Therapeutic areas & Diseases

Anatomy and Physiology of Human Body

Module 4 Topic 1 & 2

Human Body

- Cell - the smallest functional unit of the human body
- Tissues - Epithelial, Connective, Muscle, Nervous
- Organs - Heart, Lungs, Brain, Liver etc.
- Systems - Digestive, Respiratory, Circulatory, Nervous etc.
- Body - function is survival and propagation of human race

Cytoplasmic organelles

Organelles and their functions

- Mitochondria – Energy production
- Ribosomes – Protein synthesis
- Golgi bodies – Storage of starch
- Endoplasmic reticulum – Transport system

Human Body

Tissues

- Epithelial tissue- Simple and Compound
- Connective tissue – Adipose, Fibrous, Bones & cartilages
- Muscle tissue – Skeletal, Visceral, Cardiac
- Nervous tissue – Neurons, Synapse & Neurotransmitters

Human Body

- **Organs** are made up of a number of tissues

  Examples

  - **Heart**
  - **Lungs**
  - **Brain**
  - **Liver** etc

- A number of organs (& tissues) form a **System**

  Examples

  - **Digestive system**
  - **Respiratory system**
  - **Circulatory system**
  - **Nervous system** etc

Human Body

System	Main function
Cardiovascular system	Pumping & circulation of blood in the body
Digestive system	Intake of food, digestion & absorption of nutrients, and elimination of waste matter
Respiratory system	Intake of Oxygen and elimination of Carbon dioxide
Urinary system	Removal of waste material through urine
Nervous system	Co-ordination & control of body functions and responses
Musculoskeletal system	Movements of body

Cardiovascular System

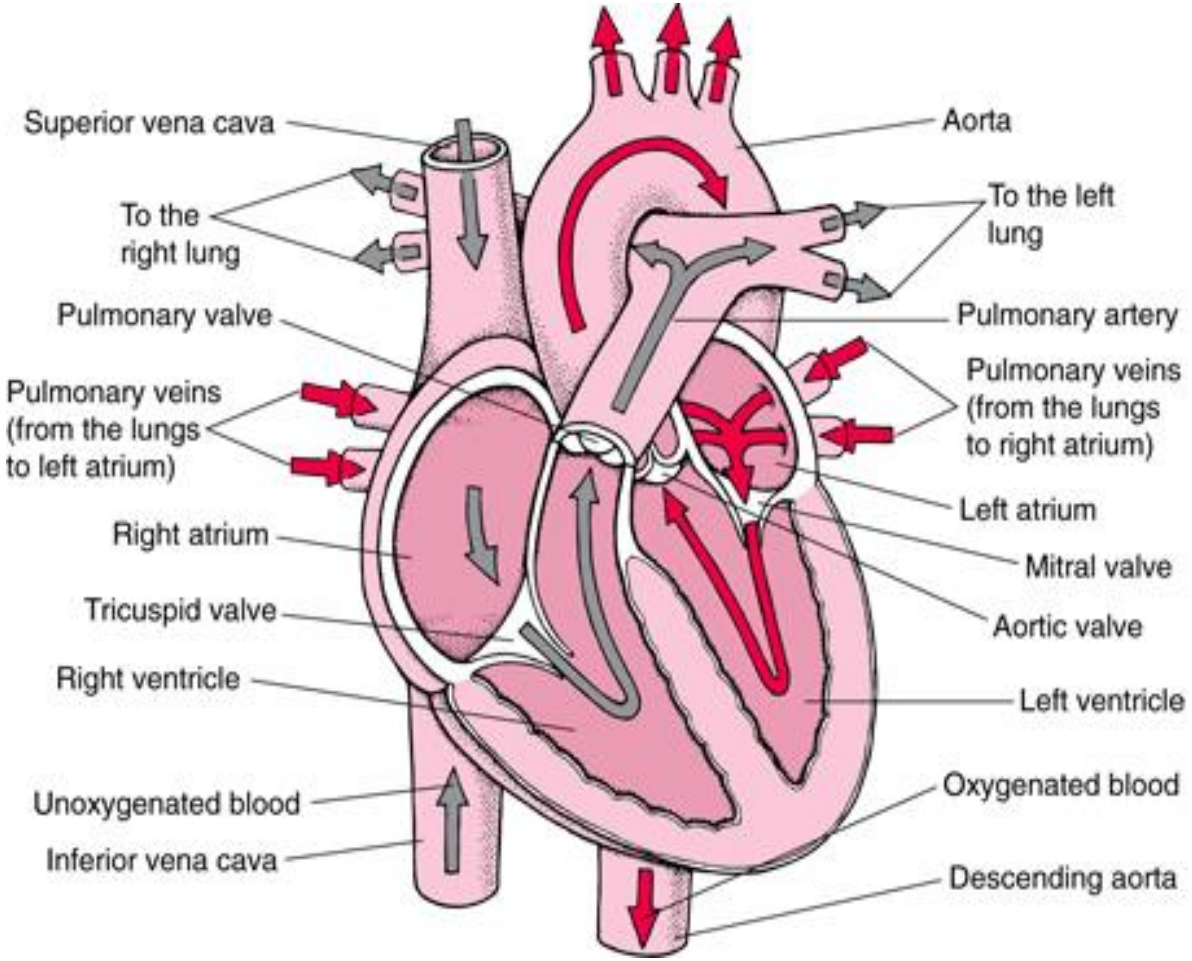
- Blood
  - Plasma - light yellow – coloured transparent fluid
    - Plasma proteins, nutrients, gases, electrolytes, waste products, hormones
  - Blood cells
    - Erythrocytes or red blood cells (RBCs)
    - Leukocytes or white blood cells (WBCs)
      - **Granulocytes - neutrophils, eosinophils, basophils**
      - **Agranulocytes - monocytes and lymphocytes**
    - Thrombocytes or platelets

Cardiovascular System

Heart

- Cone shaped, hollow muscular organ
- Divided into a right and left side by a partition (septum)
- Each side divided into an upper chamber called the **atrium** and a lower chamber called the **ventricle** by an atrioventricular valve
- Cardiac cycle

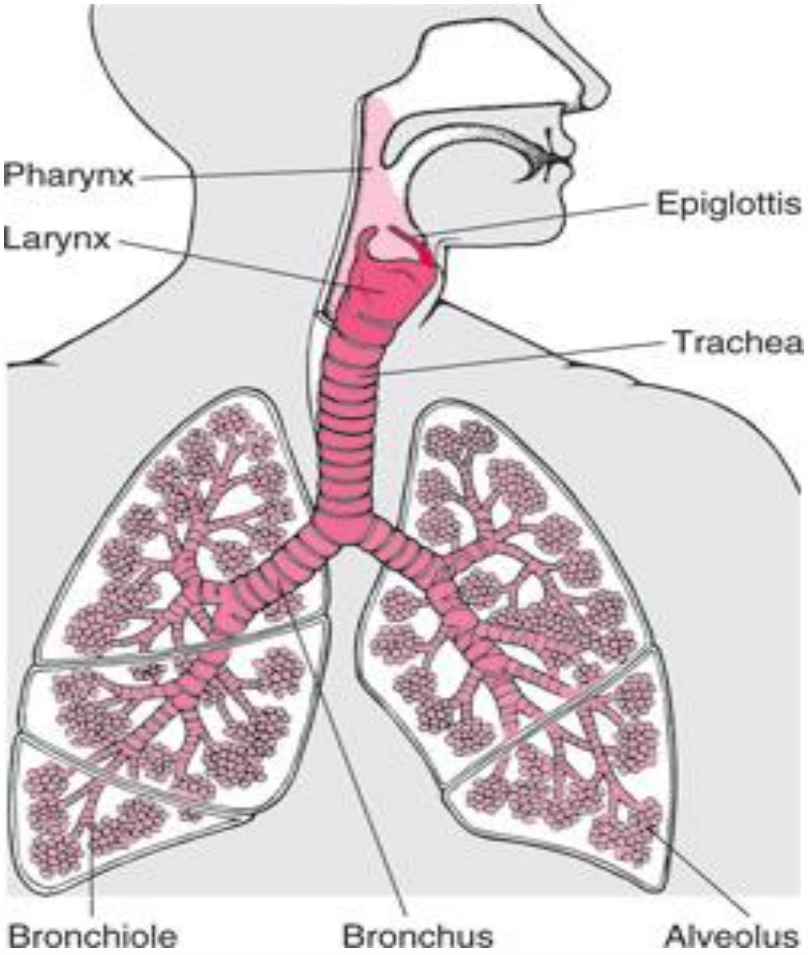
Heart


Superior vena cava
Aorta
To the right lung
To the left lung
Pulmonary valve
Pulmonary artery
Pulmonary veins (from the lungs to left atrium)
Pulmonary veins (from the lungs to right atrium)
Left atrium
Right atrium
Mitral valve
Tricuspid valve
Aortic valve
Right ventricle
Left ventricle
Unoxygenated blood
Oxygenated blood
Inferior vena cava
Descending aorta

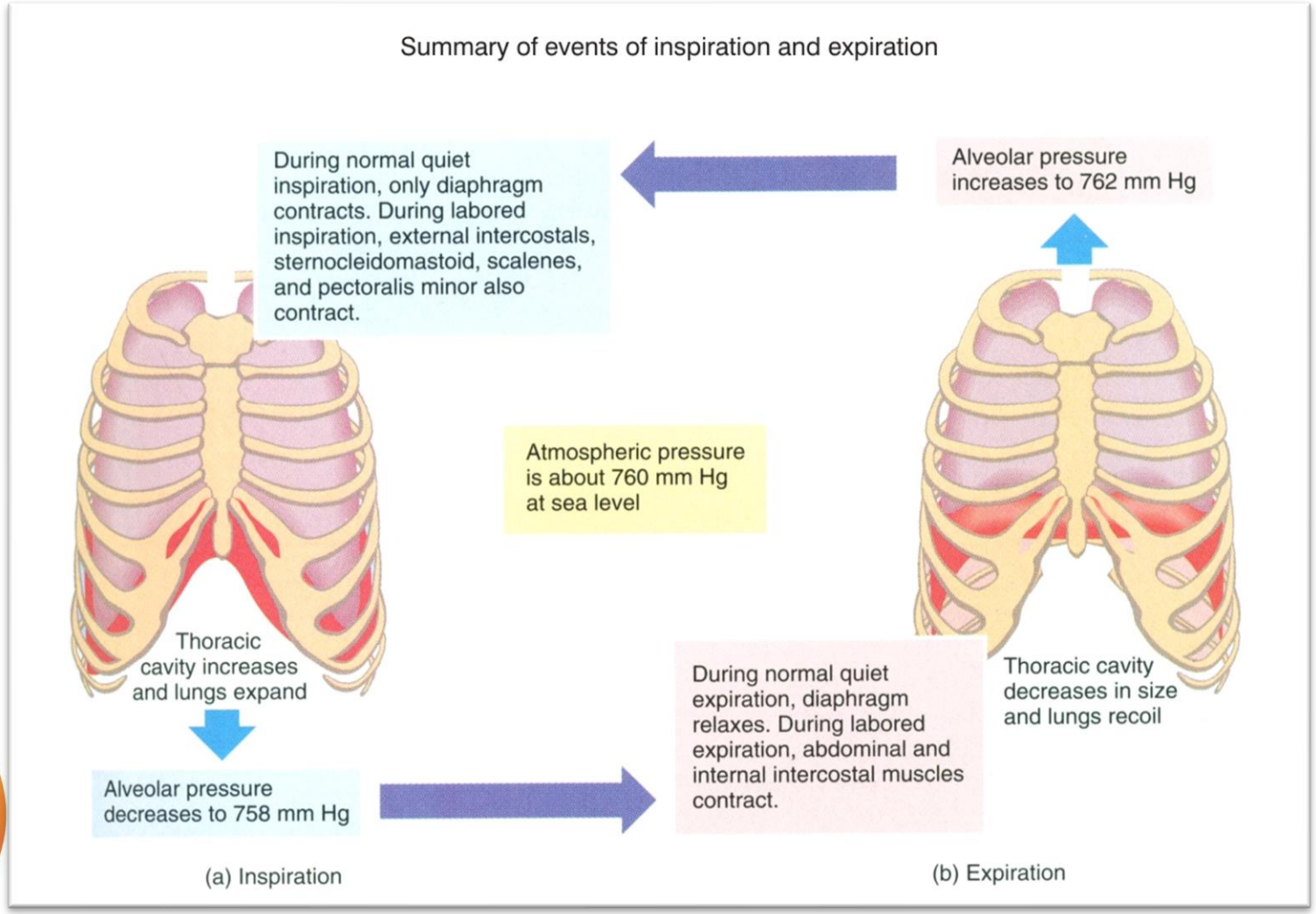
Respiratory System

- Responsible for the intake of oxygen and removal of carbon dioxide
- Parts
  - Nose
  - Pharynx
  - Larynx
  - Trachea
  - Bronchi (one bronchus to each lung)
  - Bronchioles and smaller airways
  - Lungs & their covering i.e. pleura

Lungs and Airways



Respiratory Cycle



Exchange of Gases

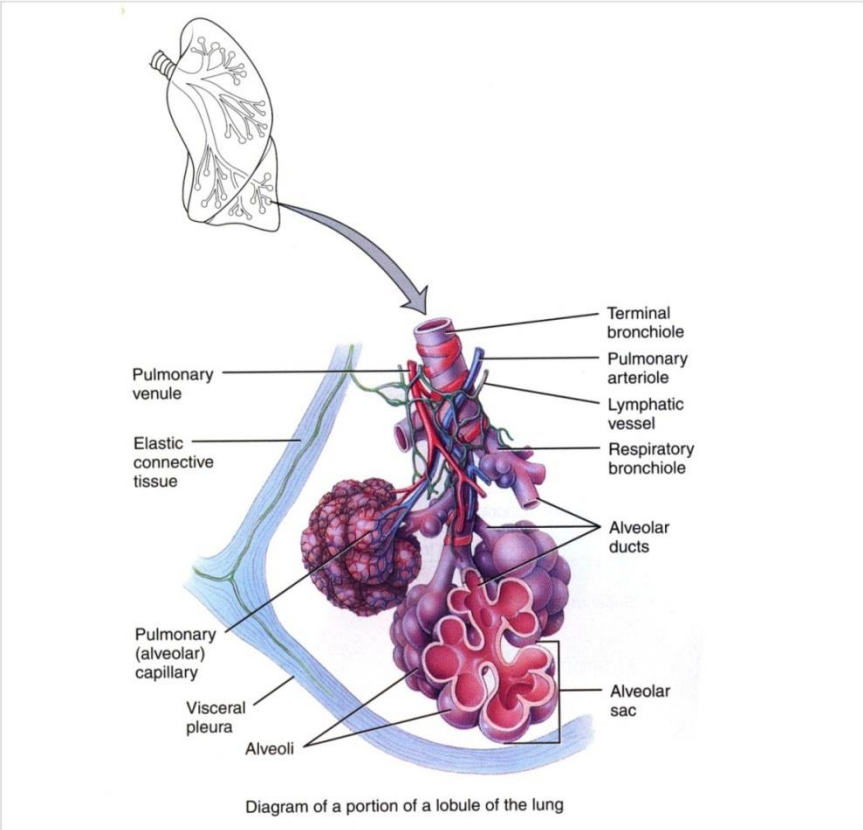
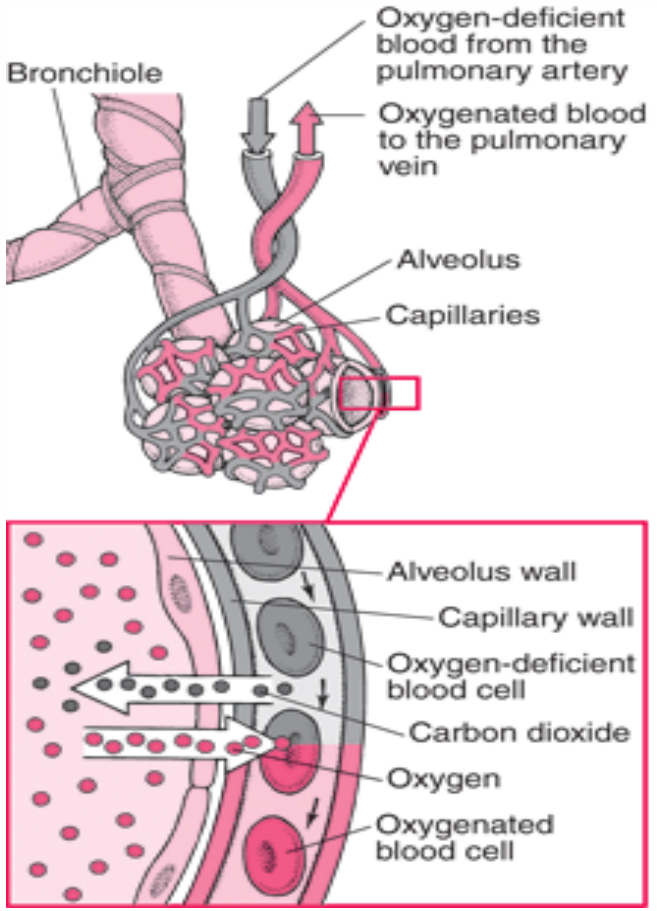


Diagram of a portion of a lobule of the lung



Digestive System

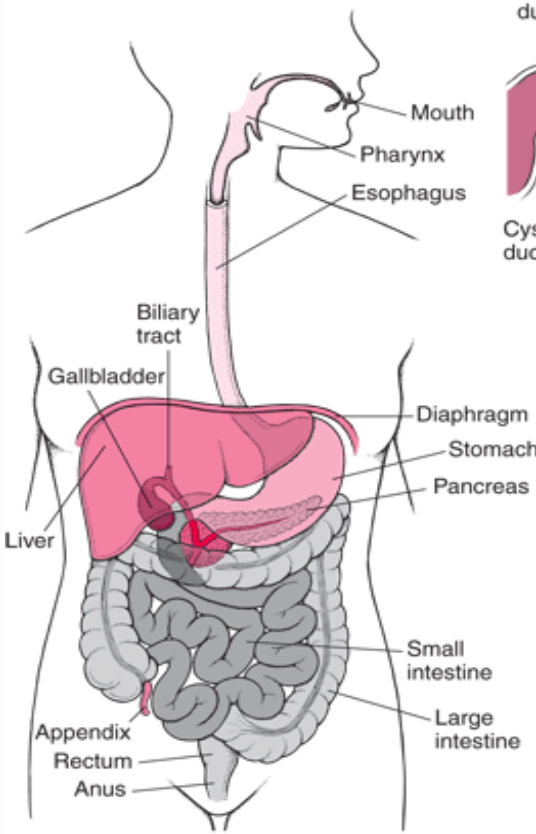
The digestive system is involved in the digestion and absorption of the food

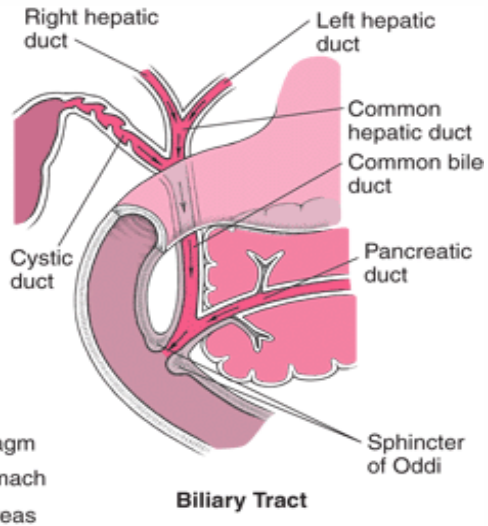
- **Alimentary Canal**
  - Mouth, pharynx, oesophagus, stomach, small- and large intestines, rectum, and anal canal
- **Accessory Organs**
  - Salivary glands, liver, gall bladder, and pancreas

Digestive System

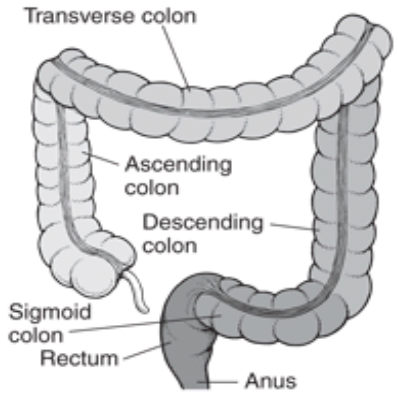
- **Ingestion** - activity of consuming food by mouth
- **Digestion** - mechanical breakdown of food by chewing and chemical breakdown by enzymes present in:
  - Saliva from the salivary glands
  - Gastric juice from the stomach
  - Intestinal juice from the small intestine
  - Pancreatic juice from the pancreas
- **Absorption** - nutrients from digested food absorbed and circulated to all parts of the body
- **Elimination** - undigested and unabsorbed portion of food excreted as faeces

Digestive System





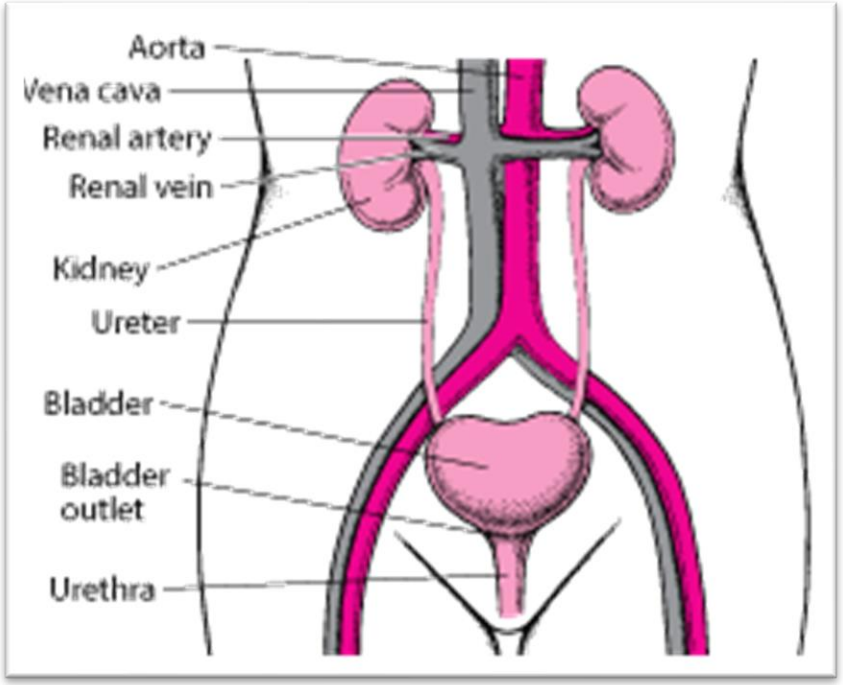
Biliary Tract



Large Intestine

Urinary System

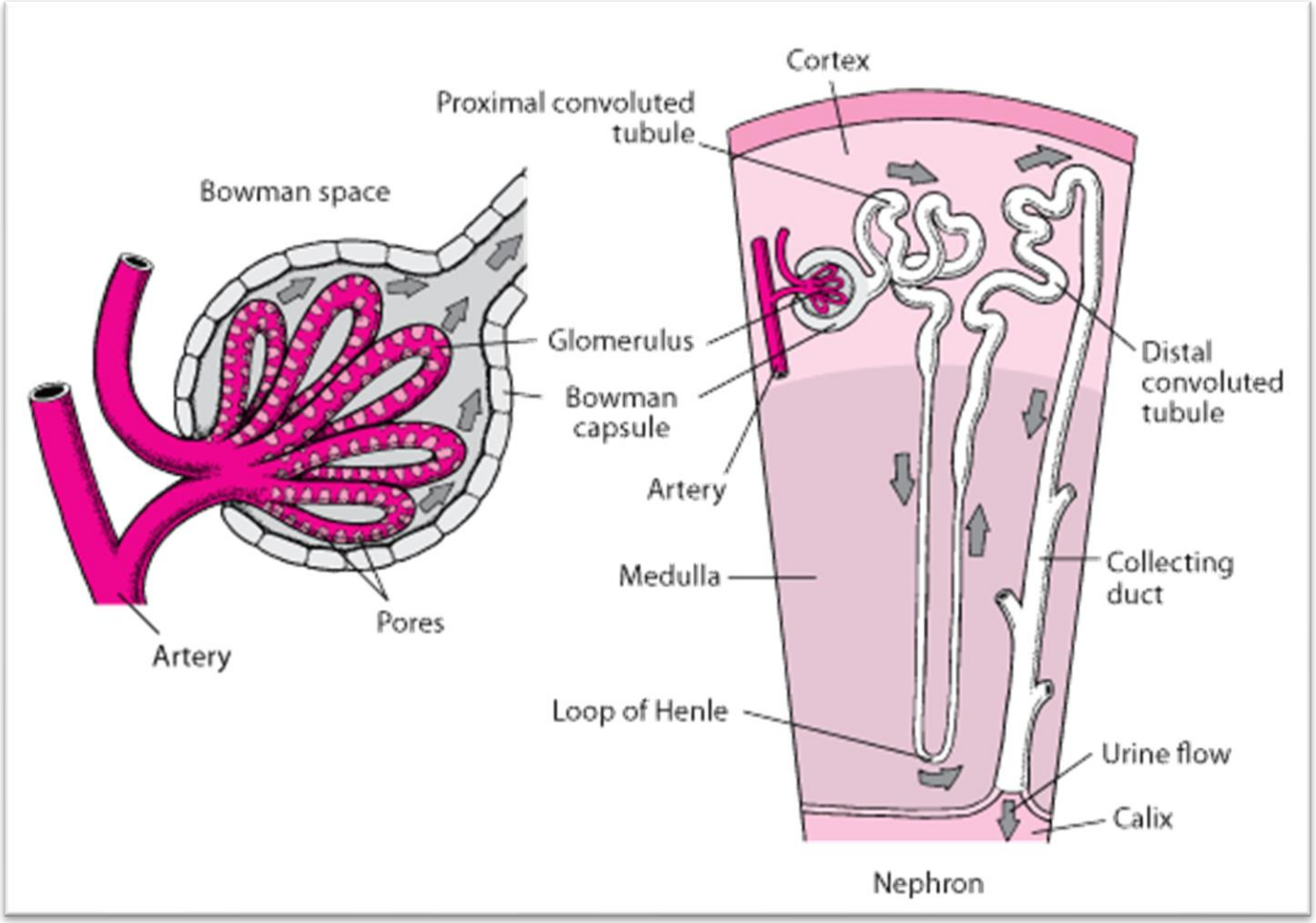
- Major excretory system of the human body
- Consists of
  - Kidneys
  - Ureters
  - Urinary bladder, and
  - Urethra



Urinary System

- Kidneys
  - Bean-shaped organs located at the back, one on either side of the vertebral column
  - Functional units known as ***nephron***
    - Glomerulus
    - Glomerular (Bowman's) capsule
    - Renal tubule
  - Collecting ducts - papillary ducts - ureters

Nephron


Cortex
Proximal convoluted tubule
Bowman space
Glomerulus
Bowman capsule
Artery
Pores
Artery
Distal convoluted tubule
Medulla
Collecting duct
Loop of Henle
Urine flow
Calix
Nephron

Musculoskeletal System

- Provides the supporting framework
- Involved in the body movements
- **Axial skeleton** consists of the ***skull, vertebral column, sternum (breast bone),*** and ***ribs***
- **Appendicular skeleton** consists of the bones of upper and lower limbs, a pair each of ***scapula, clavicle (collar bone),*** and the ***pelvic bones – ileum, ischium,*** and the ***pubis***

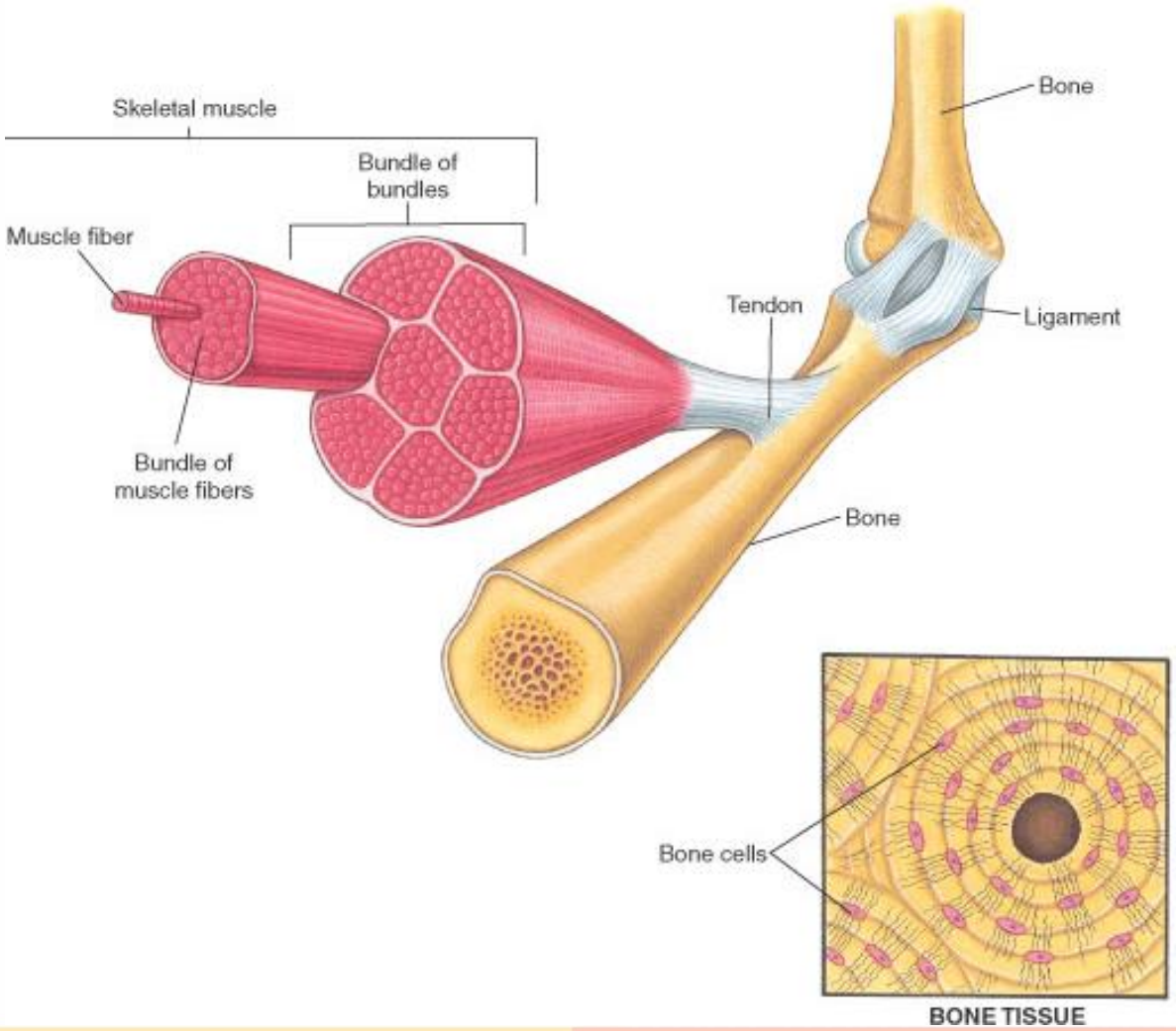
Musculoskeletal System

- **Bones**
  - One of the hardest tissues
  - Made up of water (25 %), collagen fibers (25 %), and crystallized mineral salts, mainly calcium phosphate (***hydroxyapatite***) and some calcium carbonate
  - Bone marrow - production of various blood cells

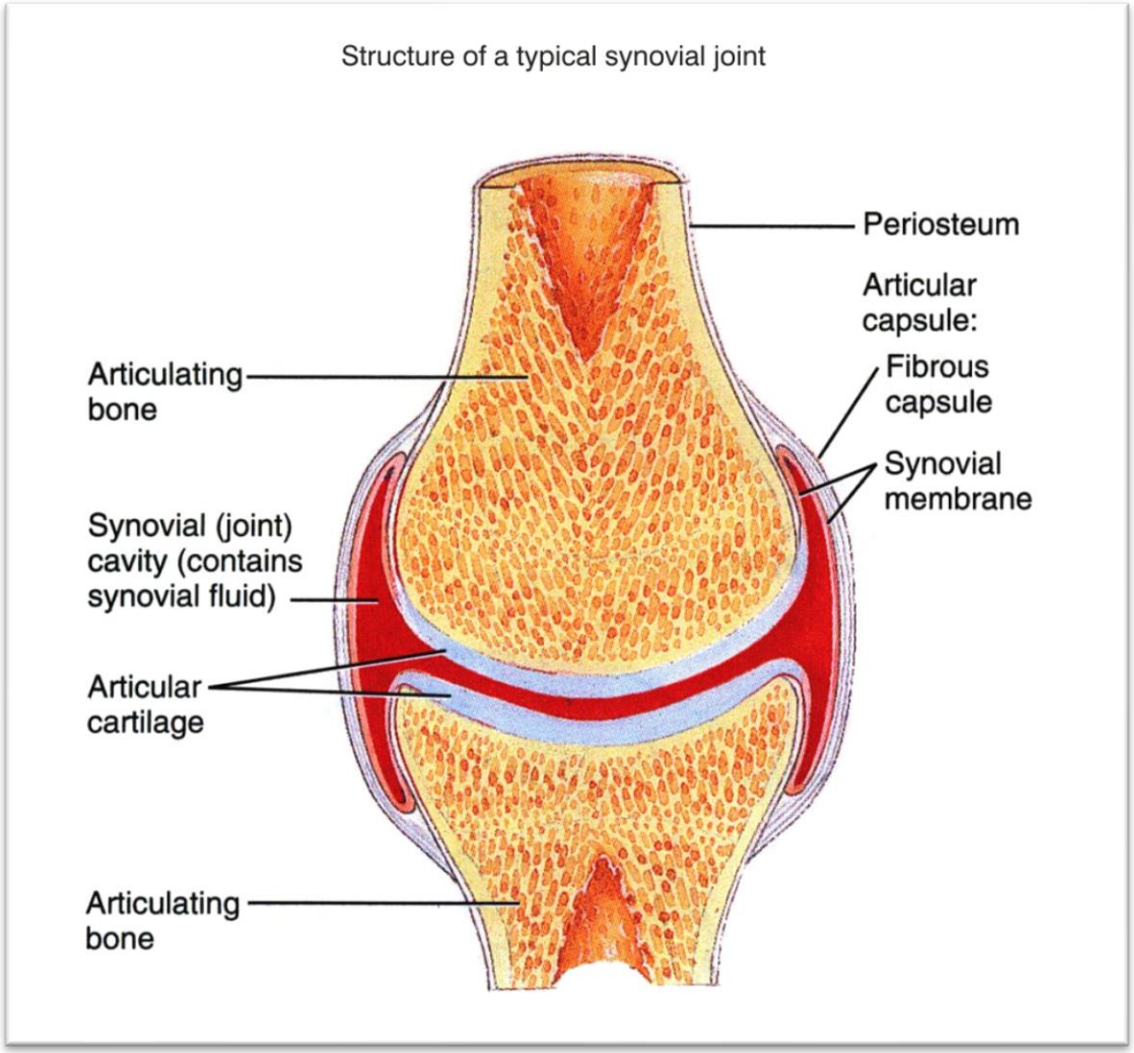
Musculoskeletal System

- Types of bones – long, short, flat, irregular
- Functions of bones
  - Support
  - Protection
  - Movements
  - Production of blood cells
  - Storage of minerals

Musculoskeletal System



Synovial Joint



Nervous System

- Central nervous system
  - Brain
  - Spinal cord
- Peripheral nervous system
  - Cranial nerves
  - Spinal nerves
  - Autonomic nervous system

Nervous System

- Brain
  - Center for registering sensations, correlating them with one another and with previously stored information, making appropriate decisions, and taking action
  - Center for intellect, emotions, behaviour, and memory
- Parts - cerebrum
  - brain stem (midbrain, pons, medulla oblongata),
  - cerebellum

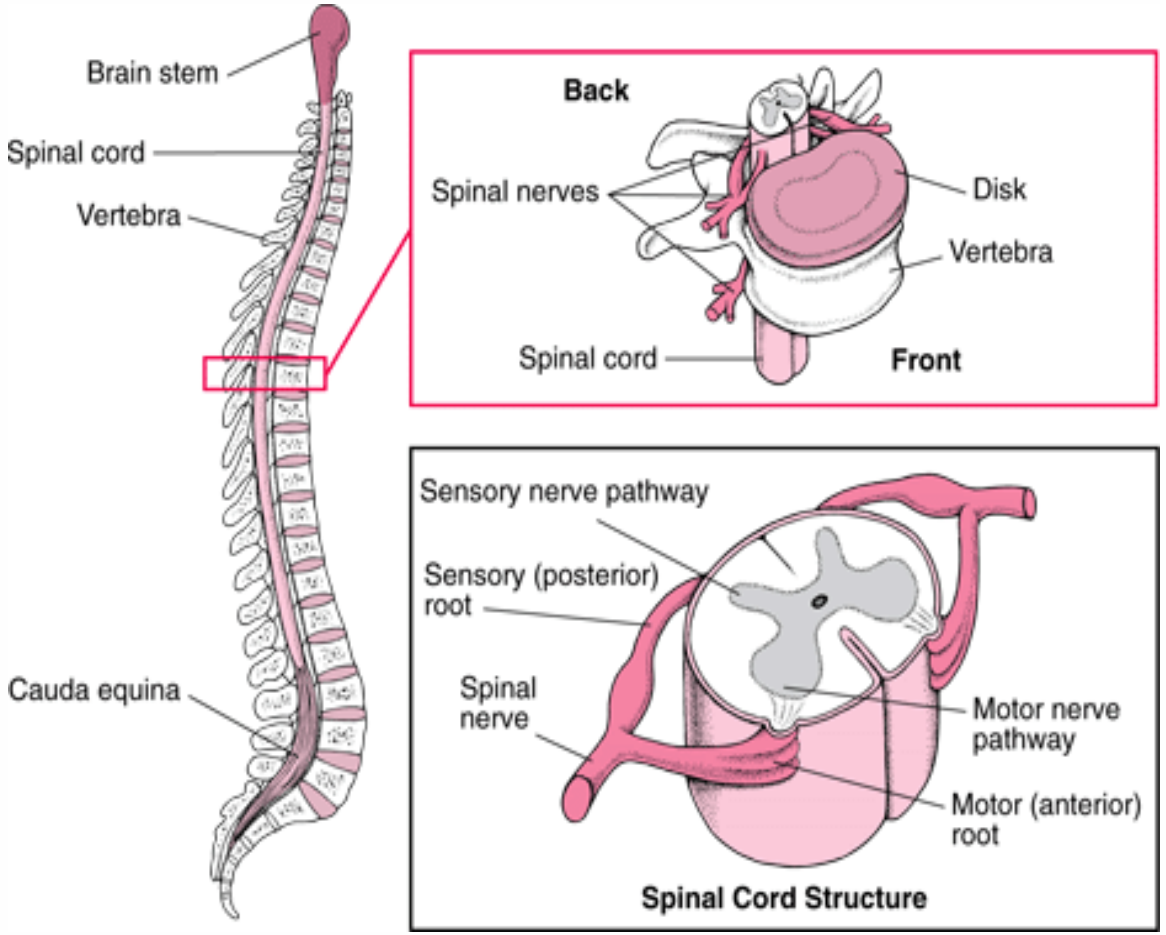
Nervous System

- **Cranial nerves**
  - Olfactory
  - Optic
  - Oculomotor
  - Trochlear
  - Trigeminal - ophthalmic, maxillary, and mandibular branches
  - Abducens
  - Facial
  - Vestibulocochlear
  - Glossopharyngeal
  - Vagus
  - Accessory
  - Hypoglossal

Nervous System

- **Spinal cord**
  - Link between the brain and the rest of the body
  - Functions
    - Transmits various sensations such as touch, pain, pressure, vibration, heat, and cold
    - Spinal neurons control the skeletal muscles of the arms, legs, and the trunk resulting in precise, voluntary movements
    - ***Spinal reflexes***

Spinal Cord


Brain stem
Spinal cord
Vertebra
Cauda equina
Back
Spinal nerves
Disk
Vertebra
Spinal cord
Front
Sensory nerve pathway
Sensory (posterior) root
Spinal nerve
Motor nerve pathway
Motor (anterior) root
Spinal Cord Structure

Autonomic Nervous System

Physiological effects of sympathetic system activation	Physiological effects of parasympathetic system activation
Heart rate, force of heart contraction, and blood pressure increase	Decrease in the rate and force of heart contraction
The airways widen allowing faster movement of greater amounts of air into and out of lungs	Decrease in the diameter of airways
Organs involved in the physical effort viz. skeletal muscles, cardiac muscle, lungs etc. receive greater blood flow while kidneys and digestive system get a reduced blood supply	Increased activity of digestive system allowing digestion and absorption of energy-supplying food

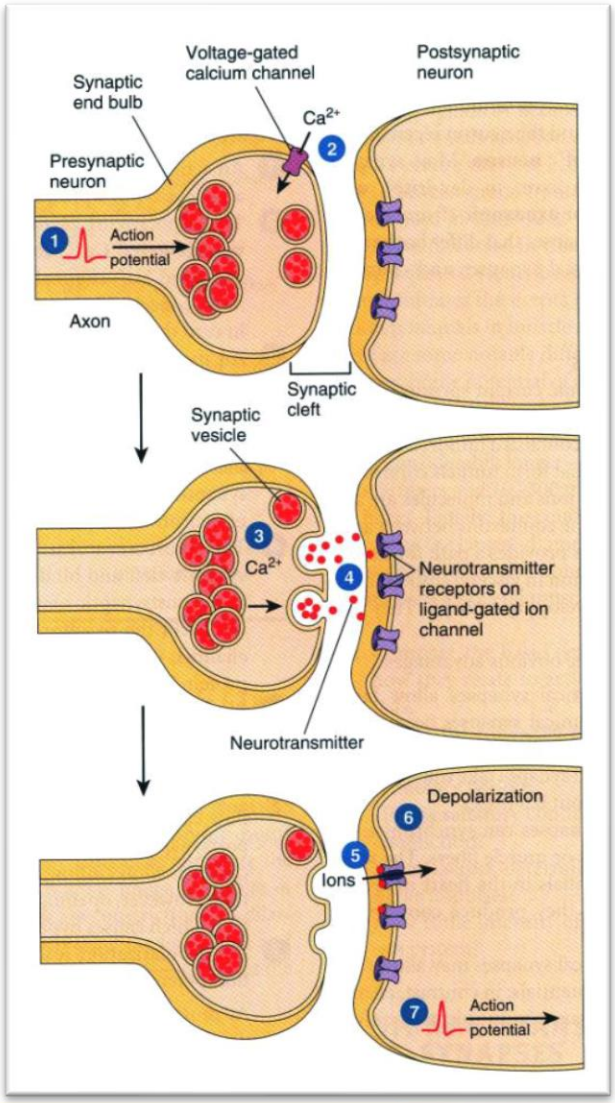
Autonomic Nervous System

Physiological effects of sympathetic system activation	Physiological effects of parasympathetic system activation
Breakdown of glycogen to glucose in the liver cells	Increased glycogen synthesis in the liver cells
Intestinal peristalsis and secretion of digestive juices slow down or even stop	Increased glycogen synthesis in the liver cells
Inhibition of urination and defaecation	

Synapse

- Junction of two neurons
- Acts as a relay station - signals passed or blocked selectively as needed
- Nerve endings called presynaptic terminals have many vesicles that contain neurotransmitters
- Synaptic cleft is the gap between presynaptic terminal and the postsynaptic receptor

Synapse


Voltage-gated calcium channel
Postsynaptic neuron
Synaptic end bulb
Ca^{2+}
2
Presynaptic neuron
1
Action potential
Axon
Synaptic cleft
Synaptic vesicle
3
Ca^{2+}
4
Neurotransmitter receptors on ligand-gated ion channel
Neurotransmitter
Depolarization
6
5
Ions
7
Action potential

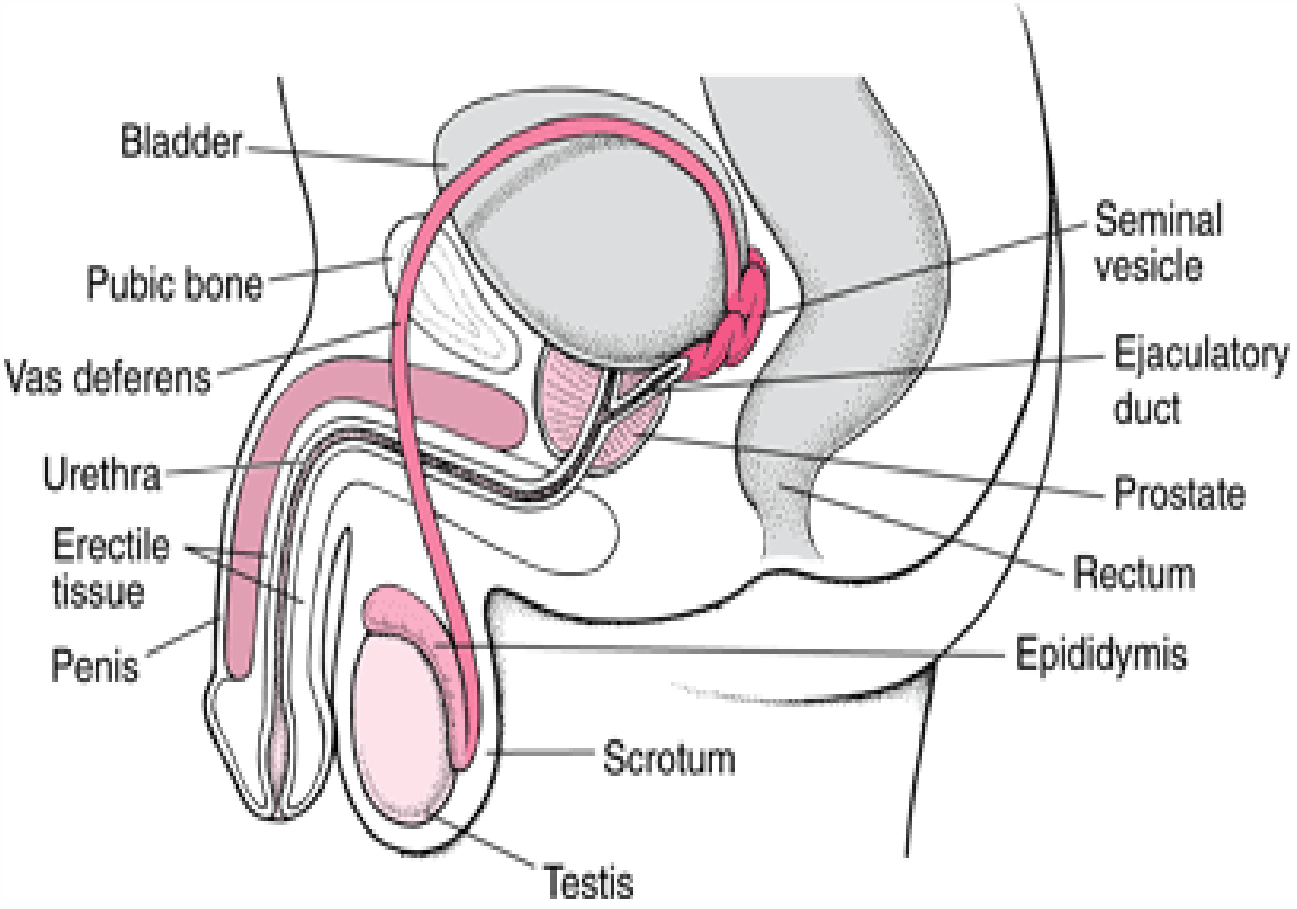
Neurotransmitters

- More than 30 neurotransmitters proved or postulated
- Examples
  - Acetylcholine, noradrenaline
  - Dopamine, serotonin
  - GABA, glycine
  - Hormones

Male Reproductive System

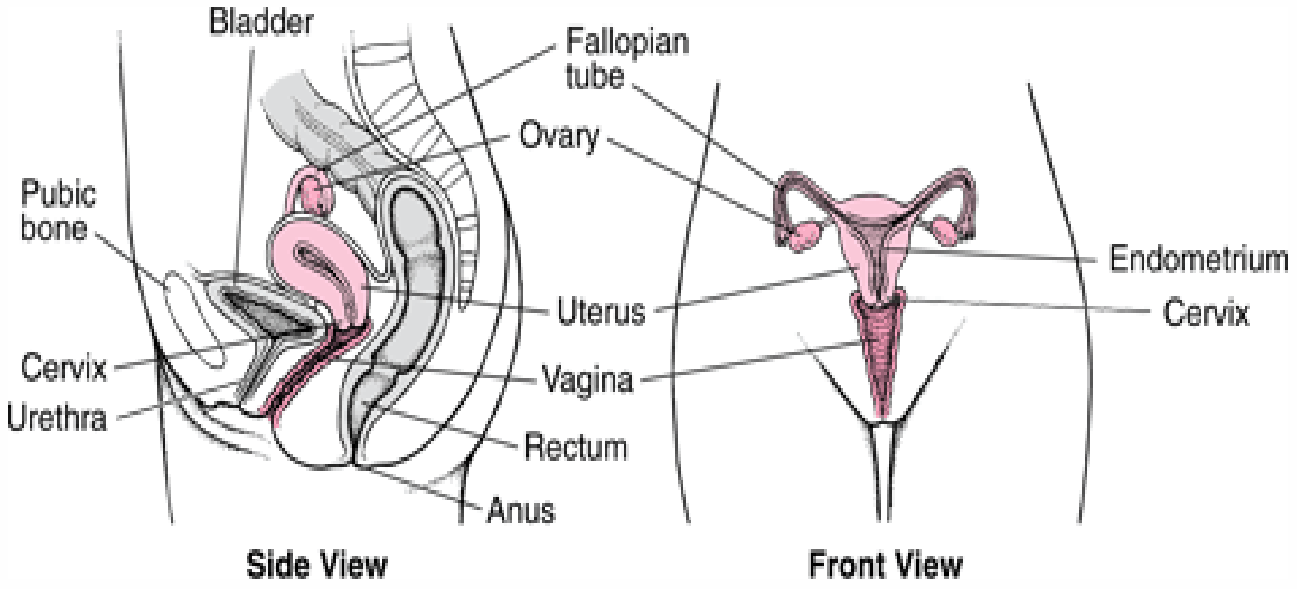
- The **penis** and the **urethra** are part of the urinary and reproductive systems
- The **scrotum, testes (testicles), vas deferens, seminal vesicles**, and **prostate** comprise the rest of the reproductive system
- **Testes** have two primary functions:
  - Producing sperm
  - Producing testosterone

Male Reproductive System



Female Reproductive System

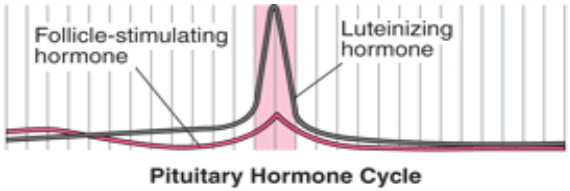
- Female reproductive system consists of the external genital organs and internal genital organs



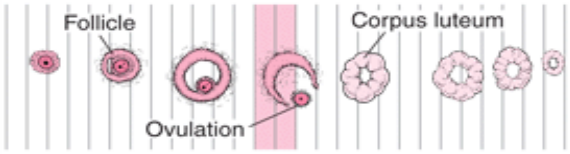
Menstrual Cycle

- Menstruation is the shedding of the lining of the uterus (endometrium) accompanied by bleeding
- Menstrual cycle is regulated by **Luteinizing hormone** (LH) and **Follicle-stimulating hormone** (FSH) produced by pituitary gland
- LH & FSH promote ovulation and stimulate the ovaries to produce estrogen and progesterone
- **Estrogen** and **progesterone** stimulate the uterus and breasts to prepare for possible fertilization
- Menstrual cycles normally range from about 25 to 36 days, menstrual bleeding lasts 3 to 7 days

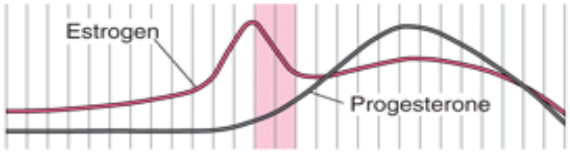
Menstrual Cycle



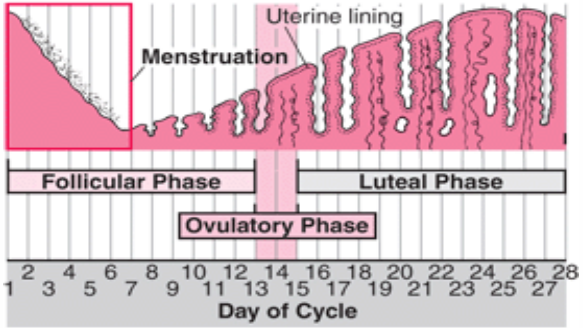
Pituitary Hormone Cycle



Ovarian Cycle



Sex Hormone Cycle



Endometrial Cycle