMONARY VALVE (located between right valve and pulmonary artery)
- MITRAL VALVE (located between left ventricle and left artery)
- AORTIC VALVE (located between left ventricle and aorta)

4.9.1 How do the Heart Valves function?

As the heart muscle contracts and relaxes
 FIGURE 8 CHAMBERS OF HEART

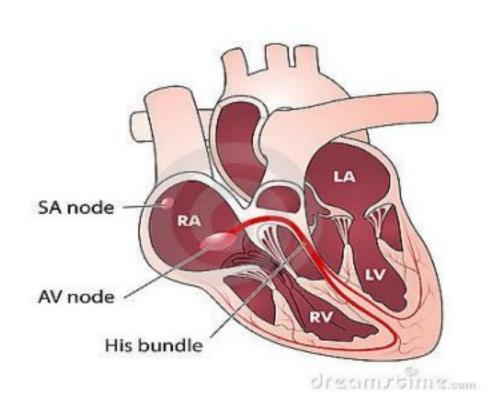
the valves open and shut letting blood flow into the ventricle and atria at alternate times. The following is the step by step description of how the valves function normally in the left ventricle.

 When the left ventricle relax the aortic valve close and mitral valve opens to allow blood to flow from the left atrium into the left



ventricle.

- The left atrium contracts allowing even more blood into the left ventricle.
- When the left ventricle contracts again the mitral valve close and the aortic valve open so blood flow in the aorta.



4.10 ORIGINATION AND CONDUCTION OF HEART BEAT:

The heart is formed of cardiac muscle which has the property of excitability and conductivity so when the cardiac muscle are stimulated by a specific stimulus, these got excite and initiate the valves of electric potential called cardiac impulse which are conducted along the special cardiac muscle fiber on the wall of heart chamber.

Initiation of heart beat occurred under 3 special bundle of cardiac muscle called NODAL TISSUE.

4.10.1 1. SINO-ATRIAL NODE (S.A NODE):

It lies in the right valve of the right auricle below the opening of superior vena cava. It is called right sided structure. It is also called pacemaker (artificial node) as it is first to originate cardiac impulses and determining the rate of heart beat. So the atrial contraction precedes ventricular contraction. It has the highest rate of auto rhythimicity (70-80 times/min) it maintains the basic rhythm of heart beat. The cardiac impulses are conducted along the tract of cardiac muscle fiber over both the auricle at the rate of 1 m/sec. these impulses reach the A.V node about 0.03 second after the origin from S.A node.

4.10.2 2. ATRIO-VENTRICULAR NODE:

It lies in the right atrium near the junction of inter circular or inter ventricular septum close to the opening of coronary sinus. It is stimulated by valves of contraction initiated by S.A node. It generates the cardiac impulses which are conducted to the muscle of ventricle through the bundle of HIS and purkinje fiber at the rate of 1.5 to 4m/s.

4.10.3 3. BUNDLE OF HIS:

It is called A.V bundle. It arises from A.V node and descends in the inter ventricular septum and divides into two branches which descends along the side of inter ventricular septum and supply the wall of ventricles of their own side by a network of fine fiber called purkinji fiber in the myocardium of the ventricle. This brings about synchrous contraction of ventricle from the apex of the heart which forces the blood into the pulmonary arc aortic arc.

S.A node, A.V node, bundle of HIS and pukinji fiber collectively forms the conducting system of the heart and is responsible for auto rhythimicity of the heart when S.A node is damaged then it is not able to generate cardiac impulses then the heart beat become irregular called the Arrhythmia (irregular heart beat)

4.11 BLOOD SUPPLY OF THE HEART:

4.11.1 CORONARY ARTERY:

The vessel that delivers oxygen reach blood to myocardium is known as Coronary Arteries. The vessel remove the deoxygenated blood from the heart muscle are known as Cardiac vein.

4.11.2 ARTERIAL SUPPLY OF HEART:

It is provided by right and left coronary arties which arise from the ascending aorta just after aorta exits left ventricle.

4.11.3 RIGHT CORONARY ARTERY:

It arises from anterior sinuses and passes forward between the pulmonary trunk and right atrium. It descends in the right part of atrio ventricular grooves to anatomies (joining) near apex of the Heart with the corresponding branch of left coronary artery.

AORTIC SINUSES are one of the anatomic dilation of ascending aorta which occurs just above the aortic valve. There are generally three aortic sinuses: The left, posterior, Anterior.

- Left posterior aortic sinus give rise to left coronary artery.
- Anterior aortic sinus gives rise to the right coronary artery.
- Right coronary artery supplies to;
- 1. Lateral wall of right ventricle
- 2. Posterior wall of right ventricle.
- Inferior wall of left Ventricle.

4.11.4 LEFT CORONARY ARTERY:

It is largest than right. It arises from aortic sinus. It passes first behind and then to left pulmonary trunk reaches the left part of atrio ventricular grooves in which it runs latterly around the left border of the heart to reach inferior inter ventricular groove.

The left coronary artery divides into left anterior descending branch (LAD) and circumflex artery. The LAD give rise to diagonal branches and the circumflex give rise to marginal branches.

4.11.4.1 LAD AND DIAGONAL BRANCHES SUPPLY:

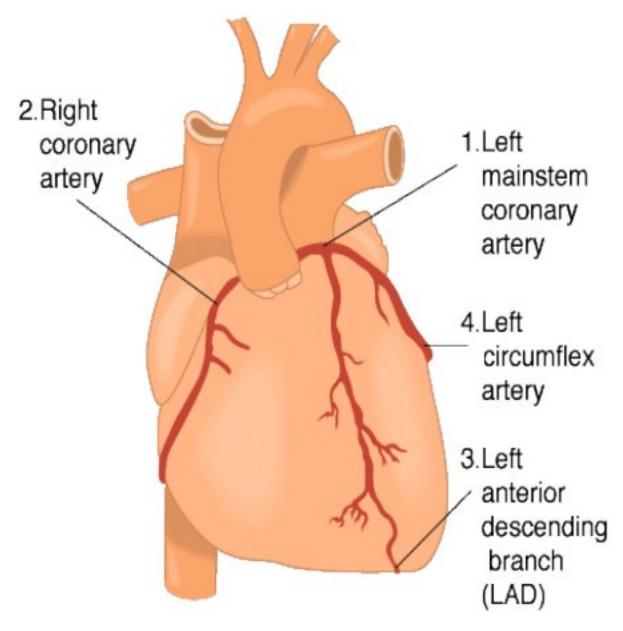


FIGURE ARTERIAL SUPPLY

- The anterior lateral wall of the left ventricle.
- The inter ventricular septum.
- The anterior wall of the Right ventricle.

The ventricular apex.

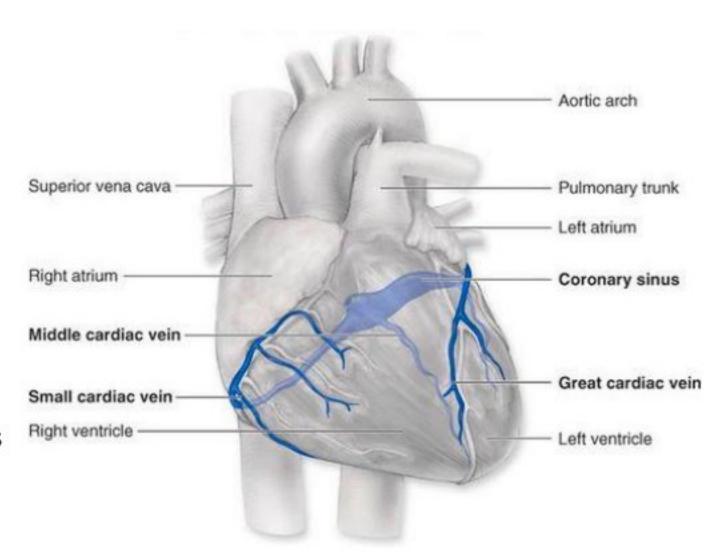
4.11.4.2 THE CIRCUMFLEX MARGINAL ARTERIES SUPPLY:

- · The left atrium
- The posterior wall of the left ventricle.
- The lateral wall of left ventricle.

4.12 VENUES SUPPLY:

About 2/3rd of venous drainage of heart is by vein, which accompanying the coronary artery and which opens into right atrium. The rest of the blood drains by means of small veins (venacordis minima) directly. The coronary sinuses receives

- Gnat cardiac vein in the anterior intra ventricular groove.
- Middle cardiac vein in inferior inter ventricular groove.
- Small cardiac vein accompany the marginal artery along the lower border of the heart.
- Oblique vein which descends obliquely in the back of left atrium, which opens nears the left extremity of coronary sinuses.
- The anterior cardiac vein lies in the atrioventricular groove. It drains much of the anterior surface of the heart and open directly into right atrium.

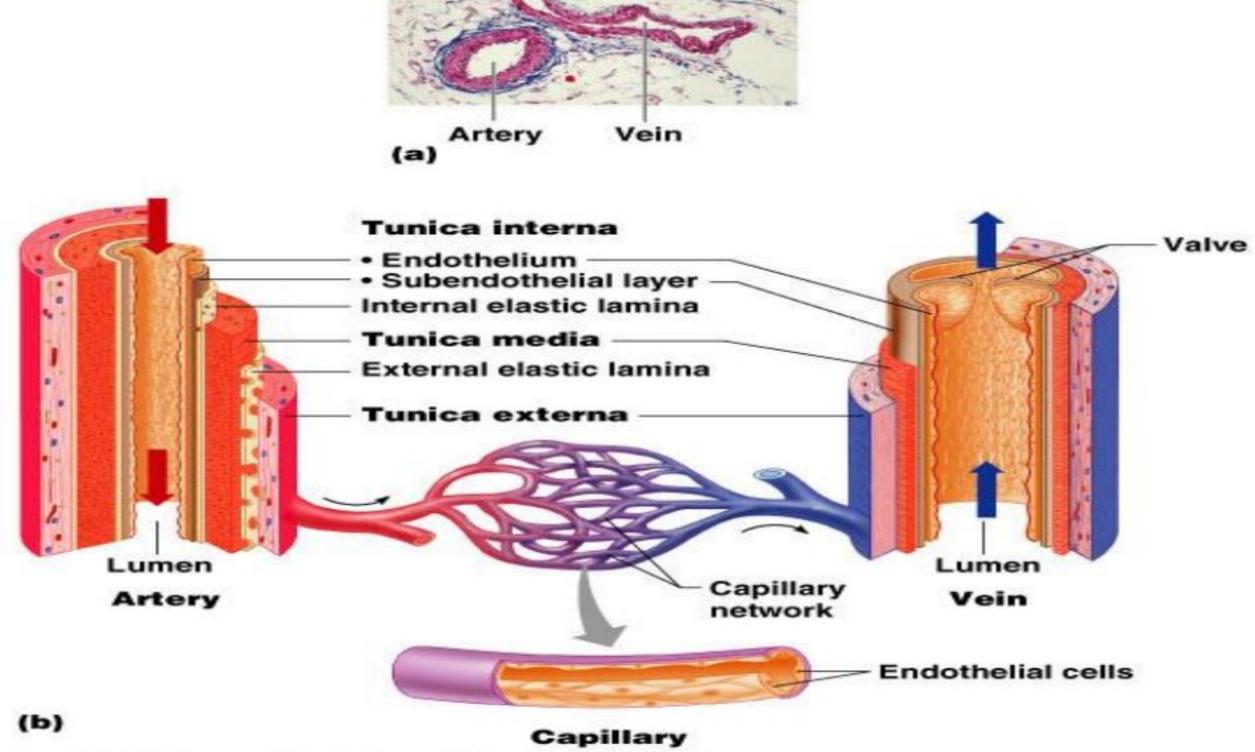


Chapter 5 BLOOD VESSELS

5.1 Introduction:

Blood circulated inside the blood vessels which forms a close transport system.

As the heart beats blood is propelled into large arteries leaving a heart. It than moves into excessively smaller and smaller arteries and then into arterioles which feed the capillary bed into tissue capillaries beds are drained by venules which is turn empty into vein and then finally empty into great vein (vena cava) entering heart.



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The arteries which carry blood away from the heart and vein which drain tissue and return blood to heart are simply conducting vessels. Only the tiny hair like capillaries which extends and branch through tissue and connect the small arteries (arterioles) to the smallest vein (venules) directly serve the need of the body cell. It is only through their walls that exchange between tissue cells and blood occurs.

5.2 ANGIOGENESIS:

Refers to growth of new blood vessels. It is an important process in embryonic and fetal development and in post-natal life (after two months) serves important function such as wound healing and development of blood vessels around obstructed arteries in coronary circulation.

5.3 MICROSCOPIC ANATOMY OF BLOOD VESSELS:

Except the microscopic capillaries, the wall of blood vessels has 3 coats or Tunies and endothelial inner lining, a middle layer consisting of smooth muscles

and elastic connective tissue and a connective tissue outer covering.

5.3.1 TUNICA INTIMAE:

The tunica intimae which lines the lumen of anterior vessels is a thin layer of endothelium (squamous epithelial cells) resting on the basement membrane. It cells fit closely together and form a surface that decreases friction as blood flows through vessel lumen (opening)

5.3.2 TUNICA MEDIA:

It is a bulky middle coat. It is mostly smooth muscle and elastic fiber. Some of layer arteries have elastic lamina, sheet of elastic tissue. In a addition to scattered elastic fiber. The smooth muscle which is controlled by sympathetic nervous system is active in changing the diameter of the vessel, as the vessel constrict or dilate, blood pressure increases or decreases respectively.

5.3.3 TUNICA EXTRNA:

It is the outer most tunic. This layer is composed largely of fibrous connective tissue and its function is basically to protect and support the vessel.

5.4 CAPILLARY STRUCTURE:

- Microscopic endothelial tubes, without smooth muscles cells, single layer of endothelial cell.
- An average diameter is 6-8μ just sufficient to permits RBC's to pass through a single file.
- Size varies from organ to organ. Largest is of 20μ that is in skin and bone marrow.

5.5 BLOOD SUPPLY TO BLOOD VESSELS:

It is by vasovasorum which forms dense capillary network and supply outer part of tunica media and tunica external (intimae is inner part of media is nourish directly by diffusion from luminal blood.

5.6 ANASTOMOSIS:

A prey capillary or post capillary communication between neighboring vessels is called ANASTOMOSES.

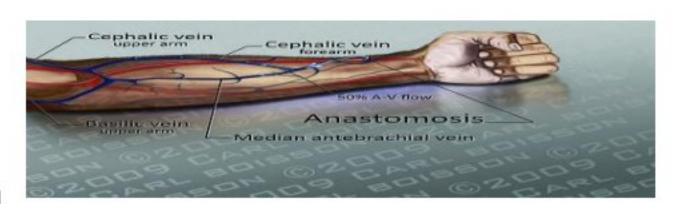
Circulation through Anastomosis is called collateral

- Arterial anastomosis (communication between branches of arteries)
- Venous anastomosis (communication between veins)
- Atrio Venous anastomosis (communication between artery and vein)

5.6.1.1 END ARTERY:

They do not anastomose with other arteries e.g; central artery of retina, central artery of cerebral arteries.

5.7 DISTINGUISH FEATURE OF BLOOD VESSELS



circulation. Blood Vessel	Size	Tunica Intimae	Tunica Media	Tunica Externa	Function
Elastic Arteries	Largest artery in the body	Well defined internal elastic lamina	Thick and dominated by elastic fiber	Thinner then tunic media	Conduct blood from heart to muscular arteries
Muscular Arteries	Medium size arteries	Well defined internal elastic lamina	Thick and dominated by smooth muscle	Thicker then tunic media	Distribute blood to arterioles
Arterioles	Microscopic (15-30μ) in "d"	Thin internal elastic lamina	Circularly oriented smooth muscle	Loose connective tissue and sympathetic nerve	Deliver blood to capillaries and help to regulate blood flow to capillary
Capillaries	Microscopic smallest blood vessels (5-10µ) in "d"	Endothelium membrane	None	None	Permit exchange of nutrient and waste between blood and interstitial fluid
Post- capillary venules	Microscopic (10-15μ) in "d"	Endothelium membrane	None	Spars (thinly scattered)	Pass blood into muscular venule, permit exchange of nutrient waste
Muscular Venules	Microscopic (50-200μ) in "d"	Endothelium membrane	Circularly oriented smooth muscle	Spars	Pass blood to the vein
Vein	Range from(0.5mm- 3cm) in "d"	Endothelial membrane, no internal elastic lamina, contain valve lumen in layer	Much thin than in arteries, no external elastic lamina	Thickest of three layer	Return blood to the heart

Chapter 6 ANATOMY OF DIGESTIVE SYSTEM

6.1 Introduction

- The digestive system, also known as the GASTROINTESTINAL SYSTEM, is responsible for the physical and chemical breakdown of food
- Breakdown is necessary so food can be taken into bloodstream and used by body cells and tissues
- System consists of alimentary canal and accessory organs

6.2 FOOD BREAKDOWN

6.2.1 INGESTION

Taking of food into the body

6.2.2 PERISTALSIS

Physical movement along the tract

6.2.3 DIGESTION

Mechanical and chemical breakdown of food

6.2.4 ABSORPTION

Passage of food from digestive tract into body

6.2.5 DEFECATION

Elimination of indigestible substances from body

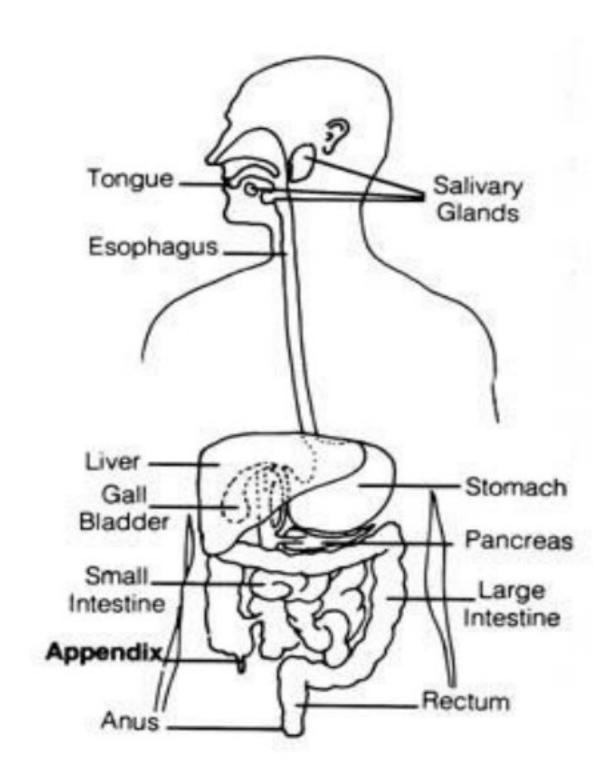
6.3 ALIMENTARY CANAL

A long, muscular tube that begins at the mouth and includes the mouth (oral cavity), pharynx, esophagus, stomach, small intestine, large intestine, and anus

6.4 ACCESSORY ORGANS

Accessory organs are the salivary glands, tongue, teeth, liver, gallbladder, and pancreas

6.5 ORGANS INVOLVED



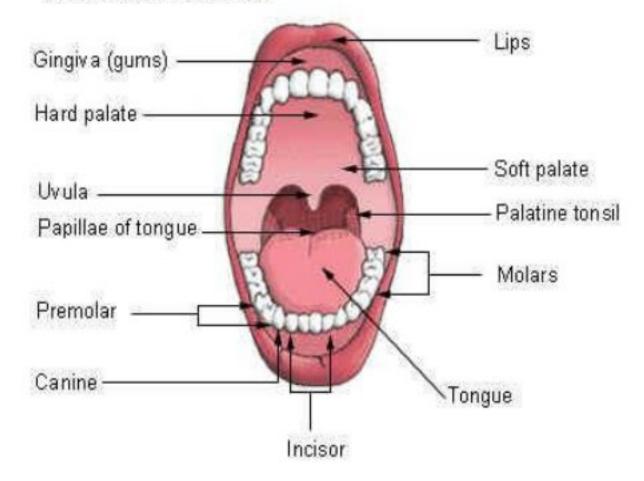
6.6 MOUTH & ORAL CAVITY

The mouth, also called the BUCCAL CAVITY, receives food as it enters body

While food is in mouth, it is

- Tasted
- Broken down physically by teeth
- Lubricated and partially digested by saliva
- swallowed

Mouth (Oral Cavity)



6.6.1 MOUTH

- The TEETH are special structures in mouth that physically break down food by chewing and grinding Process is called MASTICATION.
- The TONGUE is a muscular organ that contains special receptors, called TASTE BUDS



- TASTE BUDS allow a person to taste sweet, salt, sour, and bitter sensations
- The tongue also aids in chewing and swallowing foods
- The HARD PALATE is the bony structure that forms the roof of the mouth and separates the mouth from the nasal cavities
- Behind the hard palate is the SOFT PALATE, which separates the mouth from the nasopharynx
- The UVULA, a cone-shaped muscular structure, hangs from the middle of the soft palate and prevents food from entering the nasopharynx during swallowing

Three pairs of SALIVARY GLANDS

- Parotid (cheek/jaw)
- Sublingual (beneath tongue)
- Submandibular (chin/neck)

They produce a liquid called saliva

- Saliva lubricates mouth during speech and chewing and moistens food so it can be swallowed easily
- Also contains enzyme called salivary amylase
- Salivary amylase begins chemical breakdown of complex carbohydrates, or starches, into sugars that can be taken into the body

6.6.2 PHARYNX

- After food is chewed and mixed with saliva, it is called a BOLUS
- When bolus is swallowed, it enters the pharynx (throat)

6.6.2.1 "PHARYNX IS A TUBE THAT CARRIES BOTH AIR (TO TRACHEA) AND FOOD (TO ESOPHAGUS)"

 When a bolus is being swallowed, muscle action causes epiglottis to close over larynx

6.6.3 ESOPHAGUS

- The esophagus is the muscular tube dorsal to the trachea
- It receives bolus form pharynx and carries it to stomach
- Esophagus, and remaining part of alimentary canal, relies on rhythmic, wavelike, involuntary movement of its muscles called PERISTALSIS, it moves food in forward direction

6.6.4 STOMACH:

"The stomach is an enlarged part of alimentary canal and receives food from esophagus"

The stomach has four parts:

6.6.5 CARDIA

- This is the area where the esophagus meets with the stomach – esophagogastric junction (Z-line).
- The passage of food through this area is regulated by the lower esophageal sphincter (LES) or CARDIAC SPHINCTER.

6.6.6 FUNDUS

- This is the uppermost area of the stomach that lies just under the diaphragm.
- It ends in line with the cardia.

6.6.7 BODY

 This is the largest part of the stomach between the fundus and pylorus.

6.6.8 Pylorus

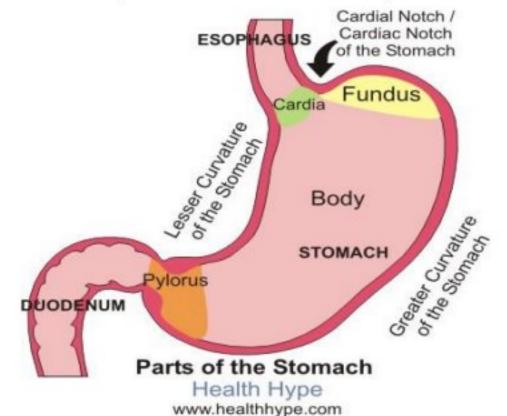
- This is the area through which the gastric contents flow out of the stomach and into the duodenum.
- It is divided into the PYLORIC ANTRUM which lies next to the body and the PYLORIC CANAL which lies next to the duodenum.
- 6.6.9 THE PASSAGE OF FOOD FROM THE STOMACH INTO THE DUODENUM IS REGULATED BY THE **pyloric** sphincter.

6.7 BLOOD SUPPLY TO STOMACH

The lesser curvature of the stomach is supplied by the RIGHT GASTRIC ARTERY inferiorly, and the LEFT GASTRIC ARTERY superiorly, which also supplies the cardiac region. The greater curvature is supplied by the RIGHT GASTROEPIPLOIC ARTERY inferiorly and the LEFT GASTROEPIPLOIC ARTERY superiorly. The fundus of the stomach, and also the upper portion of the greater curvature, is supplied by the short gastric artery which arises from splenic artery.

6.8 Venous Drainage of the Stomach

 THE RIGHT GASTRO-OMENTAL VEIN drains into the superior mesenteric vein, and then



- into the portal vein.
- THE LEFT GASTRO-OMENTAL VEIN drains into the splenic vein and then into the portal vein.
- The left and right gastric veins drain into the portal vein directly.

6.9 SMALL INTESTINE

- When food, in form of CHYME, leaves stomach, it enters the small intestine
- The small intestine is a coiled section of alimentary canal
- Approximately 20 feet in length and one inch in diameter

Divided into three sections

Duodenum

- Jejunum
- Ileum
- The duodenum is the first nine to ten inches of the small intestine
- Bile (from gallbladder and liver) and pancreatic juice (from pancreas) enter this section through ducts, or tubes
- The jejunum is approximately eight feet in length and forms middle section
- The ileum is the final 12 feet of small intestine, and connects with large intestine at the cecum

6.10 RELATIONS OF THE DUODENUM

Part	Anterior	Posterior	Superior	Inferior
First	Liver Gall bladder	Portal vein Gastro-duodenal artery Bile duct	Liver Hepatic artery Neck of gall bladder	Pancreatic head Bifurcation of gastro- duodenal artery
Second	Liver Gall bladder Transverse colon Small intestine	Right renal vessels Right kidney Right ureter		
Third	Superior mesenteric vessels	Right ureter Inferior mesenteric artery Aorta	Pancreatic head Inferior pancreatico- duodenal artery	
Fourth	Root of mesentery	Aorta		

6.11 BLOOD SUPPLY TO DUODENUM

6.11.1 ARTERIAL SUPPLY OF THE DUODENUM

- The main blood supply is from the superior and inferior PANCREATICODUODENAL arteries (branches of the gastroduodenal and superior mesenteric arteries).
- These supply the proximal and distal halves respectively.
- The superior part of the duodenum may receive blood from:
- the supraduodenal artery,
- (2) the right gastric artery,
- (3) the right gastro-omental artery and
- (4) the gastroduodenal artery.

These vessels often anastomose.

6.12 VENOUS DRAINAGE OF THE DUODENUM

Venous drainage is through the PORTAL SYSTEM OF VEINS.

Most is through the superior MESENTERIC VEIN and also the SPLENIC VEIN

6.13 JEJNUM AND ILEUM

6.13.1 JEJUNUM

The jejunum constitutes about two fifths of the small intestine and the ileum about three-fifths. The jejunum has a thicker wall and a wider lumen than the ileum and mainly occupies the left upper and central abdomen.

6.13.2 ILEUM

The ileum has a thinner wall and a smaller lumen than the jejunum and mainly occupies the central and right lower abdomen and pelvis. Mesenteric fat is abundant in the mesentery of the ileum, and vessels in the mesentery are, therefore, not well seen.

6.14 BLOOD SUPPLY TO JEJNUM AND ILEUM

6.14.1 ARTERIAL SUPPLY OF THE JEJUNUM AND ILEUM

The arteries to the jejunum and ileum arise from the superior mesenteric artery

6.14.2 VENOUS DRAINAGE OF THE JEJUNUM AND ILEUM

The superior mesenteric vein drains the jejunum and ileum.

6.15 LARGE INTESTINE

- The large intestine is the final section of the alimentary canal
- It is approximately five feet in length and two-and-a-half inches in diameter

FUNCTIONS include

- Absorption of H₂O and any remaining nutrients
- Storage of indigestible materials before eliminated
- Synthesis (formation) and absorption of some B-complex vitamins and vitamin K by bacteria present
- Transportation of waste products out of body

The large intestine is divided into a series of connected sections

The CECUM is the first section, attached to small intestine – contains a small projection called the vermiform appendix

Next section is the COLON with several divisions

- Ascending colon
- Transverse colon
- Descending colon
- Sigmoid colon

6.16 BLOOD SUPPLY TO LARGE INTESTINE

6.16.1 FIRST HALF OF LARGE INTESTINE

- Arterial supply superior mesenteric artery
- Venous drainage is via the superior mesenteric vein.

6.16.2 DISTAL HALF OF LARGE INTESTINE

- Arterial supply inferior mesenteric artery
- The descending colon is drained by the inferior mesenteric vein.

6.17 RECTUM

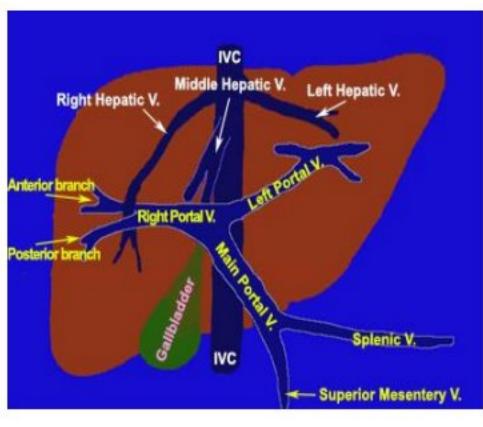
- The rectum is the final six to eight inches of the large intestine and is a storage area for indigestible and wastes
- It has a narrow canal, called the ANAL CANAL, which opens at a hole, called the anus
- Fecal material, or stool, the final waste product of the digestive process, is expelled through this opening

6.18 LIVER

- An organ in the upper abdomen that aids in digestion and remove waste products and wornout cells from the blood. It is the largest solid& glandular organ in the body.
- It occupies whole of the right hypochondrium, greater part of the epigastrium and extends into the left hypochondrium up to the left lateral line

6.19 BLOOD SUPPLY OF LIVER

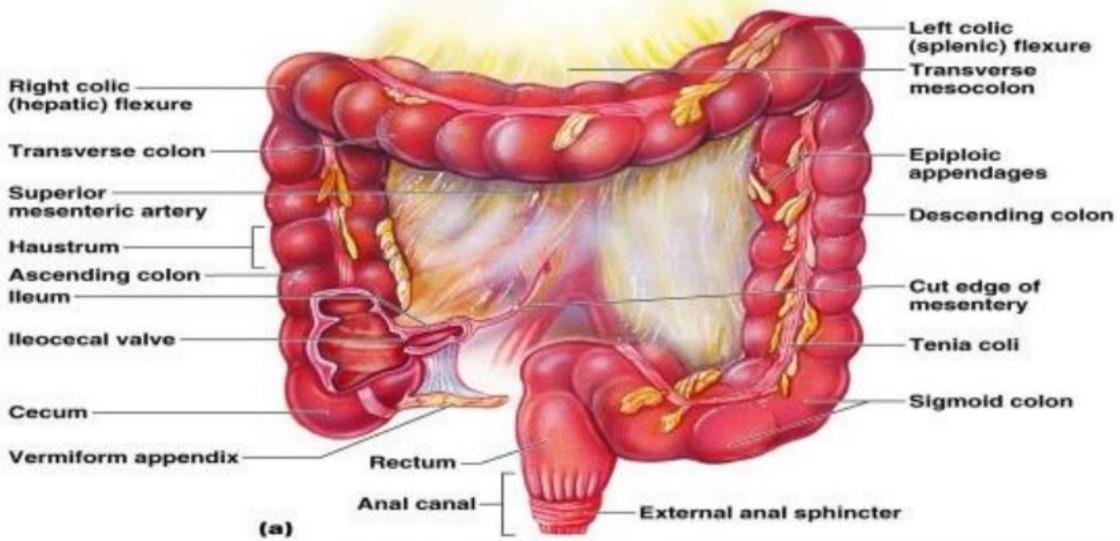
The liver receives
 20% blood supply from the hepatic artery &



80% blood supply from the portal vein. Before entering the liver, the hepatic artery & the portal vein divides into right & left branches. Within the liver they redivide to form segmental & then interlobular vessels which run in the portal canals.

Hepatic veins drains directly into the inferior vena cava.

6.19.1 FUNCTIONS

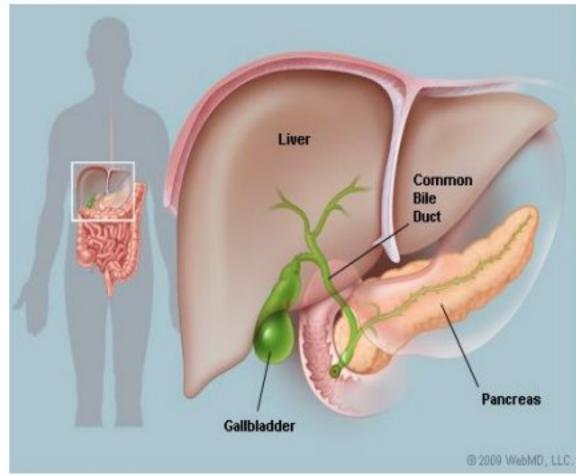


- It consists of both exocrine and endocrine parts.
 Exocrine part secretes bile which is conveyed by the biliary passages.
- The endocrine part liberates some useful chemical substances such as glucose from glycogen, most of the plasma proteins (except immuno-globulins) and heparin directly into the blood stream.
- Stores Fe and certain vitamins
- Produces heparin, which prevents clotting of blood
- Produces proteins such as fibrinogen and prothrombin
- Produces cholesterol
- Detoxifies substances such as alcohol and pesticides, and destroys bacteria taken into blood from intestine

6.20 GALL BLADDER

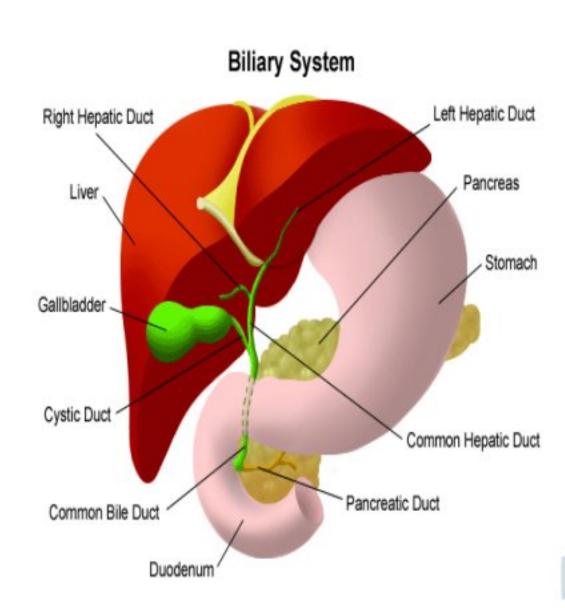
- The gallbladder is a small pouch that sits just under the liver. The gallbladder stores bile produced by the liver. After meals, the gallbladder is empty and flat, like a deflated balloon. Before a meal, the gallbladder may be full of bile and about the size of a small pear.
- In response to signals, the gallbladder squeezes stored bile into the small intestine through a series of tubes called ducts. Bile helps digest fats, but the gallbladder itself is not essential. Removing the gallbladder in an otherwise healthy individual typically causes no observable problems with health or digestion yet there may be a small risk of diarrhea and fat malabsorption.

6.21 PANCREAS



- Pancreas is an elongated (12 to 15 cm), soft, greyish-pink digestive gland.
- It is located posterior to the stomach.
- It is located in the epigastric and left hypochondriac regions and its right part.
- The pancreas is both an exocrine and endocrine gland.

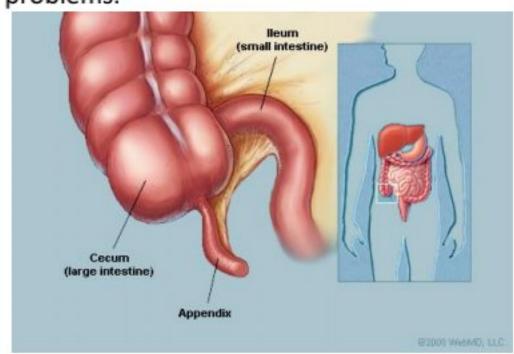
It produces:



- Pancreatic juices that enters the duodenum via the pancreatic ducts;
- Internal secretions (glucagon and insulin) that enter the blood.

6.22 APPENDIX

- The appendix sits at the junction of the small intestine and large intestine. It's a thin tube about four inches long. Normally, the appendix sits in the lower right abdomen.
- The function of the appendix is unknown.
 One theory is that the appendix acts as a storehouse for good bacteria, "rebooting" the digestive system after diarrheal illnesses. Other experts believe the appendix is just a useless remnant from our evolutionary past. Surgical removal of the appendix causes no observable health problems.



6.22.1 VARIATIONS IN APPENDIX POSITION:

 Although the base of the appendix is fixed, the tip can point in any direction. Hence, the position of the appendix is extremely variable. The appendix is the only organ in the body which is said to have no anatomy.

6.22.1.1 WHEN COMPARED TO THE HOUR HAND OF A CLOCK, THE POSITIONS WOULD BE:

- 12 o clock: Retrocolic or retrocecal (behind the cecum or colon)
- 2 o clock: Splenic (upwards and to the left
- 3 o clock: Promonteric (horizontally to the left pointing the sacral promontory)
- 4 o clock: Pelvic (descend into the pelvis)
- 6 o clock: Subcecal (below the cecum pointing towards inguinal canal)
- 11 o clcok: Paracolic (upwards and to the right)

6.23

6.24 SPLEEN

 The spleen is situated principally in the left hypochondriac region, but its superior extremity extends into the epigastric region; it lies between the fundus of the stomach

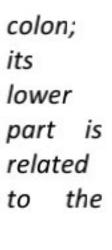
FIGURE 10 PANCREAS

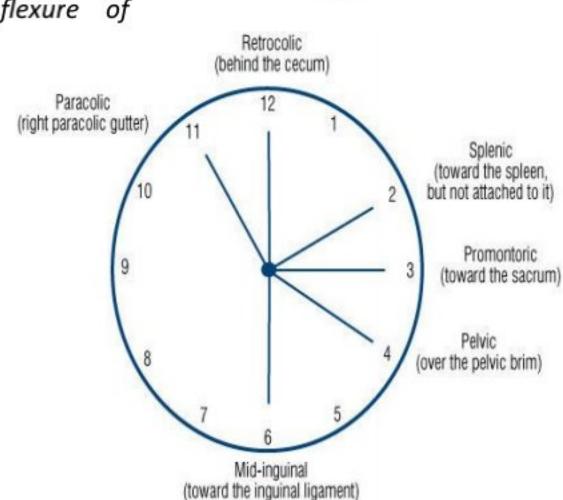
and the diaphragm. It is the largest of the ductless glands, and is of an oblong, flattened form, soft, of very friable consistence, highly vascular, and of a dark purplish color.

- The spleen's 2 ends are the anterior and posterior end. The anterior end of the spleen is expanded and is more like a border; it is directed forward and downward to reach the midaxillary line. The posterior end is rounded and is directed upward and backward; it rests on the upper pole of the left kidney.
- The spleen's 3 borders are the superior, inferior, and intermediate. The superior border of the spleen is notched by the anterior end. The inferior border is rounded. The intermediate border directs toward the right.
- The 2 surfaces of the spleen are the diaphragmatic and visceral. The diaphragmatic surface is smooth and convex, and the visceral surface is irregular and concave and has impressions.

(The gastric impression is for the fundus of the stomach, which is the largest and most concave

impression on the spleen. The renal impression is for the left kidney and lies between the inferior and intermediate borders. The colic impression is for the splenic flexure of the





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phrenicocolic ligament. The pancreatic impression for the tail of the pancreas lies between the hilum and colic impression)

6.24.1 HILUM

 The hilum can be found on the inferomedial part of the gastric impression (see the image above). The hilum transmits the splenic vessels and nerves and provides attachment to the gastrosplenic and splenorenal (lienorenal) ligaments.

6.25 VASCULAR SUPPLY

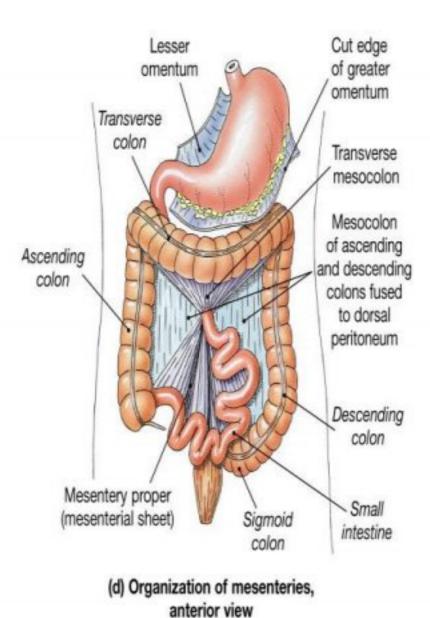
- The splenic artery supplies blood to the spleen.
- The splenic circulation is adapted for the separation and storage of the red blood cells. The spleen has superior and inferior vascular segments based on the blood supply.

6.26 VENOUS DRAINAGE

 The splenic vein provides the principal venous drainage of the spleen.

6.26.1 THE PERITONEUM AND THE PERITONEAL CAVITY

- The peritoneum is a thin, transparent serous membrane that consists of two layers.
- The peritoneum lining the abdominal wall is called the parietal peritoneum.
- The peritoneum investing the viscera is called the visceral peritoneum.
- The mesentery and the peritoneal folds and ligaments: The mesentery is a double layer of peritoneum with some connective tissue that helps support organs and allows for nerves and blood vessels to travel to those organs. The mesentery anchors the abdominal organs to the posterior abdominal wall, helping keep those organs in place but still allowing for some mobility.



Chapter 7 ANATOMY OF URINARY SYSTEM

7.1 ORGANS INVOLVED

- Two kidneys
- Two Ureters (Ureters connect kidneys to urinary bladder)
- Bladder
- · Two sphincter muscle
- Nerves in Bladder
- Urethra (Urethra leads from bladder outside the body)

7.2 KIDNEY

- The kidneys appear to be bean shape, both the left and right kidney lie against the posterior abdominal wall above the ilium and are protected by the lower two ribs.
- The renal hilus is the location where blood vessels and nerves enter the kidney.
- The lateral surface is convex and the medial surface is concave, with a vertical cleft called the renal hilus leading to the renal sinus
- · Superior to each kidney is the adrenal gland.
- Right kideny slightly lower due to liver
- Kidney is surrounded by RENAL CAPSULE (dense connective tissue) and ADIPOSE CAPSULE, the adipose capsule (contains perirenal fat) and RENAL FASCIA (layer of connective tissue encapsulating kidneys)
- There is some fat that lies close to the kidneys called PARARENAL FAT, both fat layers cushion and support the kidneys.

7.2.1 INTERNAL GROSS ANATOMY

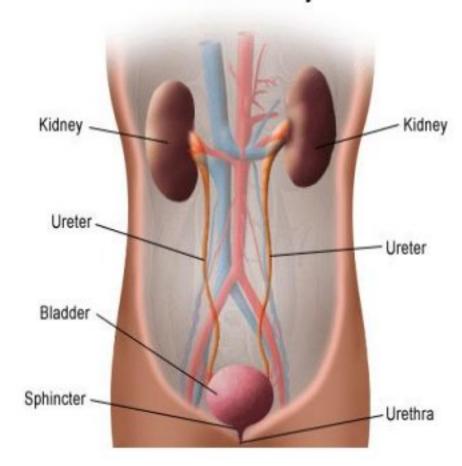
- The following features can be seen with the naked eye in dissection.
- The most superficial region is the RENAL CORTEX which is lighter in color than the deeper region called the RENAL MEDULLA.
- The RENAL MEDULLA is divided into sections called renal pyramids, the renal columns (extensions of the cortex) lie in between the renal pyramids

7.3 KIDNEY FUNCTIONS

 Filter 200 liters of blood daily, allowing toxins, metabolic wastes, and excess ions to leave the body in urine

- Regulate volume and chemical makeup of the blood
- Maintain the proper balance between water and salts, and acids and bases

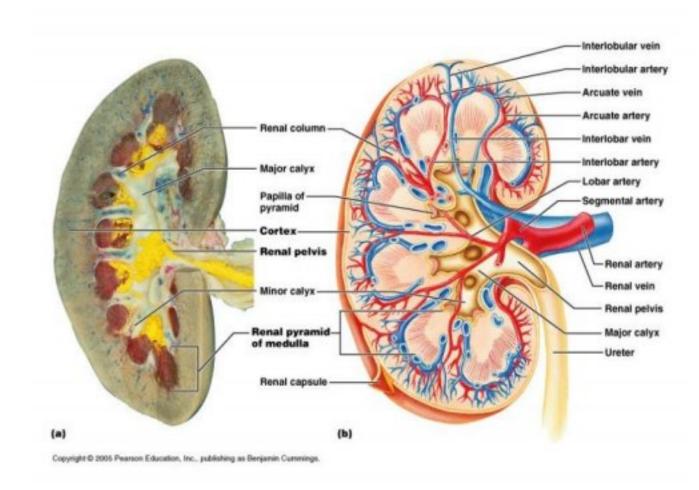
Front View of Urinary Tract



- Gluconeogenesis during prolonged fasting
- Production of rennin to help regulate blood pressure and erythropoietin to stimulate RBC production
- · Activation of vitamin D

7.3.1 OTHERS

- URINARY BLADDER provides a temporary storage reservoir for urine
- Paired URETERS transport urine from the kidneys to the bladder
- URETHRA transports urine from the bladder out of the body



7.4 RELATION OF KIDNEYS

- The UPPER POLE of the kidney is covered by the suprarenal gland.
- ANTERIORLY, the right kidney is related to the liver, duodenum, ascending colon, and small intestine.



- The left is related to the spleen, stomach, pancreas, descending colon or left colic flexure, and small intestine.
- POSTERIORLY, the kidneys are related to rib
 11 and 12 and the diaphragm

7.5

7.6 BLOOD SUPPLY

The kidneys have a rich blood supply. The largest blood vessels are the renal arteries and veins. They eventually become segmental arteries, then lobar, then interlobar. They narrow more and become arcuate, they are called interlobular ateries again and finally reach the nephron as affarent and efferent arterioles. They then wrap around the nephron as pritubular capillaries. As this point they are veins and have the same names as the ateries: interlobular, arcuate, and renal vein.

The renal plexus serves the nerves supply of the kidney carrying autonomic NS fibers.

7.7 URETERS

"Tubules that carry urine from the kidney to the bladder."

GROSS ANATOMY- about 10 inches long, runs from the renal pelvis and reaches the bladder medially on its posterior wall. It enters at an oblique angle to prevent back flow.

MICROSCOPIC ANATOMY- this tube has three layers: mucosa, muscularis, and adventitia. Urine reaches the bladder through peristalsis. The muscle contractions seem to be guided by a reflex response.

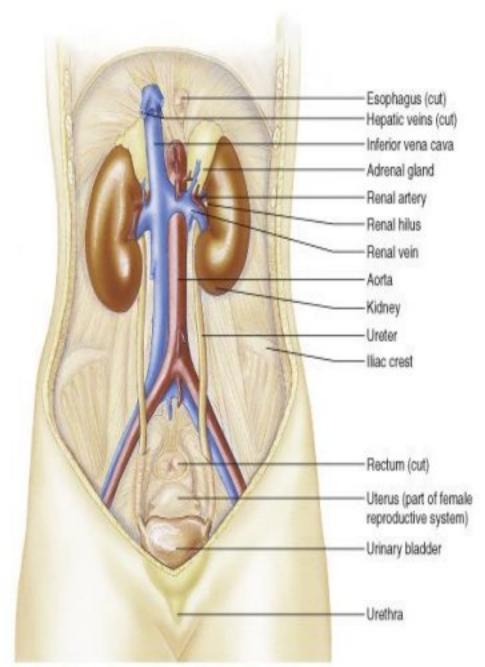
7.8 URINARY BLADDER

A muscular sac that stores urine. It can collapse when empty and expand enough to enter into the abdominal cavity. In males it lies anterior to the rectum and in females it lies anterior to the uterus and vagina. It also has three layers: the mucosa, muscularis, and adventitia

7.9 URETHRA

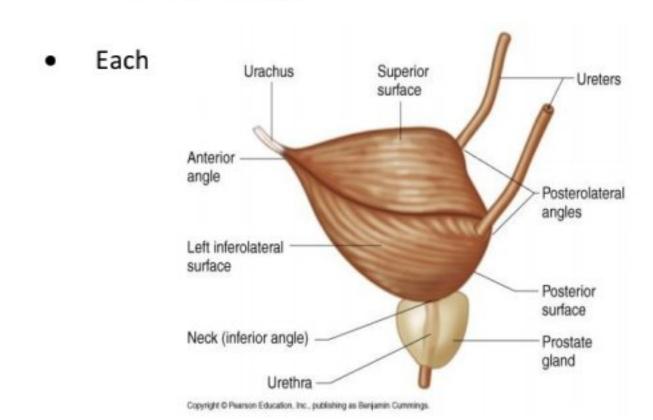
Athin tube that drains the urine out of the body from the bladder. It is short in females and long in males. In females the opening of the urethra lies anterior to the anus. The male urethra opens at the tip of the penis and carries both urine and semen. An involuntary sphincter muscle keeps the urethra closed when there is no urine, a voluntary sphincter constricts urine flow until the appropriate time to void.

7.10 SUPRARENAL GLAND



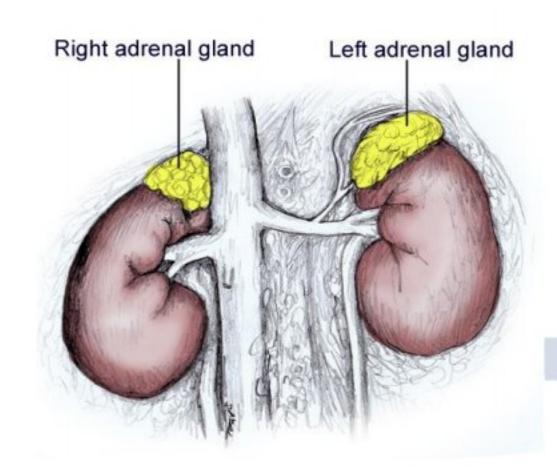
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7.10.1.1 "THE SUPRARENAL GLANDS ARE PAIRED ENDOCRINE ORGANS SITUATED SUPERIOR TO THE KIDNEYS"



suprarenal gland consists of two distinct endocrine organs, the cortex and the medulla.

 Each suprarenal gland is surrounded by renal fascia and lies on the superomedial



aspect of the front of the kidney. The right gland is in contact with the bare area of the liver and projects posterior to the inferior vena cava. The left gland, a little different in shape, is related in front to the splenic artery, and the pancreas. Both glands lie against the diaphragm.

- There are two parts in the gland are functionally different endocrine organs: The Medulla and the Cortex.
- The hormones secreted from the Medulla have secretion of epinephrine and norepinephrine, secretion stimulated by exercise, hypoglycemia, hemorrhage and stress.
- The Cortex synthesizes and secretes three classes of hormones: glucocorticoids (e.g., cortisol), mineralocorticoids (e.g., aldosterone) and androgens (e.g., testosterone).
- Glucocorticoids affect metabolism and help raise the level of blood glucose. In addition, they are widely used in therapy since they have anti-inflammatory and immunosuppressive properties.
- Mineralocorticoids affect mineral metabolism. Aldosterone is a steroid which targets the distal tubule of the kidney and stimulates re-uptake of sodium and potassium.
- Androgens such as testosterone are secreted by the adrenal cortex. Excessive production of adrenal androgens can cause premature puberty in young boys and masculine pattern of body hair in females.
- Cortisol and other glucocorticoids are released in response to adrenocorticotropic hormone secreted from the anterior pituitary which, in turn, is controlled and regulated by a hypothalamic peptide corticotrophin-releasing hormone.

7.11 BLOOD SUPPLY

- Each gland is supplied by the superior, middle and inferior suprarenal arteries, which arise from the inferior phrenic artery, abdominal aorta and renal artery respectively.
- The suprarenal vein emerges from a hilus and enters the inferior vena cava (right side) or the renal vein (left side).

Chapter 8 THE NERVOUS SYSTEM

8.1 Introduction

Nervous system is the master controlling and communicating system of the body .

- It works through sensory and motor output.
- It does not work alone to regulate and maintain homeostasis, the endocrine

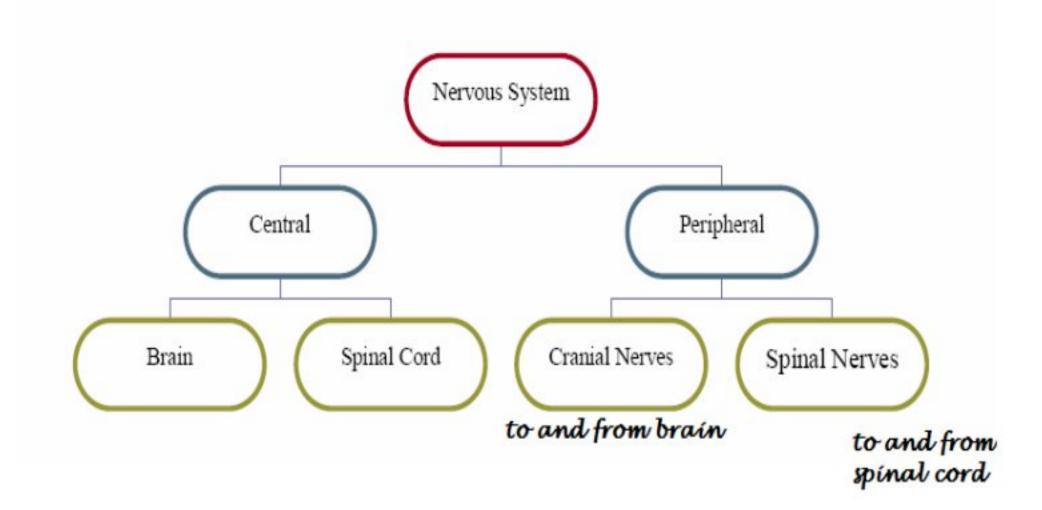
- system is a second important regulating system of the body.
- Nervous system controls with rapid electric nerve impulses.

8.2 ORGANIZATION OF NERVOUS SYSTEM

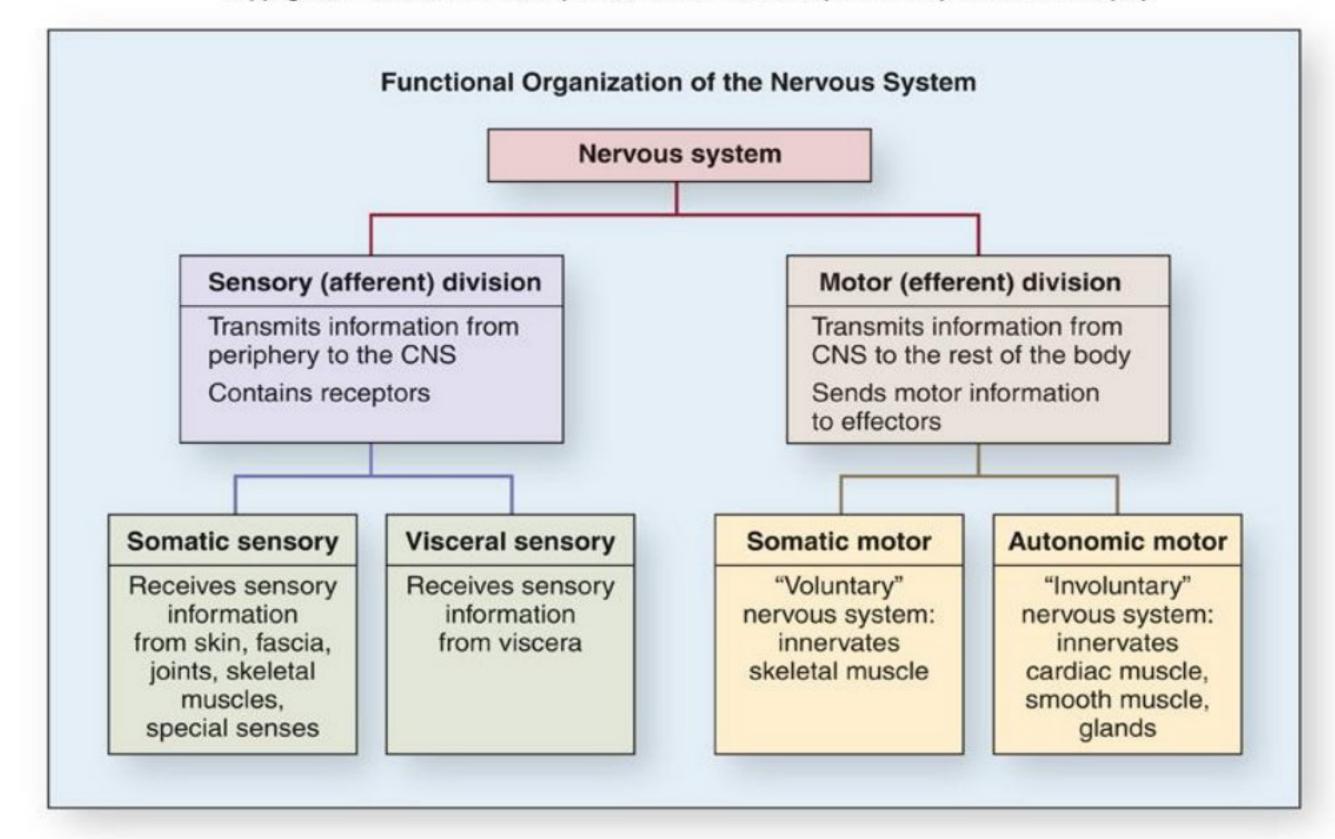
- 1. Structural Classification
- 2. Functional Classification

8.3 STRUCTURAL CLASSIFICATION

ANATOMICAL ORGANIZATION



8.4 FUNCTIONAL CLASSIFICATION



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8.5 CELLS OF NERVOUS SYSTEM (NEURONS)

NEURONS also called nerve cells, are highly specialized to transmit messages (nerve impulses) from one part of the body to another.

A nerve is made up of many nerve cell fibres (neurons) bound together by connective tissue.

8.6 ANATOMY OF NEURON

- CELL BODY: is the metabolic center of neuron and contain nucleus in it.
- · Processes: vary in length.
- Neuron processes that conveys incoming messages towards cell body are dendrites.
- Neurons processes that generates nerve impulses typically conduct them away from cell body are axon.

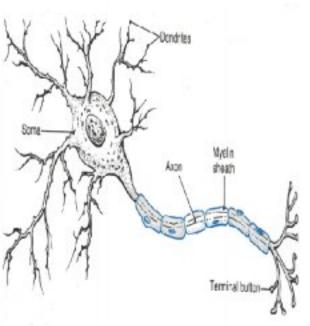
8.6.1.1 NEURONS MAY HAVE HUNDREDS OF DENDRITES DEPENDING ON NEURON TYPE, BUT EACH NEURON HAS ONLY ONE AXON

 MYELIN SHEATH: most long nerve fibers are convered with whitish, fatty material called myelin. Myelin protects and insulates the fibers and increases the tranmission rate of nerve impulses.

8.6.2 Types Of Neuron

THERE ARE THREE MAIN TYPES OF NEURONS, which are classified according their function:

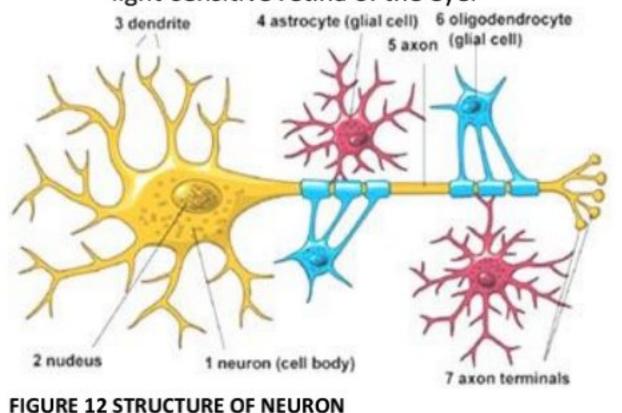
Those that conduct impulses from the sensory organs to the central nervous system (brain and spinal cord) are called SENSORY (OR AFFERENT)
NEURONS.



- that conduct impulses from the central nervous system to the effector organs (such as muscles and glands) are called MOTOR (OR EFFERENT) NEURONS.
- INTERNEURONS (ALSO KNOWN AS CONNECTOR NEURONS OR ASSOCIATION NEURONS) are those that connect sensory neurons to motor neurons.
- Nerve cells are functionally connected to each other at a junction known as a SYNAPSE, where the terminal branches of an axon and the dendrites of another neuron lie in close proximity to each other but never make direct contact.

8.6.3 CLASSIFICATION OF NEURONS

- UNIPOLAR NEURONS. Sensory neurons
 have only a single process or fibre which
 divides close to the cell body into two main
 branches (axon and dendrite). Because of
 their structure they are often referred to as
 unipolar neurons
- MULTIPOLAR NEURONS. Motor neurons, which have numerous cell processes (an axon and many dendrites) are often referred to as multipolar neurons. Interneurons are also multipolar.
- BIPOLAR NEURONS are spindle-shaped, with a dendrite at one end and an axon at the other. An example can be found in the light-sensitive retina of the eye.



8.7 SUPPORTING CELLS OF NERVOUS SYSTEM

8.7.1 NEUROGLIAL CELLS ARE:

- Non-excitable
- do not transmit nerve impulse
- 10-15 times greater in number than neurons.

8.7.2 CLASSIFICATION OF NEUROGLIAL CELLS

distributed in central nervous system and peripheral nervous system.

8.7.3 CLASSIFIED AS:

- Central Neuroglial cells
- Peripheral Neuroglial cells

8.8 CENTRAL NEUROGLIAL CELLS ARE

- Astrocytes
- Microglia
- Oligodendrocytes

8.9 Peripheral Neuroglial Cells

- Schwann cells
- Satellite Cells

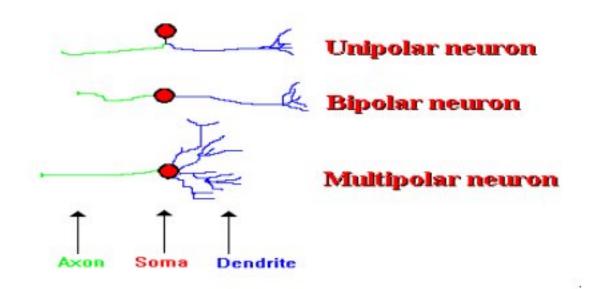


FIGURE 11 CLASSIFICATION OF NEURONS

Chapter 9 ENDOCRINE SYSTEM

9.1 DEFINITION

The **endocrine system** is a group of glands that regulate physiological functions by releasing hormones into the bloodstream.

HORMONES are chemicals that carry information to different parts of the body; specific hormones influence certain organs or parts of the body, such as the liver or pancreas.

ENDOCRINOLOGY is the branch of physiology and medicine concerned with endocrine glands and hormones.

9.2 HORMONES

Hormones that pass into the blood and act on distant target cells are called **circulating hormones** or **endocrines**.

- CIRCULATING HORMONES may linger in the blood for minutes to hours, exerting their effects for a prolonged period of time.
- Eventually, circulating hormones are inactivated by the liver and excreted by the kidneys.

Hormones that act locally without first entering the bloodstream are called **local hormones**.

- LOCAL HORMONES that act on neighboring cells are called paracrines.
- Local hormones that act on the same cell that secreted them are called autocrines.
- Local hormones are usually inactivated very quickly.

9.3 ENDOCRINE GLAND

Produce hormones that are released into the circulatory system and travel some distance where they act on target tissues to produce a response "ductless glands"

9.4 EXOCRINE GLANDS

Secrete products into ducts (sweat glands, sebaceous glands, mucous & digestive glands)

The various major exocrine glands of the body are as follows:-

- Salivary Glands
- Sebaceaous Glands
- sweat glands
- Mammary Glands
- Stomach
- Pancreas
- Liver

9.5 ENDOCRINE GLAND

9.5.1 NEUROENDOCRINE RELATIONS

Two body systems are responsible for sending and receiving sensory information and coordinating body responses. These are the *nervous system* and the *endocrine system*. Together, they are sometimes referred to as the **neuro-endocrine system**.

Certain nervous system cells act as endocrine cells

Nerve cells that produce hormones and secrete them
into the bloodstream are called NEUROSECRETORY

CELLS. In humans, neurosecretory cells are found in
the HYPOTHALAMUS.

9.5.2 WHAT ARE THE FUNCTIONS OF ENDOCRINE SYSTEM?

- Water balance
- Uterine contractions & milk release
- Growth, metabolism, & tissue maturation
- Ion regulation
- Heart rate & blood pressure regulation
- Blood glucose control
- Immune system regulation
- Reproductive functions control

9.6 HYPOTHALAMUS & PITUITARY GLAND

9.6.1 HYPOTHALAMUS:

The hypothalamus

is a portion of the brain that contains a number of small nuclei with variety of functions. One of the most important functions of the hypothalamus to link the nervous system to the endocrine system via the pituitary gland

(hypophysis). The hypothalamus is located below

the thalamus, just above the brain stem.

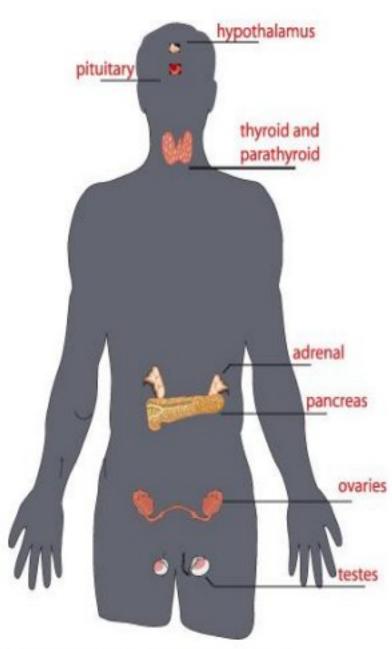
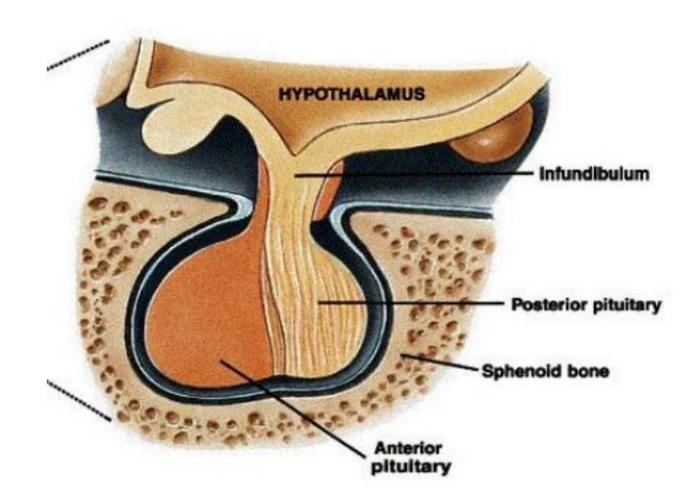


FIGURE 13ENDOCRINE GLAND



9.6.2 PITUITARY GLAND

The **pituitary gland** or **hypophysis** is attached to the **hypothalamus** at the base of the brain.

Also called "master gland"

Divided into anterior (adenohypophysis) & posterior pituitary (neurohypophysis)

9.6.3 HYPOTHALAMUS HORMONES (FUNCTION)

Most hormonal interactions of the hypothalamuspituitary complex follow a common pattern:

- A hypothalamic hormone effects control over the secretion of an anterior pituitary hormone;
- The corresponding anterior pituitary hormone controls secretion of the hormone of another endocrine gland; and
- That secretion of that gland affects other target tissues/organs.

So...

Hypothalamic hormones can have effect of stimulating or inhibiting the release of anterior pituitary hormones.

Called RELEASING HORMONES ("RH") or INHIBITING HORMONES ("IH") respectively.

9.6.4 POSTERIOR PITUITARY GLAND HORMONES

The **posterior pituitary** works as a unit with the hypothalamus.

Although the posterior pituitary does not synthesize its own hormones, it does store and release OXYTOCIN (OT) and ANTIDIURETIC HORMONE (ADH) produced in the hypothalamus.

Oxytocin controls uterine contractions during delivery and milk ejection during breastfeeeding.

ADH causes retention of body water, controlling the body's water-balancing mechanism

9.6.5 ANTERIOR PITUITARY GLAND HORMONES

 GROWTH HORMONE (GH) – regulates growth; affects protein, fat and carbohydrate metabolism.

- THYROID STIMULATING HORMONE (TSH) – controls secretion of thyroxin.
- ADRENOCORTICOTROPIC HORMONE (ACTH) – controls secretion of hormones released by adrenal cortex.
- FOLLICLE-STIMULATING HORMONE (FSH) – in females, stimulates maturation of egg cells and estrogen secretion by ovaries.
- LUTENIZING HORMONE (LH) in males, stimulates secretion of testosterone and sperm production by testes. In females, stimulates release of ovum by ovary.
- MELANOCYTE-STIMULATING HORMONE (MSH) – along with ACTH, affects pigment release in skin.
- PROLACTIN (PRL) stimulates milk production.

FIGURE 14 HYPOTHALAMUS AND PITUITARY GLAND

9.7 BLOOD SUPPLY

Most richly vascularized of all mammalian tissues
It supply by middle inferior and superior hypophysial
arteries from the internal carotid arteries

9.8 RELATION OF PITUITARY GLAND

- Anteriorly: Sphenoid sinus (part of nose which sits at base of brain)
- Posteriorly: Pons (structure in brain stem)
- Superiorly: Diaphragma sellae (is the circular fold of dura mater)
- Inferiorly: Body of sphenoid bone (unpaired bone situated at the front middle of the skull)
- Laterally: cavernous sinus (within the human head, is a large collection of thinwalled veins)

9.9 THYROID GLAND

The thyroid gland, is one of the largest endocrine glands. The thyroid gland is found in the neck, below the thyroid cartilage (which forms the "Adam's apple". The isthmus (the bridge between the two lobes of the thyroid) is located inferior to the cricoid cartilage.

The thyroid is responsible for regulating

Thyroid and Parathyroid Glands

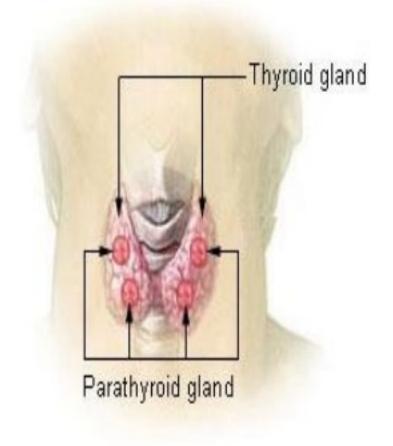


FIGURE 15 THYROID ANA PARATHYROID GLAND

metabolism, growth, and development (including bone, nerve, and muscle tissues).

The thyroid gland produces three hormones:

- Thyroxine or tetraiodothyronine (T₄),
- triiodothyronine (T₃) (which are called thyroid hormones)
- and calcitonin.

T3 AND T4 regulate rate of metabolism

CALCITONIN helps to regulate calcium homeostasis.

T3 Is the more potent of the thyroid hormones, but T4 is more abundant.

9.10 BLOOD SUPPLY

ARTERIAL SUPPLY: superior thyroid artery (branch of external carotid artery).

VENOUS DRAINAGE: drained by dense interconnected network of pharyngeal veins that eventually dump into superior thyroid vein and inferior thyroid vein.

9.11 RELATION OF THYROID GLAND

9.11.1 ANTROLATERALLY

Muscles of neck

9.11.2 MEDIALLY

Larynx, trachea, esophagus, pharynx

9.12 PARATHYROID GLAND

The four **parathyroid glands** are located on the posterior surface of the thyroid gland.

Very small (less than 5 mm).

Called *parathyroid* glands because of their position on posterior margins outer surface of thyroid gland.

PARATHYROID HORMONE (PTH) – raises the level of calcium in the blood, decreases levels of blood phosphate. Partially antagonistic to calcitonin of thyroid gland.

ACROMEGALY Results when the anterior pituitary gland produces excess growth hormone (GH)



FIGURE 16 ACROMEGALY

Pituitary gland produces large amounts of ACTH, causing the adrenal glands to produce elevated levels of cortisol causes CUSHING SYNDROME

FIGURE 17 CUSHING SYNDROME



Michael Santoro and his twin sister, Paula, who had Cushing's Syndrome.

Enlargement of the thyroid (GOITER) and can be associated with a thyroid gland that is functioning properly

9.12.1 GIGANTISM AND DWARFISM

Chapter 10 REPRODUCTIVE SYSTEM

10.1 REPRODUCTIVE SYSTEM

- Ensure the sexual maturation of each individual.
- Produce the gametes.
- Male and female structures are derived from common developmental tissues and serve a common function

10.1.1 COMPARISON OF THE FEMALE AND MALE REPRODUCTIVE SYSTEMS

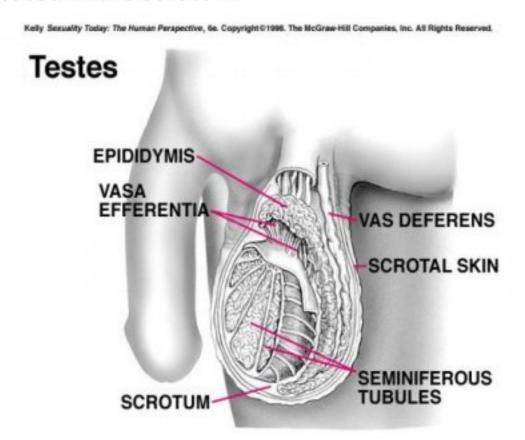
- Primary sex organs called gonads.
- ovaries in females and
- testes in males
- Produce gametes which unite to form a new individual.
- oocytes
- sperm
- Gonads produce large amounts of sex hormones which affect maturation, development, and changes in the activity of the reproductive system organs.
- · estrogen and progesterone in the female
- androgens in the male

10.2 THE MALE REPRODUCTIVE SYSTEM:

This system is simpler than the female reproductive system.

 A. SCROTUM: a sac located outside of the abdominal cavity, made up of a thin layer of smooth and skeletal muscle and skin. It is divided into left and right by a septum to TESTES: Oval shape organs made up of thousands of seminiferous tubules where the sperm is produced. It responds to **follicle stimulating hormone** that signals sperm production. When the sperm is in its last stages of maturation it moves to the epididymus.

- Each testis is an oval structure about 5 cm long and 3 cm in diameter
- · Covered by: tunica albuginea
- Located in the scrotum



10.2.1 SEMINIFEROUS TUBULES AND SPERMATOGENESIS:

The seminiferous tubules consist of a thick stratified epithelium surrounding a lumen. The epithelium has spermatogenic cells that mature into sperm. At puberty the seminiferous tubules begin to produce about 400 million sperm.

10.3 Accessory glands:

These glands produce substances that increases the chances of sperm survival once it is outside the body. These secretions in addition to sperm form semen.

1. SEMINAL VESICLES:

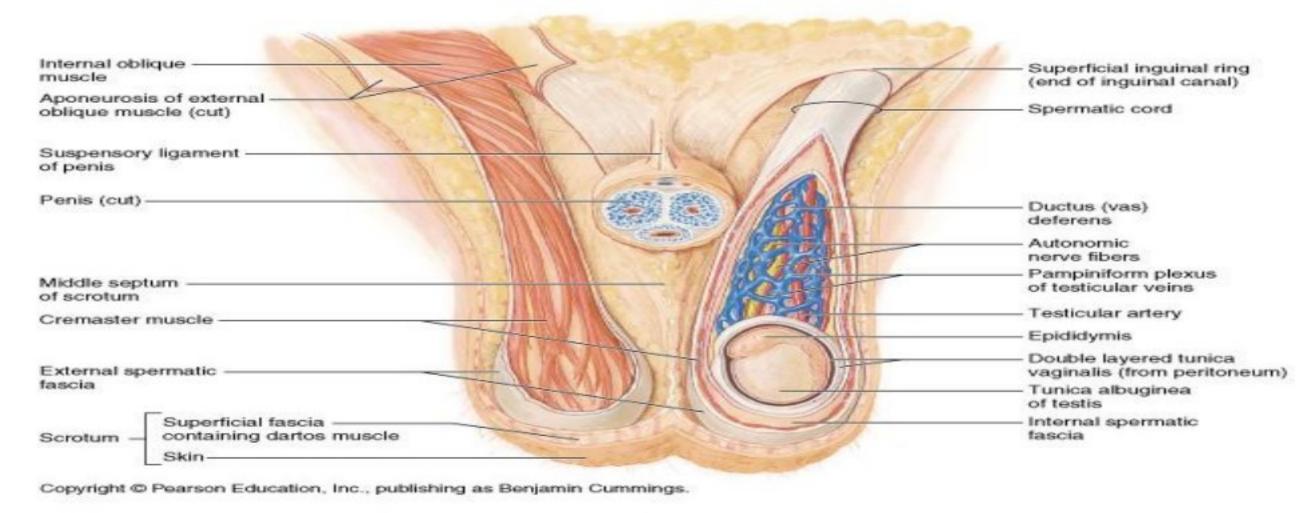


FIGURE 18 MALE REPRODUCTIVE SYSTEM

form different compartments for the testicles.

Paired glands located posterior to the bladder. During ejaculation smooth muscle contract to help secrete a fluid that contains fructose (sugar),



nutrients, prostagladins to stimulate the urethra to contract.

2. PROSTATE GLAND:, also has smooth muscle that contracts to assist in the release of prostatic secretion. This is a milky white fluid that has substances to enhance sperm mobility and thicken ejaculate. It is susceptible to tumors and sexually transmitted diseases (STDs).

3.BULBOURETHRAL GLANDS:

Secrete a mucus substances that lubricates and neutralizes the acid from urine in the male urethra.

10.4 PENIS

Designed to deliver semen .It originates at the root, expends through the body, and ends at the glans penis. Skin around the glans penis is called **prepuce**The penis contains erectile bodies:

- · corpora spongiosum,
- corpora cavernosa,

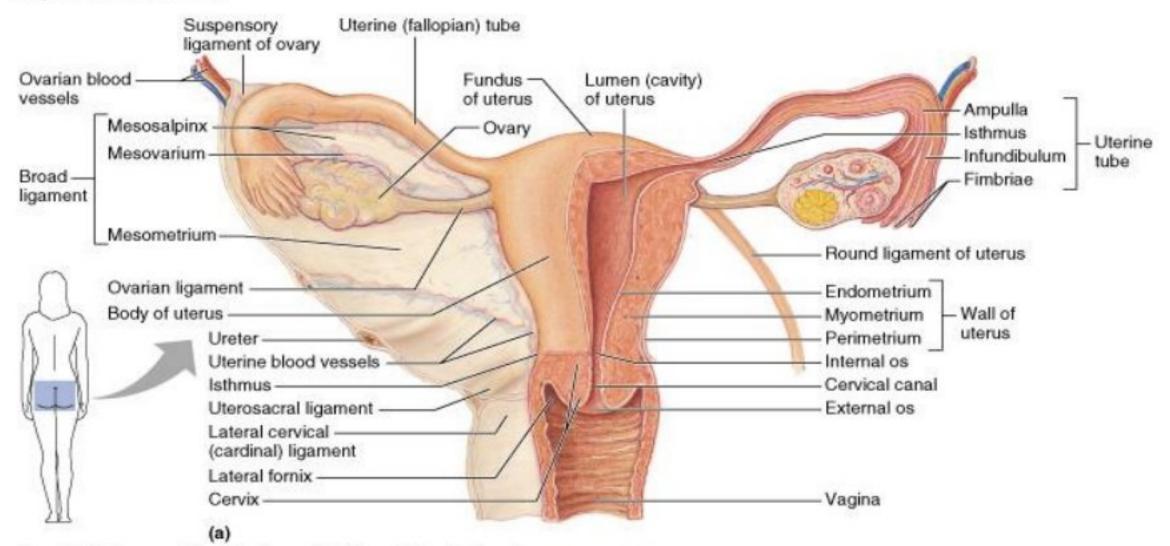
and others consisting of smooth muscle and connective tissue

10.5 SUPPLY

- Arterial Supply is by testicular artery, which is branch of abdominal cavity.
- Nerve supply is through sympathetic nervous system

10.6 FEMALE REPRODUCTIVE SYSTEM

 These organs produce the ova (eggs), sex hormones, and provide an environment for internal fertilization and development of the fetus. They undergo changes according to the menstrual cycle. Mammary glands are considered part of this system because they nourish the infant.



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THE OVARIES: the size of an almond, this
paired organ is suspended by mesenteries
and ligaments. It is surrounded by a fibrous
capsule and can be divided into a cortex and
medulla. The cortex houses the developing
ova and the medulla holds vascular tissue.
The ovary is the site of oogenesis and

female sex hormone production. It responds to **follicle-stimulating hormone** that signals the maturation of an ovum. Typically only one egg is released from an ovary every month, the ovaries alternate in releasing the egg. Every time an egg is released the ovaries become scarred.

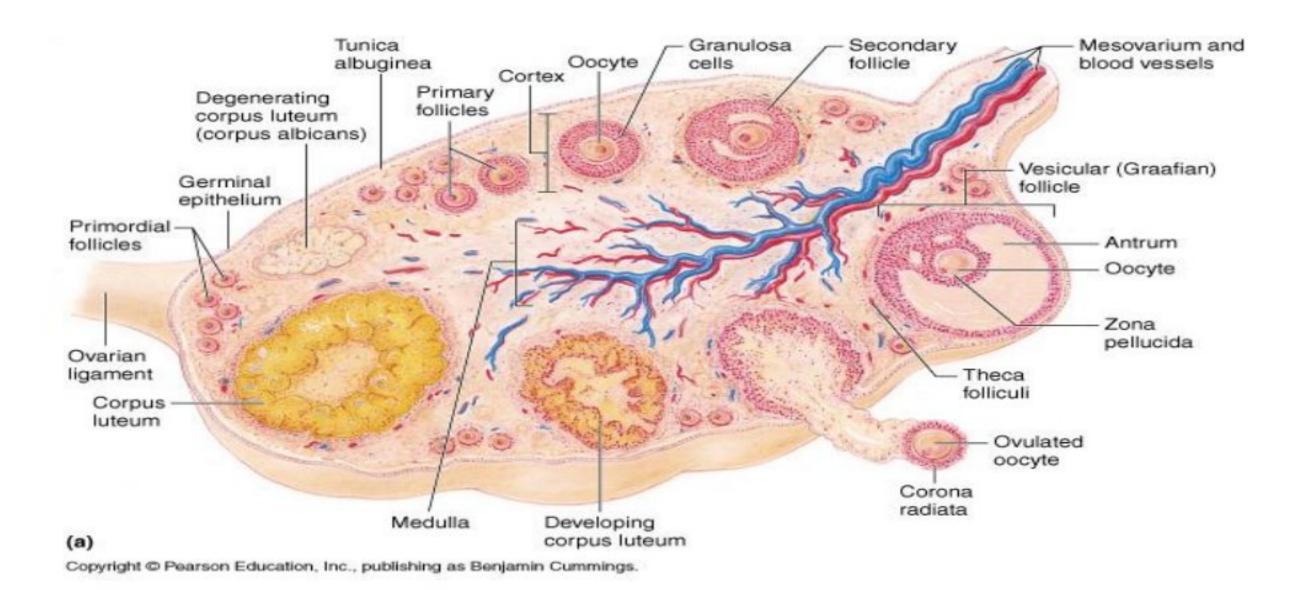


FIGURE 19 OVARIES

- UTERINE TUBES: also called fallopian tubes, they take the oocyte and provide a site for fertilization. The tube is lined with ciliated epithelium that gently guides the oocyte towards the uterus.
- THE UTERUS: a thick muscular pouch about the size of a pear that lies in the pelvic cavity superior to the bladder. The function of the uterus is to receive an embryo and provide an environment for its development. During pregnancy it stretches to accommodate the growth of the fetus. When there is no pregnancy the cavity within the uterus is small.

10.6.1 BLOOD SUPPLY

- Ovarian artery
- Uterine arteries

Chapter 11 ANATOMY OF RESPIRATORY SYSTEM

11.1 ORGANIZATION AND FUNCTIONS OF THE RESPIRATORY SYSTEM

 Consists of an upper respiratory tract (nose to larynx) and a lower respiratory tract (trachea onwards).

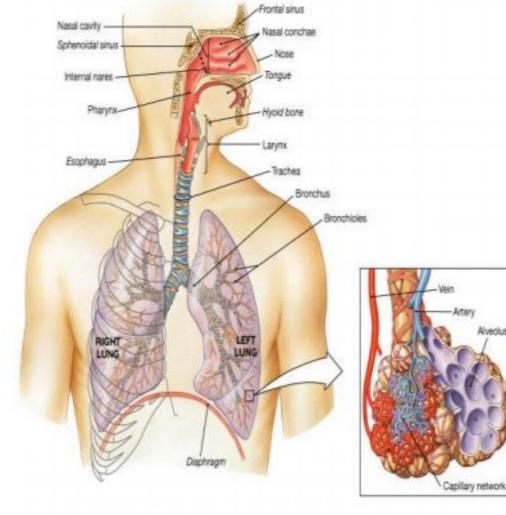
CONDUCTING PORTION

transports air.

includes the nose, nasal cavity, pharynx, larynx, trachea, and progressively smaller airways, from the primary bronchi to the terminal bronchioles
 RESPIRATORY

PORTION

carries out gas



exchange.

- composed of small airways called respiratory bronchioles and alveolar ducts as well as air sacs called alveoli

11.2 Respiratory System Functions

- supplies the body with oxygen and disposes of carbon dioxide
- 2. filters inspired air
- 3. produces sound
- 4. contains receptors for smell
- 5. rids the body of some excess water and heat

11.3 BREATHING

- Breathing (pulmonary ventilation). consists of two cyclic phases:
- INHALATION, also called inspiration draws gases into the lungs.
- EXHALATION, also called expiration forces gases out of the lungs.

11.4 UPPER RESPIRATORY TRACT

- Composed of the nose and nasal cavity, paranasal sinuses, pharynx (throat), larynx.
- All part of the conducting portion of the respiratory system.

11.5 RESPIRATORY MUCOSA

- A layer of PSEUDOSTRATIFIED CILIATED COLUMNAR EPITHELIAL CELLS that secrete mucus
- Found in nose, sinuses, pharynx, larynx and trachea
- Mucus can trap contaminants
 - Cilia move mucus up towards mouth

11.6 Nose

- EXTERNAL NARES: Openings in nose to the nasal cavities.
- INTERNAL NARES Constrictions at the end of the nasal cavities which open into the superior portion of the pharynx.
- NASAL CONCHAE folds in the mucous membrane that increase air turbulence and ensures that most air contacts the mucous membranes (increase surface area)
- NASOLACRIMAL DUCTS, which drain tears from eyes, also emptying in nasal cavities.
- rich supply of capillaries warm the inspired air
- OLFACTORY MUCOSA mucous membranes that contain smell receptors
- RESPIRATORY MUCOSA Rest of mucosa consist of pseudostratified ciliated columnar epithelium containing goblet cells that secrete mucus which traps inhaled particles,
- LYSOZYME kills bacteria and lymphocytes and
- IGA ANTIBODIES that protect against bacteria provides and airway for respiration
- moistens and warms entering air
- filters and cleans inspired air
- resonating chamber for speech detects odors in the air stream

RHINOPLASTY: surgery to change shape of external nose

11.7 PARANASAL SINUSES

PHARYNX: Muscular Passageway

- Common space used by both the respiratory and digestive systems.
- Commonly called the throat.
- Originates posterior to the nasal and oral cavities and extends inferiorly near the level



- of the bifurcation of the larynx and esophagus.
- Common pathway for both air and food.
- Walls are lined by a mucosa and contain skeletal muscles that are primarily used for swallowing.
- Flexible lateral walls are distensible in order to force swallowed food into the esophagus.
- Partitioned into three adjoining regions:
- nasopharynx
- oropharynx
- laryngopharynx

11.8 NASOPHARYNX

- Superior-most region of the pharynx.
 Covered with PSEUDOSTRATIFIED CILIATED
 COLUMNAR EPITHELIUM.
- Located directly posterior to the nasal cavity and superior to the soft palate, which separates the oral cavity.
- · Normally, only air passes through.
- Material from the oral cavity and oropharynx is typically blocked from entering the nasopharynx by the UVULA of soft palate, which elevates when we swallow.
- In the lateral walls of the nasopharynx, paired AUDITORY/EUSTACHIAN TUBES connect the nasopharynx to the middle ear.
- Posterior nasopharynx wall also houses a single pharyngeal tonsil (commonly called the ADENOIDS).

11.9 OROPHARYNX

- · The middle pharyngeal region.
- Immediately posterior to the oral cavity.
- Bounded by the edge of the soft palate superiorly and the hyoid bone inferiorly.
- Common respiratory and digestive pathway through which both air and swallowed food and drink pass.
- Contains NONKERATINIZED STRATIFIED SQUAMOUS EPITHELIM.
- Lymphatic organs here provide the first line of defense against ingested or inhaled foreign materials. PALATINE TONSILS are on the lateral wall between the arches, and the LINGUAL TONSILS are at the base of the tongue.

11.10 LARYNGOPHARYNX

Inferior, narrowed region of the pharynx.

- Extends inferiorly from the hyoid bone to the larynx and esophagus.
- Terminates at the superior border of the esophagus and the epiglottis of the larynx.
- Lined with a NONKERATINIZED STRATIFIED SQUAMOUS EPITHELIUM.
- Permits passage of both food and air.

11.10.1 LOWER RESPIRATORY TRACT

CONDUCTING AIRWAYS (trachea, bronchi, up to terminal bronchioles).

RESPIRATORY PORTION of the respiratory system (respiratory bronchioles, alveolar ducts, and alveoli).

11.11 LARYNX

- VOICE BOX is a short, somewhat cylindrical airway ends in the trachea.
- Prevents swallowed materials from entering the lower respiratory tract.
- Conducts air into the lower respiratory tract.
- Produces sounds.
- Supported by a framework of nine pieces of cartilage (three individual pieces and three cartilage pairs) that are held in place by ligaments and muscles.
- Nine c-rings of cartilage form the framework of the larynx
- THYROID CARTILAGE (1) Adam's apple, hyaline, anterior attachment of vocal folds, testosterone increases size after puberty
- CRICOID CARTILAGE (1) ring-shaped, hyaline
- ARYTENOID CARTILAGES (2) hyaline, posterior attachment of vocal folds, hyaline
- CUNEIFORM CARTILAGES (2) hyaline
- CORNICULATE CARTLAGES (2) hyaline
- EPIGLOTTIS (1) elastic cartilage

Muscular walls aid in voice production and the swallowing reflex

- GLOTTIS the superior opening of the larynx
- EPIGLOTTIS prevents food and drink from entering airway when swallowing

11.11.1.1 PSEUDOSTRATIFIED CILIATED COLUMNAR EPITHELIUM

11.11.2 SOUND PRODUCTION

- Inferior ligaments are called the vocal folds.
- are true vocal cords
 [±] because they produce sound when air passes between them

- Superior ligaments are called the vestibular folds.
- are false vocal cords to because they have no function in sound production, but protect the vocal folds.
- The tension, length, and position of the vocal folds determine the quality of the sound.
 - Intermittent release of exhaled air through the vocal folds
- Loudness depends on the force with which air is exhaled through the cords
- Pharynx, oral cavity, nasal cavity, paranasal sinuses act as resonating chambers that add quality to the sound
- Muscles of the face, tongue, and lips help with enunciation of words
- Conducting zone of lower respiratory tract

11.12 TRACHEA

- A flexible tube also called WINDPIPE.
- Extends through the mediastinum and lies anterior to the esophagus and inferior to the larynx.
- Anterior and lateral walls of the trachea supported by 15 to 20 C-shaped tracheal cartilages.
- Cartilage rings reinforce and provide rigidity to the tracheal wall to ensure that the trachea remains open at all times
- Posterior part of tube lined by trachealis muscle
- Lined by ciliated pseudostratified columnar epithelium.
- the trachea bifurcates into two smaller tubes, called the right and left primary bronchi.
- Each primary bronchus projects laterally toward each lung.
- The most inferior tracheal cartilage separates the primary bronchi at their origin and forms an internal ridge called the carina.

11.13 Bronchial Tree

- A highly branched system of air-conducting passages that originate from the left and right primary bronchi.
- Progressively branch into narrower tubes as they diverge throughout the lungs before terminating in terminal bronchioles.
- Incomplete rings of hyaline cartilage support the walls of the primary bronchi to ensure that they remain open.

 Right primary bronchus is <u>shorter</u>, <u>wider</u>, and more <u>vertically oriented</u> than the left primary bronchus.

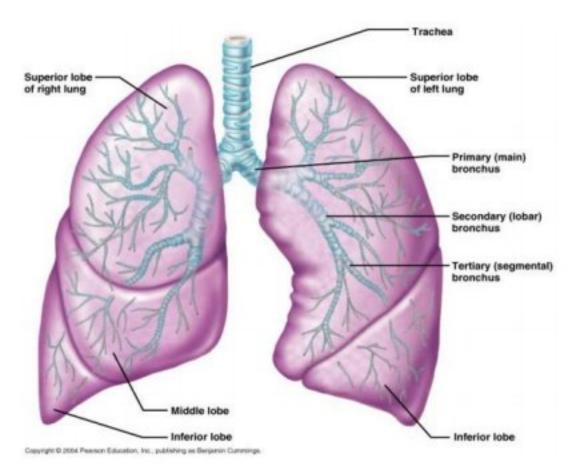


FIGURE 20 CONDUCTING ZONE OF LOWER RESPIRATORY TRACT

- Foreign particles are more likely to lodge in the right primary bronchus.
 - The primary bronchi enter the hilus (depression) of each lung together with the pulmonary vessels, lymphatic vessels, and nerves.
- Each primary bronchus branches into several secondary bronchi (or lobar bronchi).
- The left lung has two secondary bronchi. The right lung has three secondary bronchi.
- They further divide into tertiary bronchi.
- Each tertiary bronchus is called a segmental bronchus because it supplies a part of the lung called a bronchopulmonary segment.
- Each primary bronchus branches into several secondary bronchi (or lobar bronchi).
- The left lung has two secondary bronchi.
 The right lung has three secondary bronchi.
- WHY ???????
- They further divide into tertiary bronchi.
- Each tertiary bronchus is called a segmental bronchus because it supplies a part of the lung called a bronchopulmonary segment.

11.14 Bronchopulmonary segment

Each of the TERTIARY BRONCHI serves a specific bronchopulmonary segment. These segments each have their own artery. Thus, each bronchopulmonary segment is supplied by a segmental bronchus, and two arteries, a pulmonary artery and a bronchial artery which run together through the center of the segment. Veins and lymphatics drain along the edges. There are 10 bronchopulmonary segments in the right lung (3 in superior lobe, 2 in middle lobe, 5 in inferior lobe) and 8-10 segments on the left (4-5 in upper lobe, 4-5 in lower lobe). Each segment is separated from the others by a layer of CONNECTIVE TISSUE.

This means that each bronchopulmonary segment is a discrete anatomical and functional unit, and this separation means that a bronchopulmonary segment can be surgically removed without affecting the function of the other segments.

11.15 BRONCHIAL TREE

- Secondary bronchi
 → tertiary bronchi
 bronchioles → terminal bronchioles
- with successive branching, amount of cartilage decreases and amount of smooth muscle increases, this allows for variation in airway diameter
- during exertion and when sympathetic division active -> bronchodilation
- mediators of allergic reactions like histamine → bronchoconstriction
- epithelium gradually changes from ciliated pseudostratified columnar epithelium to simple cuboidal epithelium in terminal bronchioles

11.16 CONDUCTION VS. RESPIRATORY ZONES

- Most of the tubing in the lungs makes up CONDUCTION ZONE
 - Consists of nasal cavity to terminal bronchioles
- The RESPIRATORY ZONE is where gas is exchanged
 - Consists of alveoli, alveolar sacs, alveolar ducts and respiratory bronchioles

11.17 RESPIRATORY BRONCHIOLES, ALVEOLAR DUCTS, AND ALVEOLI

- Lungs contain small saccular outpocketings called alveoli.
- They have a thin wall specialized to promote diffusion of gases between the alveolus and the blood in the pulmonary capillaries.
- Gas exchange can take place in the respiratory bronchioles and alveolar ducts as well as in the alveoli, each lung contains approximately 300 to 400 million alveoli.

 The spongy nature of the lung is due to the packing of millions of alveoli together.

11.18 RESPIRATORY MEMBRANE

- squamous cells of alveoli .
- basement membrane of alveoli.
- basement membrane of capillaries
- simple squamous cells of capillaries
- about .5 μ in thickness

11.19 CELLS IN ALVEOLUS

- Type I cells: simple squamous cells forming lining (95%)
- Type II cells: or septal cells secrete surfactant (contains phospholipids and proteins in surfactants, reduces the surface tension inside alveoli which keeps walls away from sticking)
- Alveolar macrophages (Dust Cell) protect lung from damage

11.20 GROSS ANATOMY OF THE LUNGS

- Each lung has a conical shape. Its wide, concave base rests upon the muscular diaphragm.
- Its superior region called the apex projects superiorly to a point that is slightly superior and posterior to the clavicle.
- Both lungs are bordered by the thoracic wall anteriorly, laterally, and posteriorly, and supported by the rib cage.
- Toward the midline, the lungs are separated from each other by the mediastinum.
- The relatively broad, rounded surface in contact with the thoracic wall is called the costal surface of the lung.

11.21 LUNGS

11.22 LEFT LUNG

- divided into 2 lobes by oblique fissure
- smaller than the right lung
- cardiac notch accommodates the heart

11.23 RIGHT

- divided into 3 lobes by oblique and horizontal fissure
- located more superiorly in the body due to liver on right side

11.24 PLEURA AND PLEURAL CAVITIES

The outer surface of each lung and the adjacent internal thoracic wall are lined by a serous membrane called PLEURA.

The outer surface of each lung is tightly covered by the VISCERAL PLEURA.

while the internal thoracic walls, the lateral surfaces of the mediastinum, and the superior surface of the diaphragm are lined by the PARIETAL PLEURA.

The parietal and visceral pleural layers are continuous at the HILUS of each lung.

11.25 PLEURAL CAVITIES

The potential space between the serous membrane layers is a PLEURAL CAVITY.

 The pleural membranes produce a thin, serous PLEURAL FLUID that circulates in the pleural cavity and acts as a lubricant, ensuring minimal friction during breathing.

11.26 BLOOD SUPPLY OF LUNGS

- PULMONARY CIRCULATION
- BRONCHIAL CIRCULATION bronchial arteries supply oxygenated blood to lungs, bronchial veins carry away deoxygenated blood from lung tissue → superior vena cava

11.27 RESPIRATORY EVENTS

- PULMONARY VENTILATION = exchange of gases between lungs and atmosphere
- EXTERNAL RESPIRATION = exchange of gases between alveoli and pulmonary capillaries
- INTERNAL RESPIRATION = exchange of gases between systemic capillaries and tissue cells

Chapter 12 Introduction to Epithelia

12.1 TISSUES AND HISTOLOGY

- HISTOLOGY: Microscopic Study of cells, tissues, and organs.
- CELL-the basic structural and functional unit of all known living organisms
- TISSUES -groups of cells that are similar in structure and function.
- ORGANS-collection of tissues joined in structural unit to serve a common function
- Cells specialize into types of tissues, then interspersed into organs
- Tissue classification based on structure of cells, composition of non-cellular extracellular matrix, and cell function

12.1.1 MAJOR TYPES OF ADULT TISSUES

12.1.1.1 Epithelium

- Linings of surfaces
- Coverings

12.1.1.2 CONNECTIVE

- Support
- · Bone, ligaments, fat

12.1.1.3 MUSCLE

Movement

12.1.1.4 NERVOUS

- Control
- Brain, nerves, spinal cord

12.2 HISTOLOGICAL METHODS

12.2.1 SECTION PREPARATION

- > Frozen tissues sections made
- Cutting thin sections of tissue by MICROTOMES
- Microtome enclosed in refrigerator is called CRYOSTAT

- Apart from freezing, it is also suitable by embedding it in suitable medium, common being PARAFFIN WAX
- Thinner and reveal more details but loose some materials like fat

12.2.2 FIXING:

- it preserves tissue by denaturing its proteins
- Cell metabolism is stopped & cell structure is preserved
- Mostly used formaldehyde (water+formaldehyde=formalin)

12.2.3 STAINING:

- Commonly used is HAEMATOXYLIN-EOSIN
- Nuclei stained blue and other components in various shades of pink

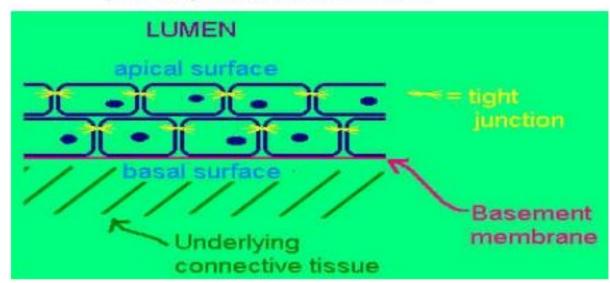
12.3 EPITHELIAL TISSUE

- The outer surface of the body and luminal surfaces of cavities within the body are lined by one or more layers of cells that completely cover them. Such layers of cells are called EPITHELIA(epithelium)
 - FREE SURFACE:- epithelial tissue has an apical surface or free edge
- Covers body surfaces, lines hollow organs, and forms glands
 - Outside surface of the body
 - Lining of digestive, respiratory and urogenital systems
 - o Heart and blood vessels
 - o Linings of many body cavities

12.4 CHARACTERISTICS

- CELLULARITY Consists almost entirely of cells bound closely with tight junctions
- ARRANGEMENT:- All epithelial tissue is composed of a sheet of cells one or more thick
- The shape of epithelial cells is related to the amount of cytoplasm and organelles. This in turn relates to metabolic activity. Squamous cells are less active than columnar that contain abundant mitochondria and endoplasmic reticulum

- AVASCULARITY:- Epithelial cells lacks blood vessels. They obtain nutrition and elimination process by diffusion from blood vessels in underlying tissues
- RAPID REPARING:-They have considerable capacity for repair after damage. They grow rapidly after injury to repair the defect
- DIFFERENTIAL FUNCTIONS:-Epithelial cells that look alike could have different functions e.g. Cuboidal cells lining follicles of thyroid have very little in common as with of ovary
- The surface area of epithelial cell may be greatly increased by presence of microvilli
- Some epithelial cells contain pigment. Such cells are present in skin, the retina and iris
- ATTACHMENT:-All epithelia rest on a very thin BASEMENT MEMBRANE



12.5 FUNCTIONS OF EPITHELIA

12.5.1 PROTECTION

- Protecting underlying structures; e.g., epithelium lining the mouth
- Acting as barriers; e.g., skin

12.5.2 ABSORPTION

Lining of small intestine, absorbing nutrients into blood

12.5.3 FILTRATION

Lining of Kidney tubules filtering wastes from blood plasma

12.5.4 SECRETION

Different glands produce perspiration, oil, digestive enzymes and mucus

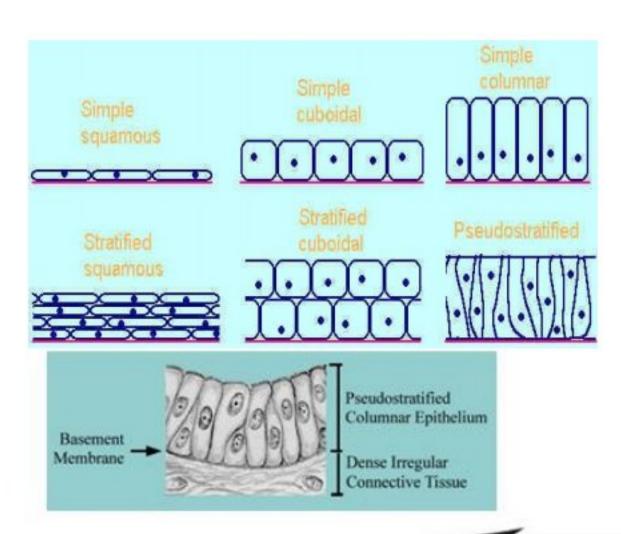
12.6 CLASSIFICATION OF EPITHELIUM

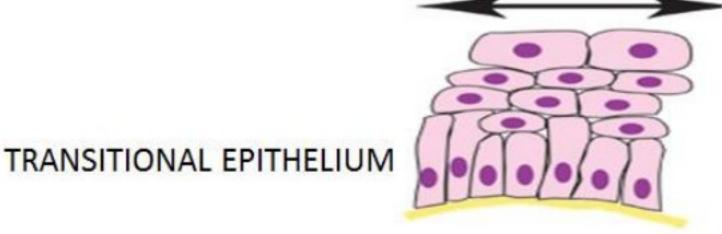
12.6.1.1 NUMBER OF LAYERS OF CELLS

- Simple- one layer of cells. Each extends from basement membrane to the free surface
- Stratified- more than one layer.
- Pseudo stratified- tissue appears to be stratified, but all cells contact basement membrane cells appears stratified because the cells have different heights: all the cells rest on the basement membrane, but all do not reach the apical surface.

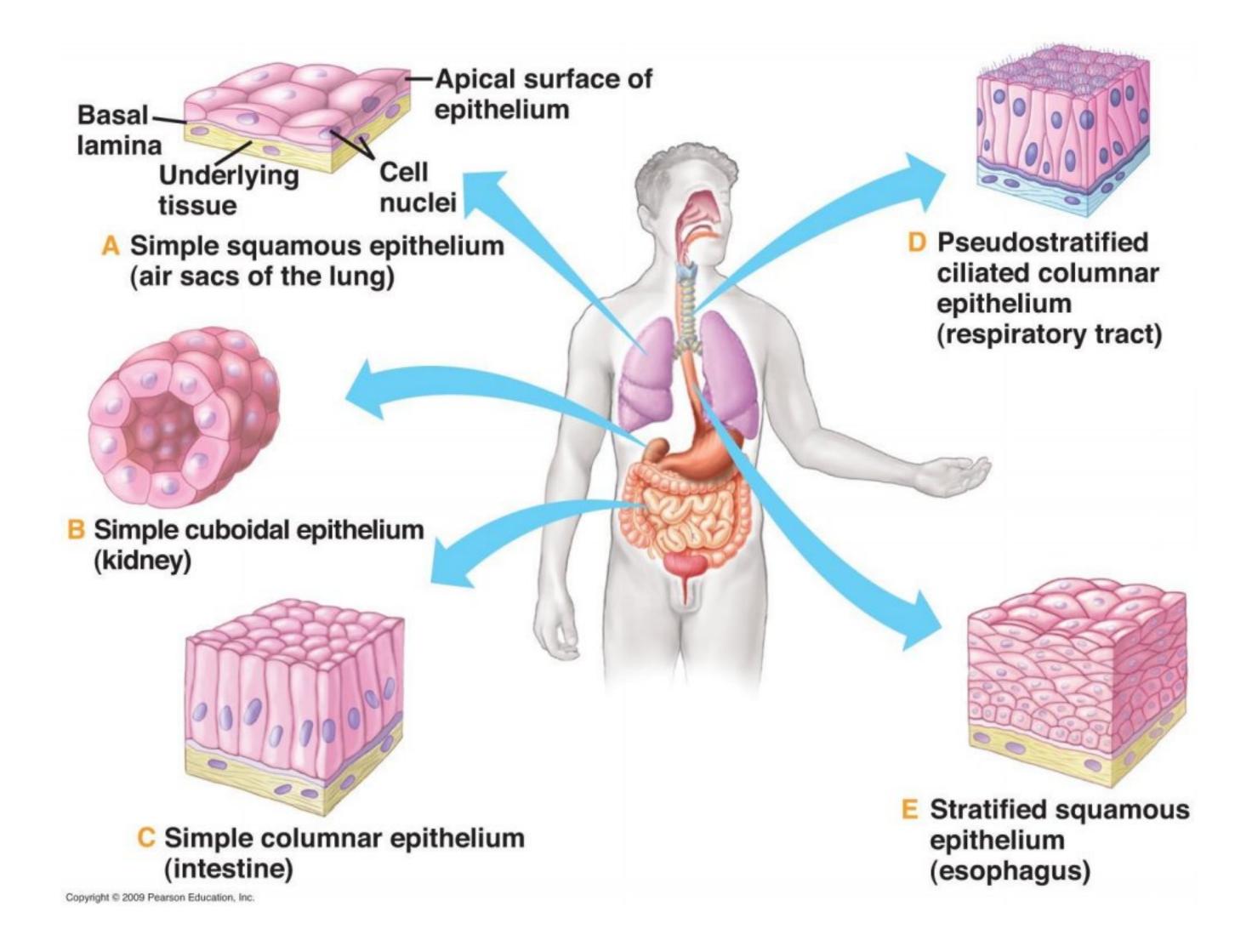
12.6.1.2 SHAPE OF CELLS

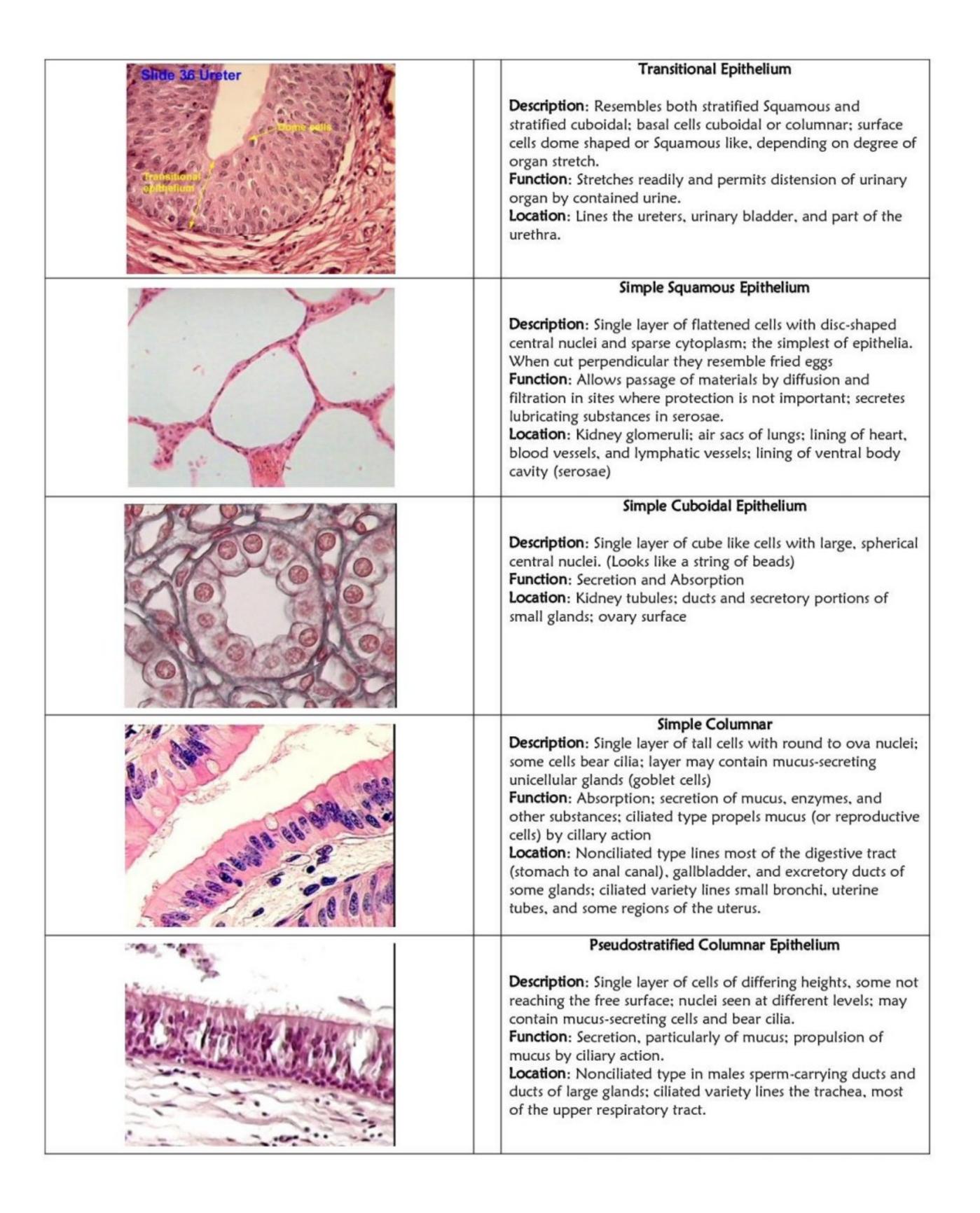
- Squamous- flat, scale-like
- Cuboidal- about equal in height and width
- Columnar- taller than wide
- Transitional-multi layered epithelium, basically it is characteristic for the urinary system. Because of this distribution it is called UROTHELIUM.











12.7 Types of Squamous Cells

 Simple squamous(composed of one layer of these cells) Stratified squamous(may possess multiple layers)

Both types perform differing functions, ranging from nutrient exchange to protection

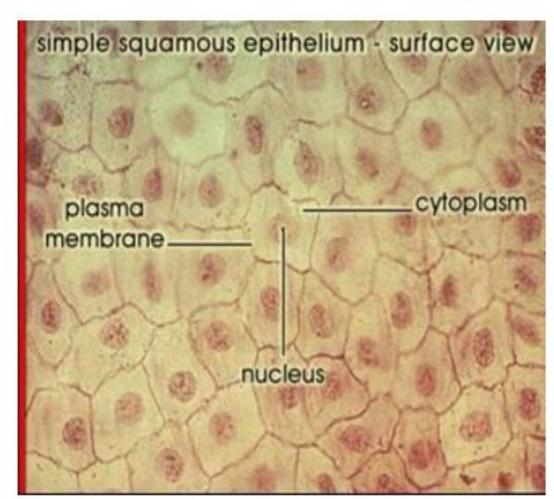
12.8 SIMPLE SQUAMOUS EPITHELIUM

12.8.1 STRUCTURE

- Simplest of epithelium
- Single Layer of flattened cells
- Disc shaped central nuclei and sparse cytoplasm
- In sections appear so thin that bulging are produced on surface by nuclei

12.8.2 FUNCTION

- Absorption, and filtration of nutrients by diffusion
- Not effective protection single layer of cells.



12.8.3 LOCATION

- Free surfaces of peritonium, pleura, pericardium (mesothelium)
- Inside of blood vessels(endothelium)
- Heart(endocardium)
- Kidney glomeruli.

12.9 STRATIFIED SQUAMOUS EPITHELIUM

- Epithelium made of several layers of cells arranged in layers upon a <u>basement</u> <u>membrane</u>
- Only one layer is in contact with the basement membrane; the other layers adhere to one another to maintain structural integrity.
- Stratified epithelia are normally found in places where there is a great deal of wear and tear.
- These typically are at sites needing a more defensive, rather than a metabolic function
- The deepest layer is of columnar cells that lie on basement membrane.

- Lying on columnar cells are polyhydral or cuboidal cells.
- As we pass towards upper epithelium cells become more flat, so that most of superficial cells are flattened squamous cells
- Cells divide in deep layers and push older cells outward
- Older cells flatten
- Forms outer layer of skin

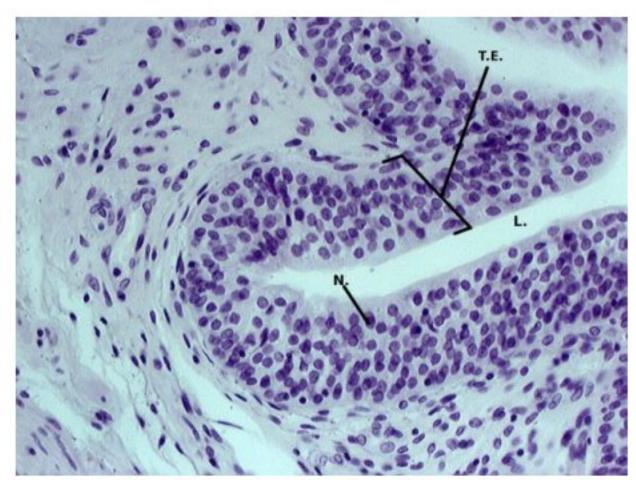
12.9.1 TYPES

- Can be divided into two types:
 - non-keratinized
 - Keratinized
- In non keratinized the most superficial cells are living and surface is moist. Nuclei can be seen in them
- In contrast, places where epithelial surface is dry the superficial cells die and loose their nuclei is keratinized stratified squamous epithelium. These cells contain substance keratin, which forms non living covering
- These both are found over the surfaces of body thar are subject to friction.as a result the most superficial layers are cosequently being removed and replaced by poliferation of cells from basal layer.

12.9.2 LOCATION

- Keratinized covers the skin of whole body and forms the epidermis
- Non keratinized is seen in lining of mouth, the toungue, the oesophagus, the vagina and the cornea

12.10 Transitional Epithelium



Muti layered epithelium & is 4-6 cells thick

- Different from stratified squamous epithelium in that the cells at the surface are not squamous
- The appearance of cells depend on the state of stretch of organ, hence named transitional
- That is the reason it is difficult to identify correctly
- > The deepest cells are cuboidal or columnar
- Middle layers are made of polyhedral or pear shaped
- The surface layer are large and often shaped like an umbrella or balloon shaped

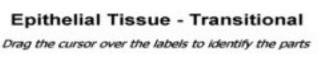
12.10.1 LOCATION

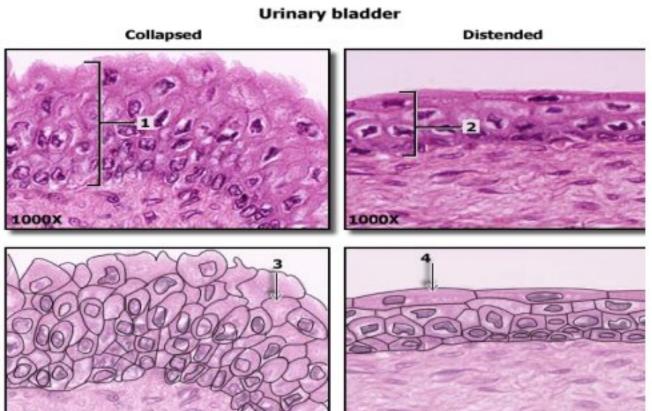
The distribution of this epithelium is limited to urinary tract

- Renal pelvis and calyces
- > The ureter
- > The urinary bladder
- Part of urethra
- Because of this distribution it is called as UROTHELIUM

12.10.2 CHARACTERISTICS

- An epithelium composed of more than one layer
- A regular arrangement of nuclei, in that the nuclei appear to be arranged in rows
- A variation in cell shape when you compare the deepest layer with the superficial layer
- Cells at the free surface that typically are large and rounded (relaxed organ) or flattened almost squamous in shape (stretched)





Chapter 13 HISTOLOGICAL STUDY OF MUSCLE

13.1 Types

Muscle tissues can be divided into three types. The different types of muscle tissue are determined by the different functions of each tissue type. The three types of tissues include: smooth, cardiac and skeletal

13.2 SKELETAL MUSCLES

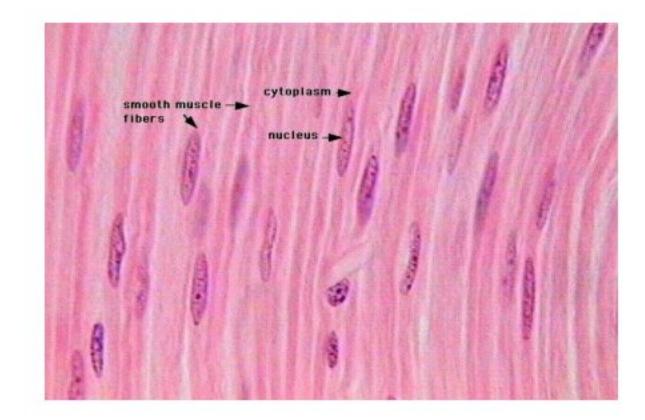
- Striated muscles, also called skeletal or voluntary muscles, include those that are activated by the somatic, or voluntary, nervous system. They are joined together without cell walls and have several nuclei
- Skeletal muscle is supplied with nerves from the central nervous system, and because it is partly under conscious control, it is also called voluntary muscle.
- Most skeletal muscle is attached to portions of the skeleton by connective-tissue attachments called tendons. Contractions of skeletal muscle serve to move the various bones and cartilages of the skeleton
- Cells are long and cylindrical fibers in shape
- The fibers show prominent transverse striations therefore called striated muscle
- Cells are multinucleate
- Nuclei are peripherally located just under the cell membrane (sarcolema)
- The cytoplasm(sarcoplasm) filled with numerous longitudinal fibrils called myofibrils



13.3 SMOOTH MUSCLE

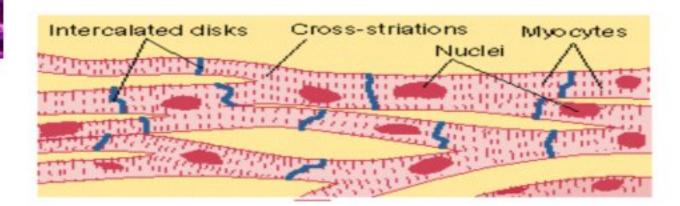
- Visceral, or involuntary, muscle is composed of spindle-shaped cells, each having a central nucleus. The cells have no cross striations, although they do exhibit faint longitudinal striations.
- Stimuli for the contractions of smooth muscles are mediated by the autonomic nervous system.
- Smooth muscle is found in the skin, internal organs, reproductive system, major blood vessels, and excretory system.

- Made up of long spindle shaped cells (myocytes) having broad central part and tapering ends.
- The nucleus which is oval or elongated lies in the central part of the cell.
- smooth muscle is not striated
- Aggregated to form bundles



13.4 CARDIAC MUSCLE

- Cardiac muscles, which have characteristics of both striated and smooth muscles, are joined together in a vast network of interlacing cells and muscle sheaths.
- The cells, which show both longitudinal and imperfect cross striations, differ from skeletal muscle primarily in having centrally placed nuclei and in the branching and interconnecting of fibers.
- Cardiac muscle is not under voluntary control.
- Nuclei in cardiac muscle are centrally located
- Cardiac muscle possess specialized cell junctions called intercalated discs(visible in longitudinal section)
- Cardiac muscle exhibits fibers running in several different directions



Skeletal Muscle Cell	Cardiac Muscle Cell	Smooth Muscle Cell
Elongated Cells	Branching Cells	Spindle-Shaped Cell
Multiple Peripheral Nuclei	Single Central Nucleus	Single Central Nucleus
Visible Striations	Visible Striations	Lack Visible Striations
Voluntary	Involuntary	Involuntary
limbs	heart	skin, internal organs, reproductive system, major blood vessels, and excretory system.

Chapter 14 HISTOLOGY OF LIVER

14.1.1 LIVER

- The liver, hepar, is a vital organ present in vertebrates and some other animals.
- It is both the largest internal organ (the skin being the largest organ overall) and the largest gland in the human body
- It is located in the right upper quadrant of the abdominal cavity, resting just below the diaphragm. The liver lies to the right of the stomach and overlies the gallbladder

14.2 Functions of the Liver

Digestive and Metabolic Functions

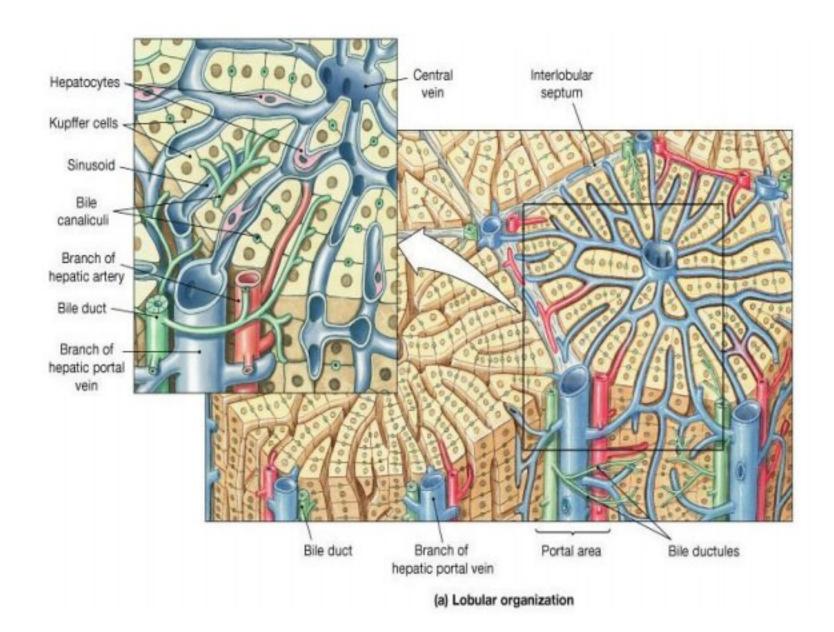
- synthesis and secretion of bile
- storage of glycogen and lipid reserves
- maintaining normal blood glucose, amino acid and fatty acid concentrations
- synthesis and release of cholesterol bound to transport proteins
- · inactivation of toxins
- storage of iron reserves
- storage of fat-soluble vitamins

Non-Digestive Functions

- synthesis of plasma proteins
- synthesis of clotting factors
- phagocytosis of damaged red blood cells
- breakdown of circulating hormones (insulin and epinephrine) and immunoglobulins

14.3 HISTOLOGICAL FEATURES

- Liver is an encapsulated structure
- Liver is anatomically divided into 4 lobes by loose connective tissue septae and each of which consists of numerous hexagonal hepatic lobules. Due to scanty connective tissue the lobules appear to merge with one another
- Liver is made up of liver cells called hepatocytes with a round nucleus that are arranged radially around a branch of the hepatic vein, called the central vein
- A collection of 3-4 hepatocytes along with their vasculature is called a lobule

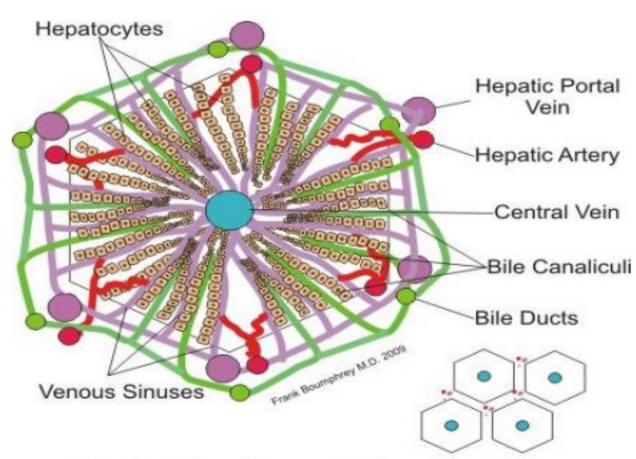


14.4 BLOOD SUPPLY

- It has dual blood supply, portal vein supplying 70% and hepatic artery with 30% of its required oxygen.
- It is connected to two large blood vessels, one called the hepatic artery and one called the portal vein.
- The hepatic artery carries blood from the aorta, whereas the portal vein carries blood containing digested nutrients from the entire gastrointestinal tract and also from the spleen and pancreas.
- These blood vessels subdivide into capillaries, which then lead to a lobule. Each lobule is made up of millions of hepatic cells which are the basic metabolic cells. Lobules are the functional units of the liver.

14.4.1 BILIARY FLOW

- The exocrine secretion liver is called bile
- The bile produced in the liver is collected from liver cells into very delicate bile canaliculi, which then is poured into large bile ducts
- This duct conveys bile into duodenum where it plays role in digestion of fats.

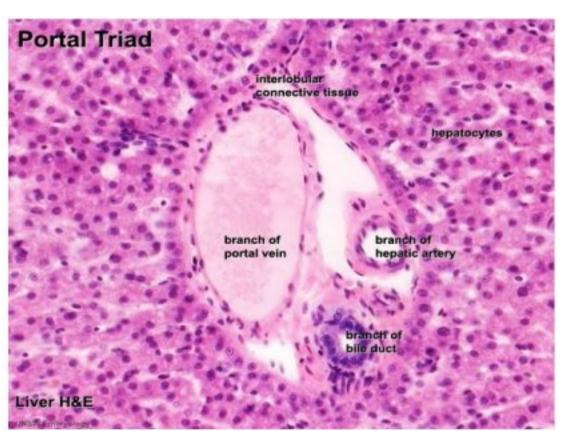


Basic Structure of Liver Lobule

- The histology of liver is distinct from that of other organs in that every 3-4 cells (lobule) of it have their own vessels and their own drainage systems. No other organ in the body has such a deeply penetrating blood supply, with a separate vessel for each 3-4 cells.
- The hepatocytes are arranged around the central vein, radiating away from it.
- The space between 3-4 lobules contains portal triad / tract.

14.4.1.1 PORTAL TRIAD IS MADE OF:

- A) HEPATIC ARTERY
- B) PORTAL VEIN
- c) BILE DUCT
- Portal triads are a key feature of the organization of the liver. Portal triads are embedded in interlobular connective tissue.



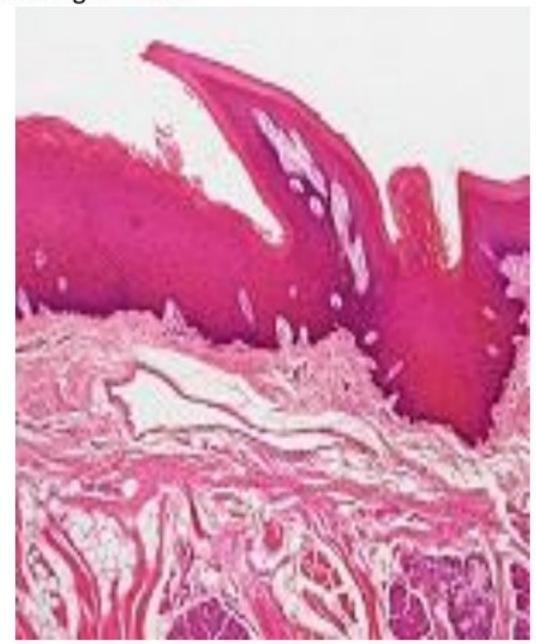
- The communication between portal and central veins is called sinus, which is a widened space between hepatocytes.
- Hepatocytes are arranged in rows that radiate out from the central

- vein. These rows are one cell wide and are surrounded by sinusoidal capillaries or **sinusoids**. This arrangement ensures that each hepatocyte is in very close contact with blood flowing through the sinusoids, i.e. bathed in blood.
- Adjacent to canaliculi is the endothelium of vessel running, and around endothelium of each central vein are present, 'kupfer cells', which are the macrophages of liver.

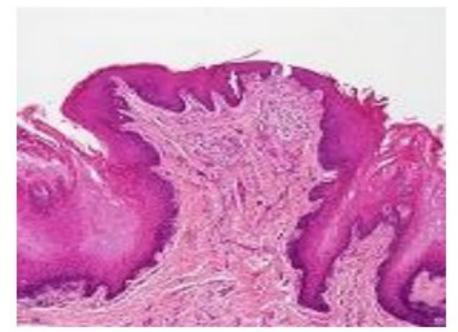
Chapter 15 HISTOLOGY OF TONGUE

- The tongue lies on the floor of the oral cavity
- It has a dorsal surface that is free; and a ventral surface
- The substance of the tongue is made up chiefly of skeletal muscle supported by connective tissue. The muscle is arranged in bundles that run in vertical, transverse and longitudinal directions
- The dorsal surface of the oral part has a characteristic appearance due to the presence of a large number of small projections, the lingual papillae
- The lingual papillae consist of a connective tissue core covered with a stratified squamous epithelium. On the basis of their appearance four types of papillae can be distinguished - filiform, fungiform, circumvallate and foliate papillae.

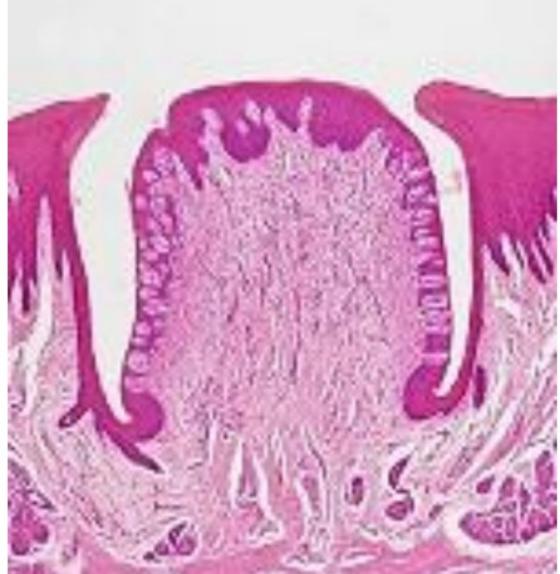
Filiform papillae are the smallest and most numerous papillae. By providing the tongue with a rough surface they aid in the manipulation and processing of foods.

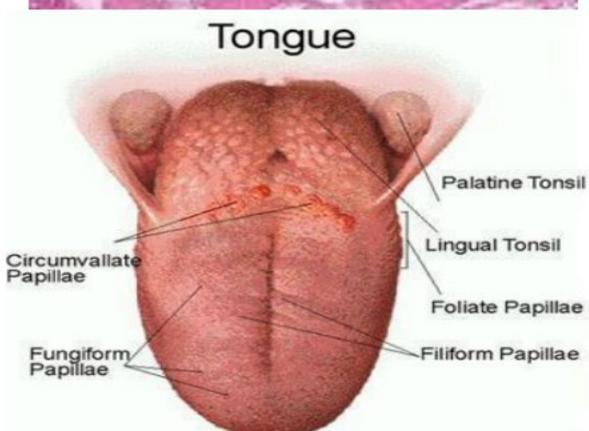


Fungiform papillae occur singly and are fairly evenly spaced between the filiform papillae. Their connective tissue core is richly vascularised. The epithelium is slightly thinner than on the remaining surface of the tongue.



Circumvallate papillae are the largest and least numerous papillae. In humans there are between 8 and 12 of them. They occur in depressions of the surface of the tongue and are surrounded with a trench formed by the infolding of the epithelium. Taste buds are particularly numerous on the lateral surfaces of these papillae





- The epithelium of the dorsal surface of the tongue rests on a fairly dense layer of connective tissue, which connects the epithelium firmly with the underlying muscular and connective tissues
- The muscles of the tongue (skeletal muscle) are organized into strands oriented more or less perpendicular to each other. Their actions provide the tongue with the necessary motility to participate in the



- formation of speech and to aid in the initial processing of foods.
- Filiform papillae of the tongue have keratinized tips which form in the same way as the stratum corneum of the epidermis. Cells accumulate keratohyalin, which hardens into keratin as the cells die. But rather than occuring uniformly over the entire surface (as on skin), on the tongue keratinization occurs in many tiny, separate patches, each of which creates one papilla.

Filiform Papillae of the Tongue

- 1 epithelium covering papilla (stratified squamous keratinizing)
- 2 keratinized layer of the epithelium 3 - core of the papilla (lamina propria of the mucosa of dorsal surface of the tongue) 4 - tongue muscles

The bulk of the tongue consists of striated muscle fibers arranged in bundles

This section illustrates the general organization of the tongue. Taste buds will be rare, if present at all, in this section. Examine the tissue and have a close look at the small salivary glands located in the connective tissue of the tongue

15.1 VON EBNER'S GLANDS

Von Ebner's glands are exocrine glands found in the mouth. More specifically, they are serous salivary glands. they secrete lingual lipase, beginning the process of lipid hydrolysis in the mouth

Chapter 16 HISTOLOGY OF JEJUNUM

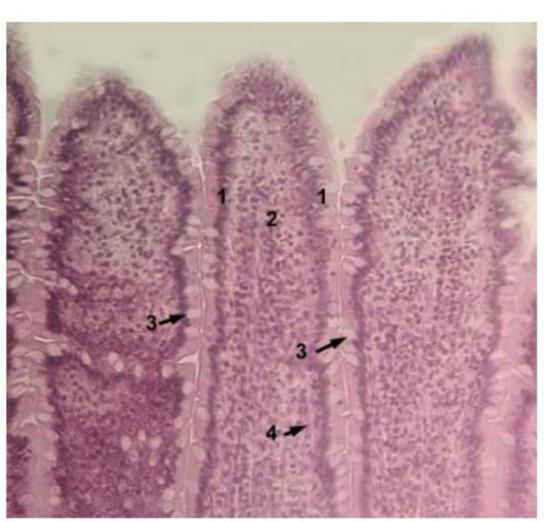


- Jejunum is the second part of the small intestine. It is about 15 feet long and absorbs nearly all nutrients, except water.
- The jejunum lies between the duodenum and the ileum.

16.1.1 Mucosa

The mucosa consists of three sub-layers:

- epithelium
- lamina propria
- muscularis mucosae
- In mucosa there is Presence of finger like projections that cover entire surface called VILLI. The villi are taller and more slender in the jejunum than in other region of small intestine
- The surface of the villi consists of columnar cells having oval nucleus at lower part that are specialized for absorption. These are called ENTEROCYTES
- The mucosa also possess numerous depressions termed INTESTINAL CRYPTS which open between villi and extend as deep as the muscularis mucosae
- Presence of goblet cells in the mucosa of jejunum that are more in number as in duodenum. They secrete mucus to promote movement and effective diffusion of gut contents.
- The thin muscularis mucosa of the small intestine forms a thin layer beneath the deep ends of the crypts consisting of of smooth muscle fibers



- 1 epithelium of the mucosa (covers villi)
- 2 lamina propria of the mucosa
- 3 goblet cells in the epithelium
- 4 parts of the muscularis mucosae

16.2 SUB-MUCOSA

- The submucosa is dense ,irregular connective tissue containing nerves, blood vessels, and lymphoid nodules.
- The jejunum has many large circular folds in its sub mucosa called PLICAE CIRCULARES(valves of Kerckring) which increase the surface area for nutrient absorption.

16.3 Muscularis Externa

- Muscularis externa of the jejunum has the standard inner circular and outer longitudinal layers of smooth muscle.
- muscular wall of the tract, surrounding (outside, deep to) the sub mucosa.

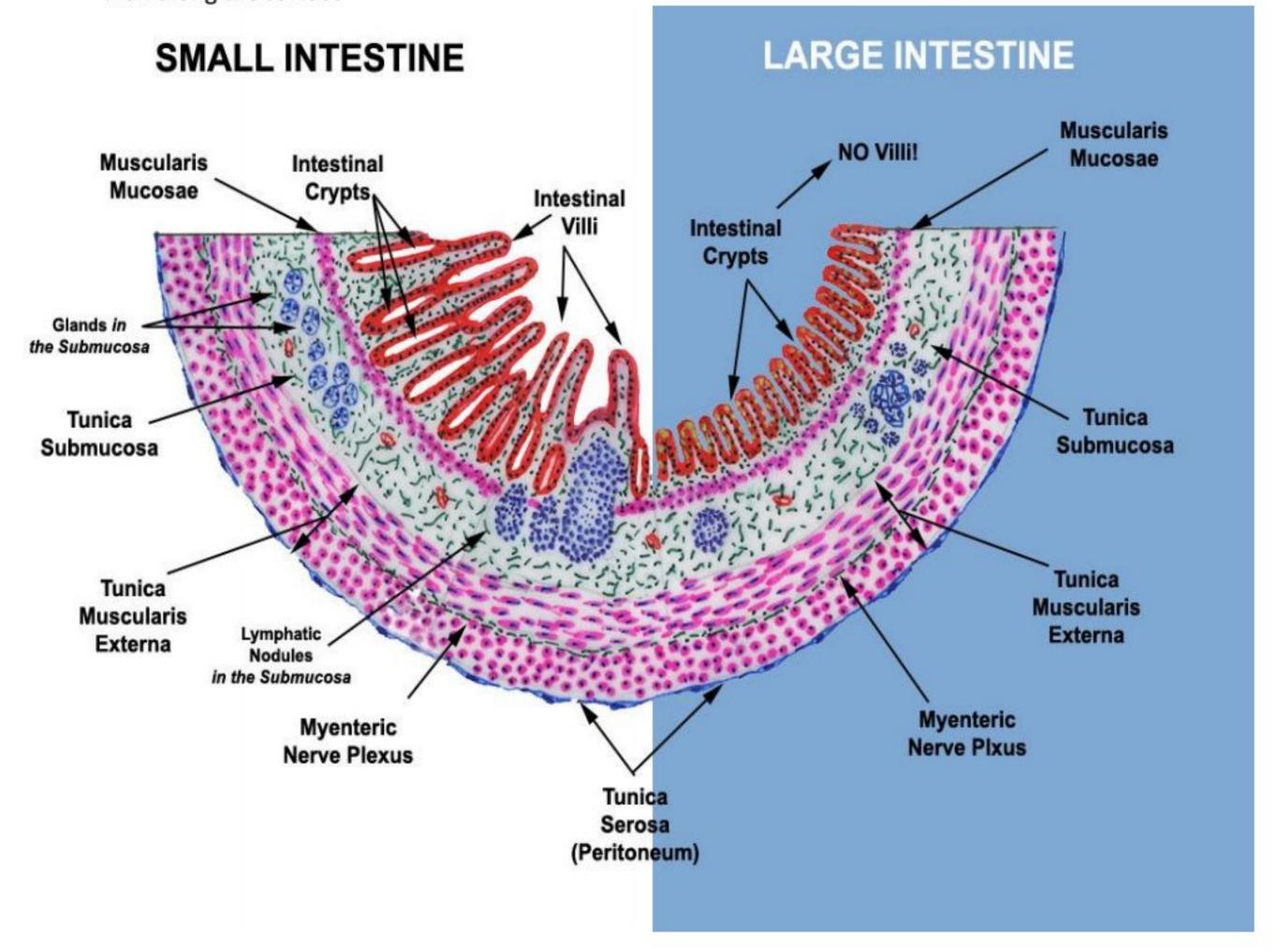
Chapter 17 HISTOLOGY OF LARGE INTESTINE

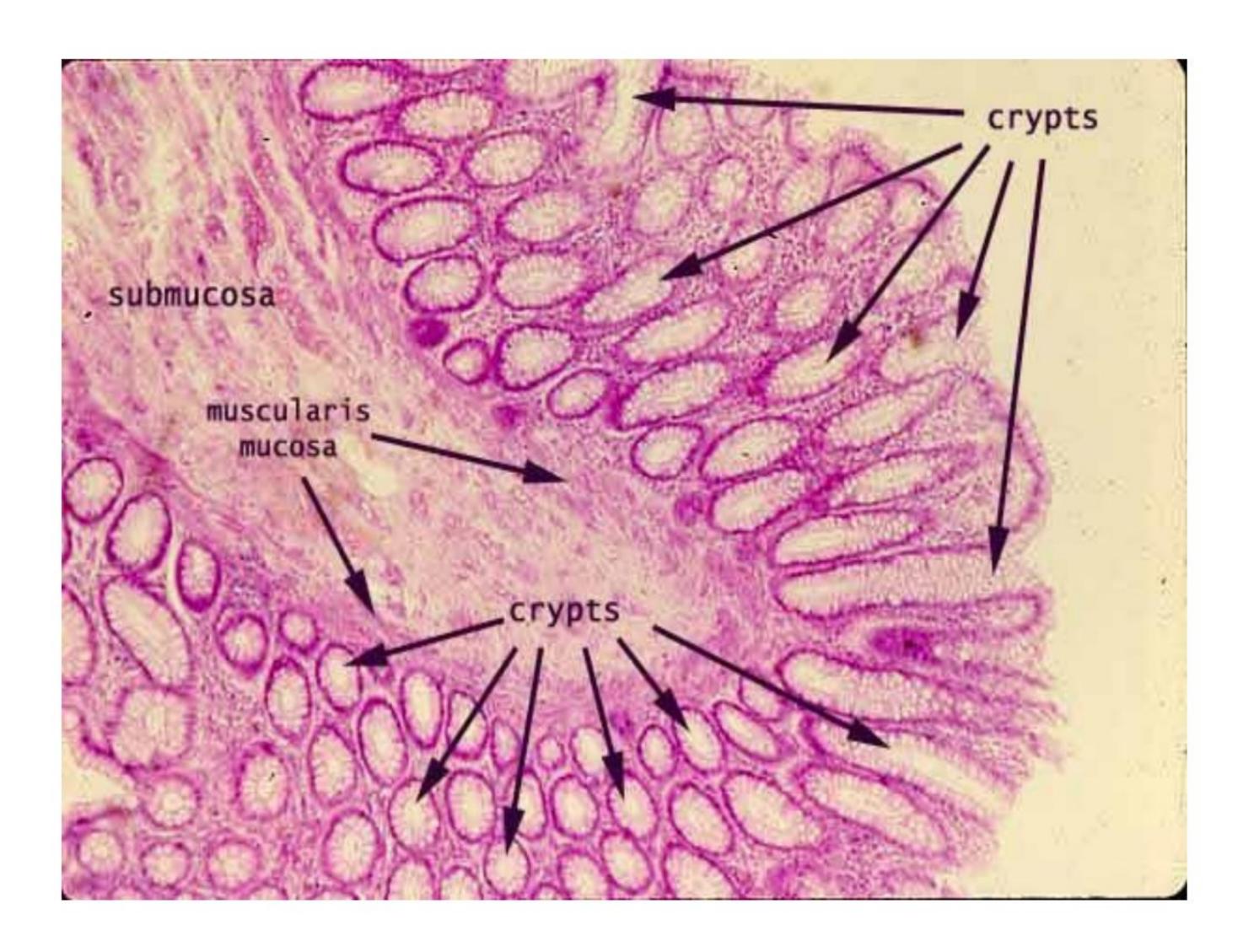
17.1 Introduction

- The intestines are the parts of the digestive system responsible for the absorption of nutrients and water.
- The Principal functions of the colon are the reabsorption of electrolytes and water and the elimination of undigested food and waste.
- It secretes large amounts of mucus

Pharmacy Exam Guide

- Mucosa of large intestine made up of simple columnar epithelium except the anal part
- · No circular folds
- No villi
- Presence of goblet cells
- The mucosa consists of cells of two types, absorptive cells and mucus secreting goblet cells.
- Goblet cells are more prevalent in the crypts than along the surface
- The lamina propria and submucosa are similar to the small intestine.
- The muscularis externa consists of an inner circular and outer longitudinal layer. The inner circular layer is typical, but the outer longitudinal layer of the colon is very thin, except for three extremely thick longitudinal bands, called teniae coli.





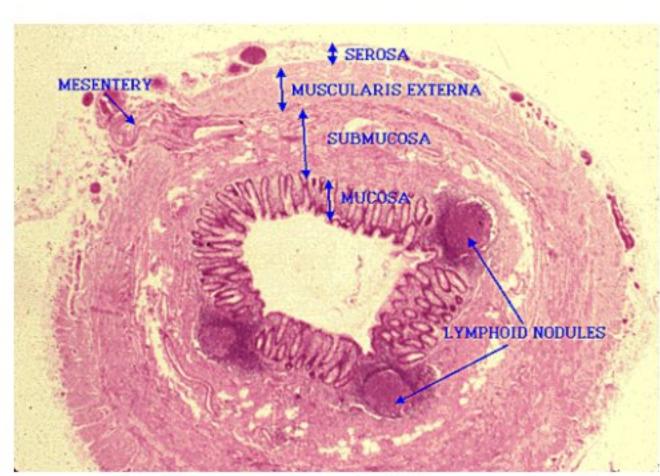
Chapter 18 HISTOLOGY OF APPENDIX

18.1 Introduction

- The appendix sits at the junction of the small intestine and large intestine. It's a thin tube about four inches long. Normally, the appendix sits in the lower right abdomen.
- The function of the appendix is unknown. One theory is that the appendix acts as a storehouse for good bacteria. Other experts believe the appendix is just a useless remnant from our evolutionary past. Surgical removal of the appendix causes no observable health problems.

18.2 CHARACTERISTICS

- > The mucosa resembles that of the colon
- The muscularis externa resembles that of the small intestine in that it has an inner smooth muscle layer and a COMPLETE outer smooth muscle layer (i.e. the outer muscle layer is NOT bundled into taenia coli)
- Lymphoid nodules frequently accumulate in the submucosa, disrupt the muscularis mucosae and extend into the mucosa, almost approaching the luminal surface.



The most characteristic property of the appendix is the presence of masses of lymphoid tissue in the mucosa and submucosa



Chapter 19 HISTOLOGICAL FEATURES OF ARTERY & VEIN

19.1 Introduction

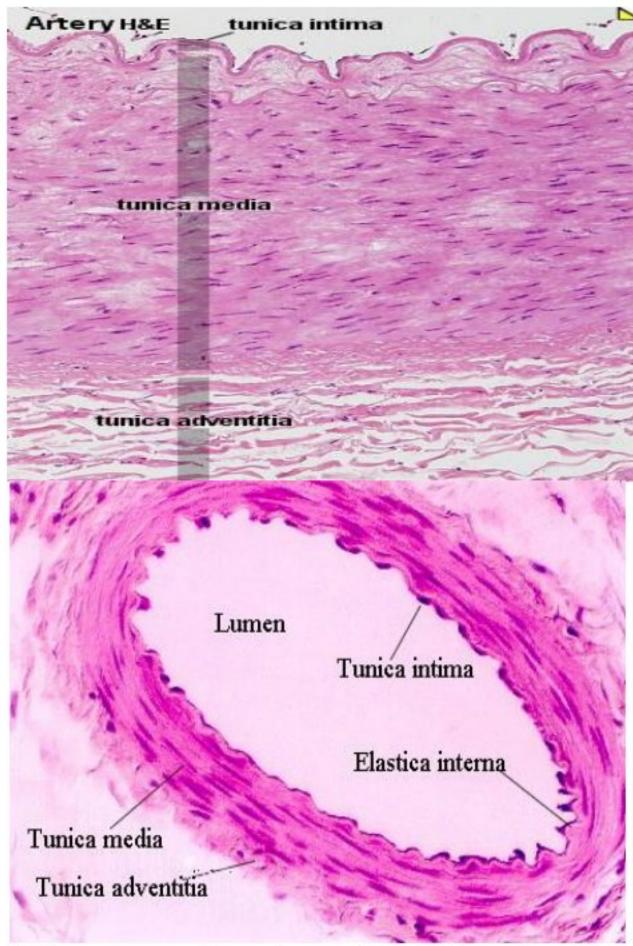
- CVS consists of the heart and blood vessels.
- Blood vessels that take blood from the heart to various tissues are called ARTERIES.
- Blood vessels that return blood back to heart are called VEINS
- The inner surfaces of the heart and all blood vessels are lined by flattened ENDOTHELIAL CELLS (also called ENDOTHELIOCYTES)

19.2 BASIC STRUCTURE

Wall of an artery is made up of 3 layers:

1. The innermost layer is called **TUNICA INTIMA**

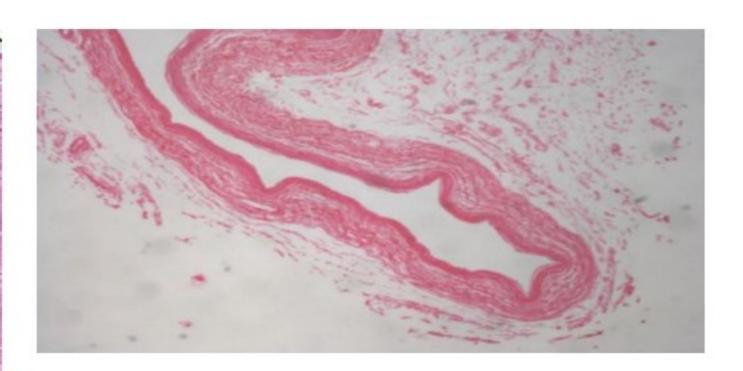
- an endothelial lining
- A thin layer of glycoprotein which lines the endothelium called basal lamina
- Delicate layer of sub endothelial connective tissue(fibrocytes, smooth muscle and thin collagen fibers)
- Membrane formed by elastic fiber called internal elastic lamina(as a boundary between media and adventitia)
- 2. Outside the tunica media is the middle layer called TUNICA MEDIA. This media may consist predominantly of elastic tissue or of smooth muscle. Some connective tissue is usually present. On the outside the media is limited by a membrane formed by elastic fibers called external elastic lamina



- The outermost layer is called TUNICA ADVENTITIA.
 This coat consists of connective tissue in which collagen fibers are prominent. This layer prevents undue stretching or distension of artery
 - The fibrous elements in the intima and the adventitia(mainly collagen) run longitudinally (i.e., along the length of vessel) whereas in the media (elastic or muscle) run circularly
 - Elastic fibers, including those of internal and external laminae are often in form of fenestrated sheets(having holes in it)

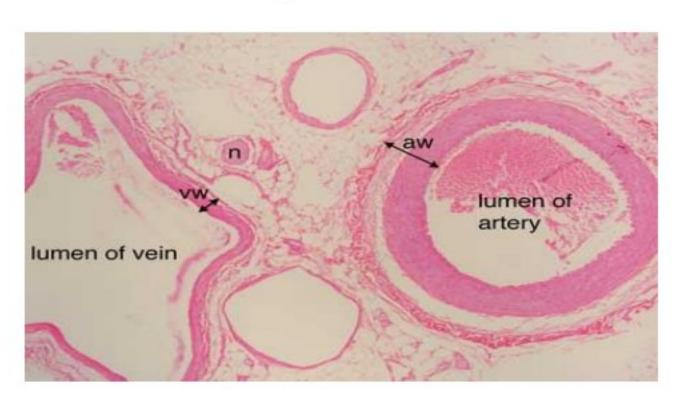
19.3 **VEIN**

- Basic structure is same as that of artery
- The walls of veins are thinner than the walls of arteries, while their diameter is larger
- In contrast to arteries, the layering in the wall of veins is not very distinct



19.4 DIFFERENCES

- The wall of a vein is distinctly thinner that of an artery having the same sized lumen
- A clear distinction between the tunica intima, media, adventitia cannot be made out in small veins as all these layers consists predominantly of fibrous tissue
- The tunica media consists of larger quantity of collagen than in arteries. The amount of elastic tissue or of muscle is much less
- The wall of vein is easily compressed. After death veins are usually collapsed. In contrast arteries retain their patency
- In arteries the tunica media is usually thicker than adventitia. In contrast the adventitia of veins is thicker than the media(especially in large veins)
- Internal and external elastic laminae are absent or very thin



Chapter 20 HISTOLOGY OF RESPIRATORY SYSTEM

20.1 NORMAL LUNG

- Sections of lung tissue have the appearance of fine lace because most of the lung is composed of thin-walled alveoli. The alveoli are composed of a single layer of squamous epithelium.
- Between the alveoli you may see a thin layer of connective tissue and numerous capillaries also lined with simple squamous epithelium.
- Bronchioles can be recognized by the fact that they are lined by ciliated columnar epithelium (larger bronchioles) or by cuboidal epithelium (smaller bronchioles leading to alveoli).
- Remember that bronchioles are tubes and may be sectioned either transversely (across) or longitudinally.

20.2 PHARYNX

- The pharynx connects the nasal cavity with the larynx.
- Depending on the extent of abrasive forces on the epithelium, the pharynx is either lined with respiratory epithelium (nasopharynx or epipharynx) or with a stratified squamous epithelium (oropharynx or meso- and hypopharynx), which also covers the surfaces of the oral cavity and the oesophagus.
- Lymphocytes frequently accumulate beneath the epithelium of the pharynx.
- Accumulations of lymphoid tissues surrounding the openings of the digestive and respiratory passages form the tonsils.
- The nasal cavity and pharynx form the upper respiratory passages.

20.3 EPIGLOTTIS

It consists of a plate of elastic cartilage covered on both sides by mucosa.

20.3.1.1 EPITHELIUM:

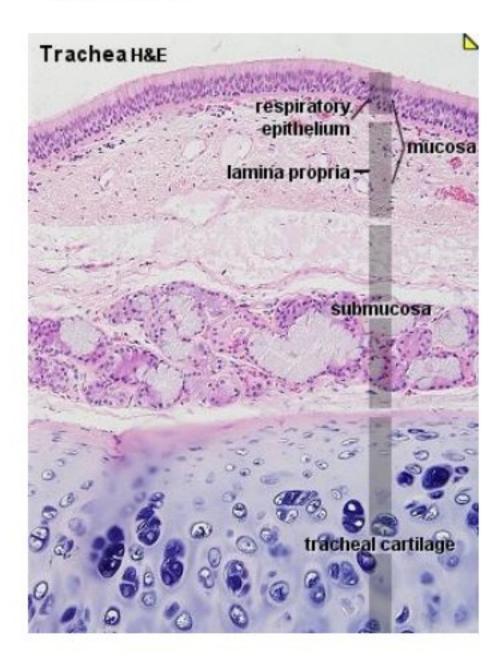
- Anterior (lingual) surface and upper part of posterior (laryngeal) surface are covered by stratified squamous epithelium.
- Lower half of the posterior surface is covered by the respiratory epithelium.

20.4 Bronchi

The histological structure of the epithelium and the underlying connective tissue of the bronchi correspond largely to that of the trachea and the main bronchi. In addition, bronchi are surrounded by a layer of smooth muscle, which is located between the cartilage and epithelium

20.5 Bronchioles

- Bronchioles are the terminal segments of the conductive portion.
- At the transition from bronchi to bronchioles the epithelium changes to a ciliated columnar epithelium, but most of the cell types found in the epithelium of other parts of the conductive portion are still present.
- Glands and cartilage are absent. The layer of smooth muscle is relatively thicker than in the bronchi.



Chapter 21 HISTOLOGY OF EXCRETORY SYSTEM

21.1 KIDNEY:

Gross section of kidney reveals that the outer cortex has somewhat different texture from the deeper Medulla. This difference reflects this position of various portion of many Nephron which comprise the kidney.

- The CORTEX consist of convoluted tubules together with renal capsule
- The MEDULLA consist of Loop of henle and the Collection duct
- Medulla may be divided into zones or strips, visible grossly which reflects the structural differentiation of the tubules that form the loop of henle.
- The medulla has a remarkable interstitial Environment , hypertonic and poorly oxygenated
- The cortex and medulla together comprise million of individual nephron all pack together.
- Cortex and Medulla surrounds and drains (ureter) holopelvic the funnel shop beginning of the ureter like the pelvis is lined by Transitional epithelium.

21.2 URETER:

- The adult Ureter is a thick walled ureter tube 25-30cm in length running from the kidney to urinary bladder.
- > The ureter is composed of three layers
- Fibrous layer(tunica adventitia)
- Muscular layer(tunica muscularis)
- o Mucosa layer(tunica mucosa)
- The Muscular layer subdivided further into three fibrous layer
- o An external Longitudinal
- o A middle circular
- An internal longitudinal

21.3 BLADDER:

We can describe anatomically by its four layer from its inside to outwards

- MUCOSA-a transitional epithelium layer formed into folds
- SUB MUCOSA-connects the muscular layer to mucosa layer
- MUSCULAR-the detrusor muscle is the muscle of urinary bladder wall
- SEROUS LAYER-cover cavity

21.3.1 DETRUSOR MUSCLE:

The adult detrusor muscle consists of three layers of smooth (involuntary) muscle fiber.

- Internal layer fiber arranged longitudinally
- Middle layer fiber arranged circularly
- External layer fiber arranged longitudinally

21.4 URETHRA:

21.5 FEMALE (4-5cm):

- Satisfied squamous epithelium
- · Some pseudo satisfied columnar epithelium

MID PART-External sphincter muscle, striated muscle.

21.6 MALE(4 PARTS)

- PROSTATIC URETHRA-transitional epithelium
- MEMBRANOUS URETHRA-stratified or pseudo stratified columnar epithelium

External sphincter muscle, striated muscle

- BULBOSAL URETHRA-pseudo stratified columnar to stratified squamous epithelium.
- PENDULOUS URETHRA-pseudo stratified and columnar and some stratified squamous epithelium

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