INTRODUCTION TO HUMAN ANATOMY & PHYSIOLOGY

ECE 311 – INTRODUCTION TO BIOMEDICAL ENGINEERING

Monday, September 8, 2025

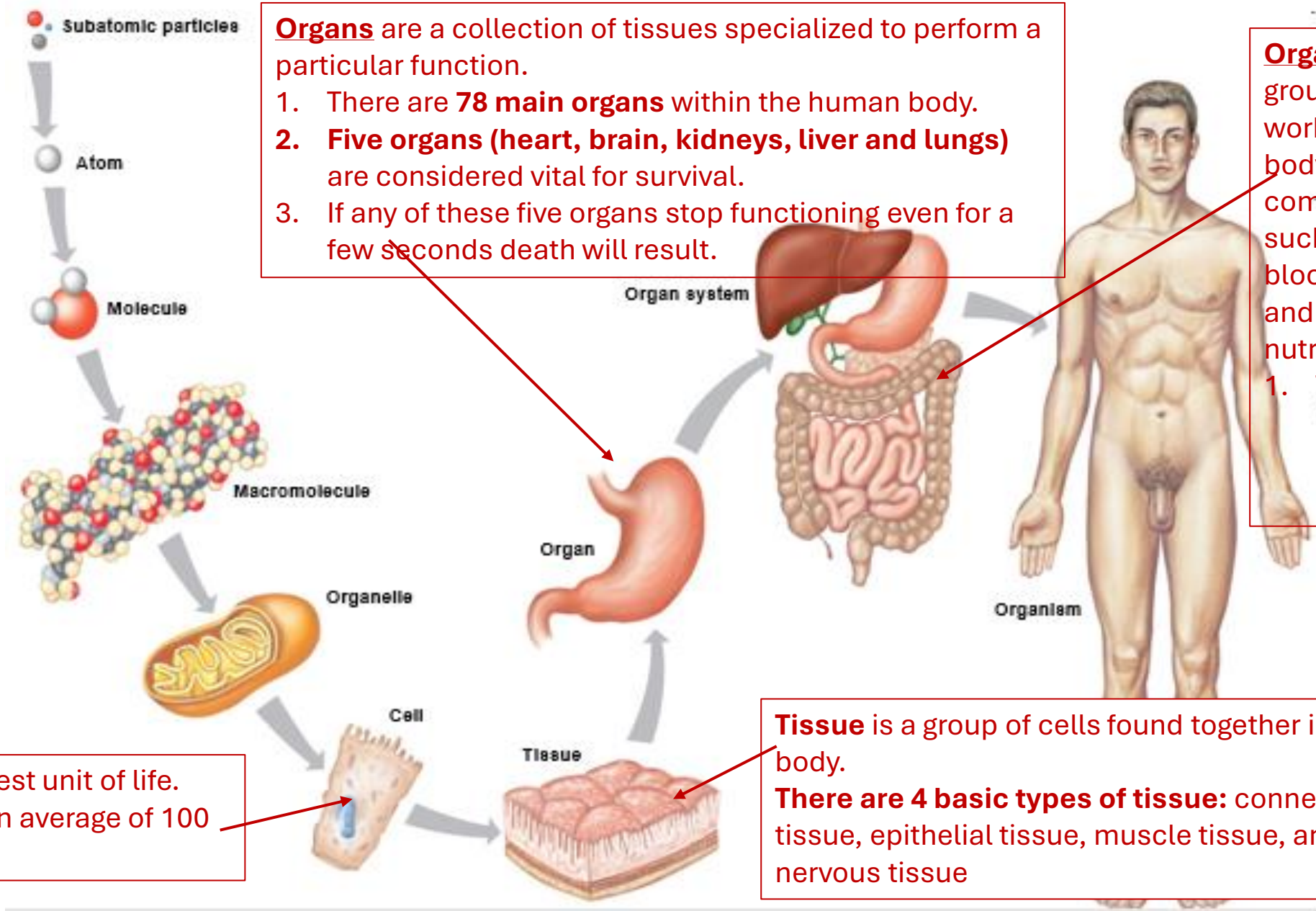
DEFINITIONS – HUMAN ANATOMY

1. **Human anatomy** is the study of the parts and structures of the human body.
2. **Types of Human Anatomy studies:**
   a) **Gross anatomy:** The study of the parts and structures of the human body that can be seen with the naked eye and without a microscope.
   b) **Microscopic anatomy:** The study of the parts and structures of the human body that can not be seen with the naked eye and only seen with the use of a microscope.

ORGANIZATION OF THE HUMAN BODY

1. **Human body** is organized into cells, tissues, organs, organ systems, and the total organism.
2. **Cells** are the smallest living unit of body construction.
3. **Tissue** is a grouping of like cells working together. Tissue is a group of cells found together in the body. The cells is a tissue share a common embryonic origin and are arranged in an orderly pattern that achieves the tissue's functions. Examples are muscle tissue and nervous tissue.
4. **Organ** is a structure composed of several different tissues performing a particular function. Examples include the lungs and the heart.
5. **Organ systems** are groups of organs which together perform an overall function. Examples are the respiratory system and the digestive system.
6. **The total organism** is the individual human being. You are a total organism.

ORGANIZATION OF THE HUMAN BODY



Organs are a collection of tissues specialized to perform a particular function.

1. There are **78 main organs** within the human body.
2. **Five organs (heart, brain, kidneys, liver and lungs)** are considered vital for survival.
3. If any of these five organs stop functioning even for a few seconds death will result.

Organ system is a group of organs that work together in the body to perform a complex function, such as pumping blood or processing and utilizing nutrients.

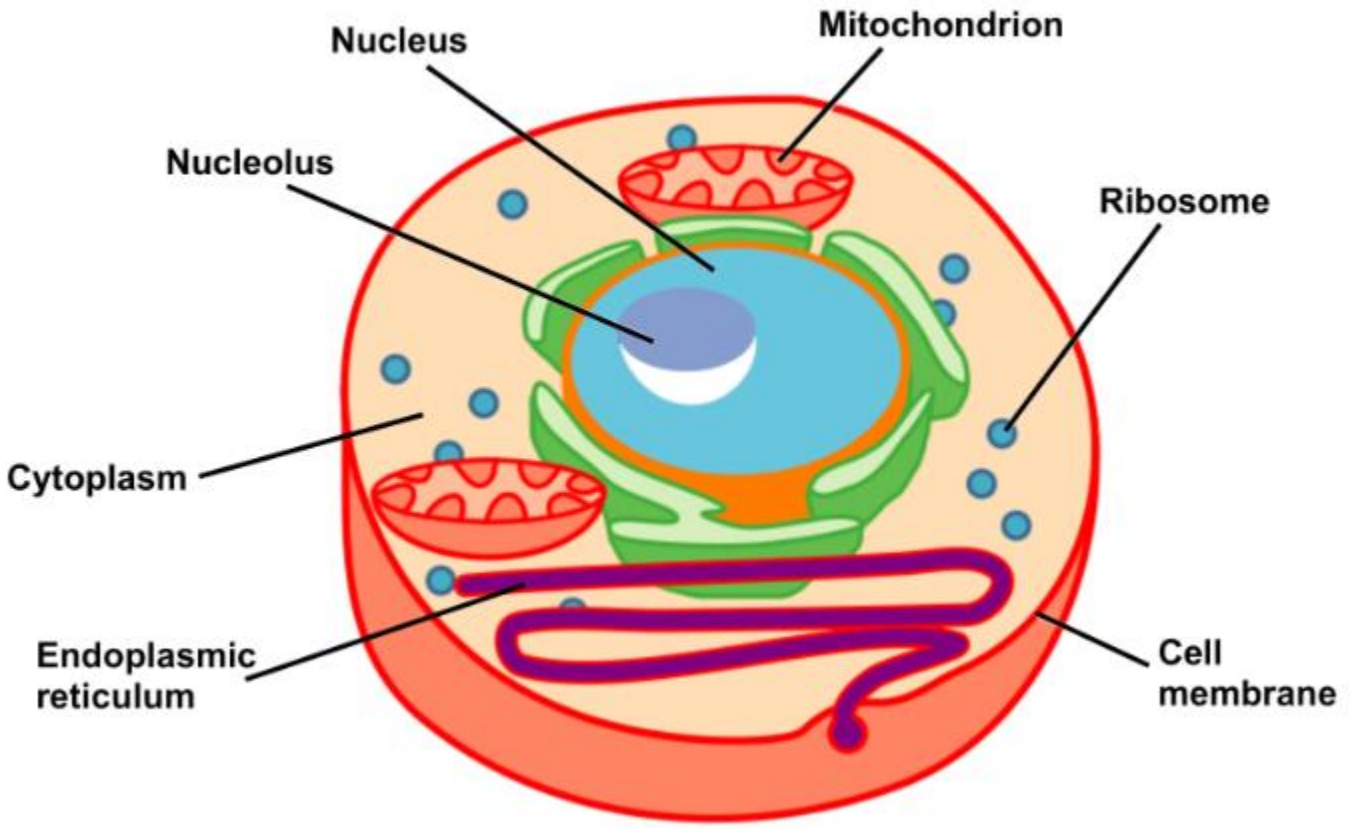
1. There are 11 major organ systems in the human body.

Cell is the smallest unit of life. Each of us has an average of 100 trillion cells.

Tissue is a group of cells found together in the body.
There are 4 basic types of tissue: connective tissue, epithelial tissue, muscle tissue, and nervous tissue

ORGANALLES IN HUMAN BODY

1. **Organelle** is a subcellular structure that has one or more specific jobs to perform in the cell, much like an organ does in the body.
2. Among the more important cell organelles are:
   a) **Nuclei**, which store genetic information;
   b) **Mitochondria**, which produce chemical energy; and
   c) **Ribosomes**, which assemble proteins.

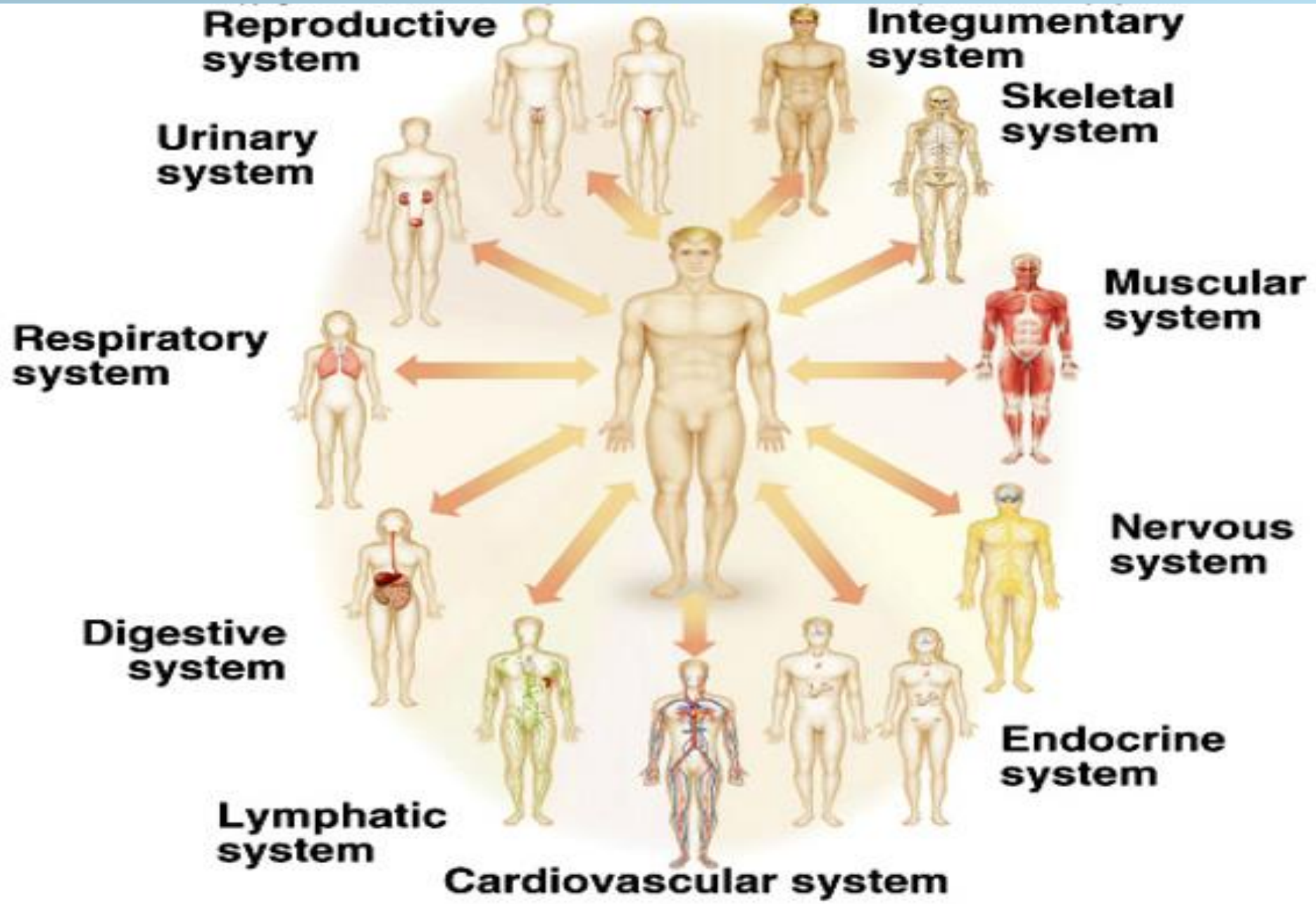


THE MAIN ORGANS IN THE HUMAN BODY

1. There are **78 main organs** within the human body.
2. **Five organs (heart, brain, kidneys, liver and lungs)** are considered vital for survival.

Anus	Capillaries	Joints	Nerves	Skin	Tendons
Arteries	Cerebellum	Liver	Nasal Cavity	Spleen	Tongue
Appendix	Diaphragm	Lungs	Ovaries	Scrotum	Thyroid
Adrenal Glands	Ears	Larynx	Oesophagus / Esophagus	Stomach	Trachea
Brain	Eyes	Ligaments	Penis	Spinal Cord	Thymus Gland
Bones	Fallopian Tubes	Lymph Nodes	Pancreas	Small Intestine	Ureters
Bronchi	Genitals	Large Intestine	Pharynx	Salivary Glands	Urethra
Bladder	Gallbladder	Lymphatic vessel	Placenta	Skeletal Muscles	Uterus
Bone Marrow	Heart	Mouth	Prostate	Seminal vesicles	Vulva
Bulbourethral glands	Hair follicle	Mesentery	Pineal Gland	Subcutaneous tissue	Veins
Colon	Hypothalamus	Mammary Glands	Pituitary Gland	Teeth	Vagina
Cervix	Interstitium	Nose	Parathyroid Glands	Tonsils	Vas deferens
Clitoris	Kidneys	Nails	Rectum	Testes	Vestigial organ

11 ORGAN SYSTEMS OF THE HUMAN BODY



HUMAN ANATOMY & PHYSIOLOGY

ORGAN SYSTEMS (1)

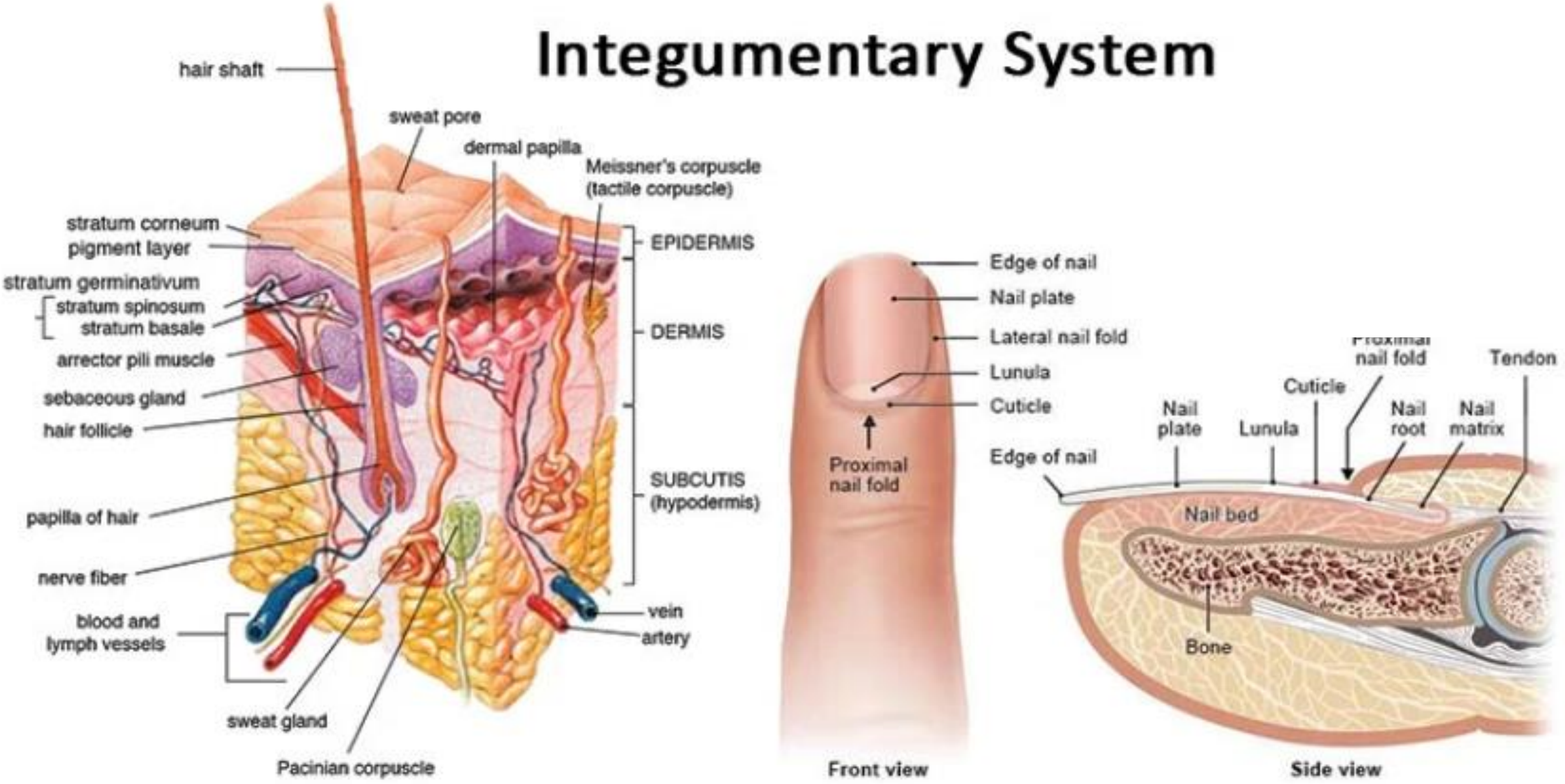
INTEGUMENTARY, SKELETAL, MUSCULAR

Monday, September 8, 2025

1. INTEGUMENTARY SYSTEM

1. **Integumentary system** the body's outer layer consisting of skin, hair, nails and glands.
2. Functions:
   a) Physical protection against bacteria and germs.
   b) Helps heal abrasions, cuts and other injuries.
   c) Protects body from the sun’s ultraviolet (UV) rays and sunburn.
   d) Excretes sweat and other waste from your body.
   e) Regulates your body temperature and allows us to stay cool.
   f) Helps us feel heat, cold and detect other sensations.
   g) Synthesizes vitamin D.

Integumentary System



Integumentary system includes the epidermis, dermis, hypodermis, associated glands, hair, and nails.

CONDITIONS & DISORDERS OF INTEGUMENTARY SYSTEM

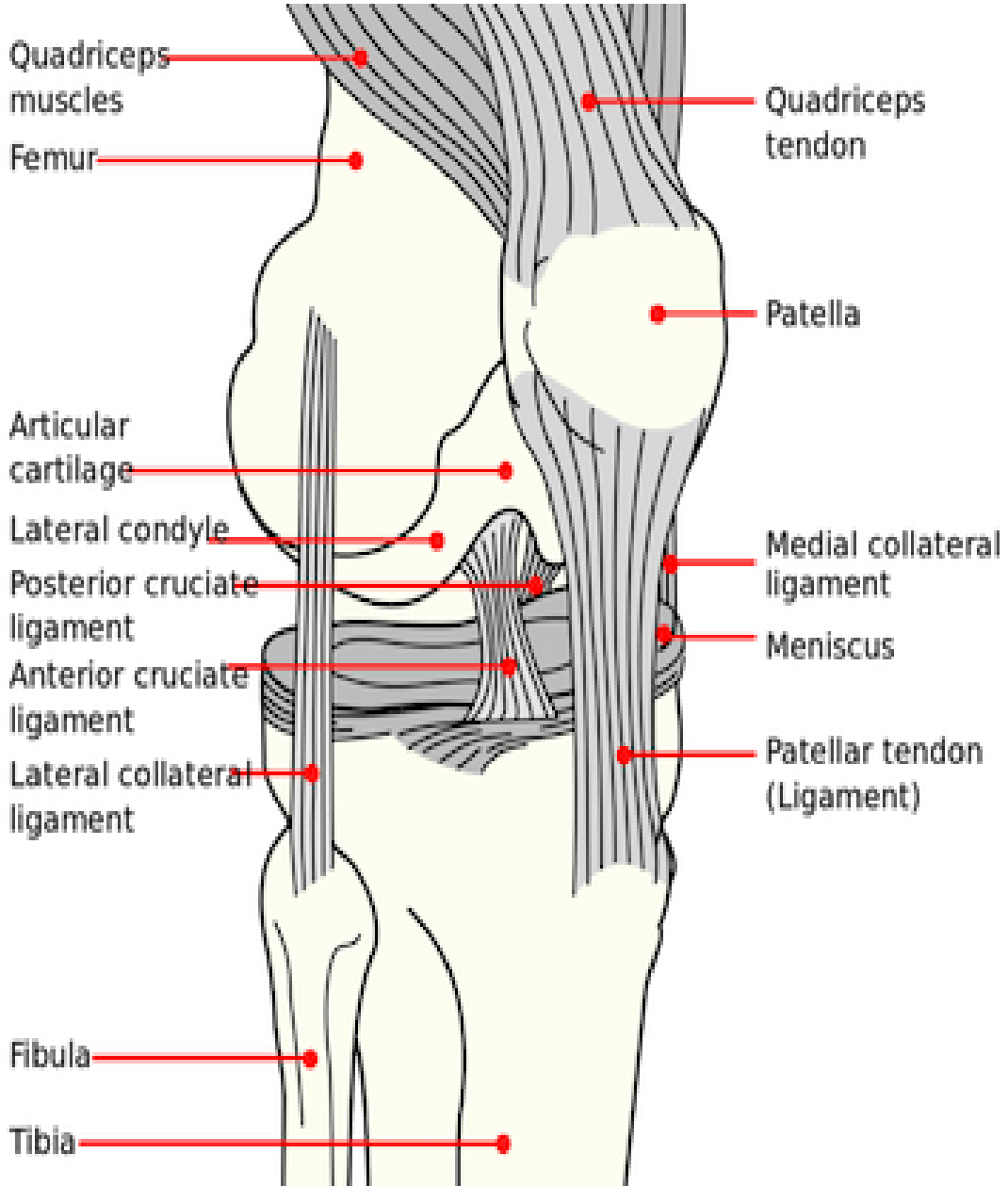
1. Skin disorders including allergies, skin cancer.
2. Hair loss
3. Gland disorders

2. SKELETAL SYSTEM

1. **Skeletal system (also known as muscoloskeletal system)** is your body's support structure.
2. Functions:
   a) Supports the body weight and anchors for all the tissue that connects to it.
   b) Helping body to move
   c) Protecting your organs
   d) Creating red blood cells
   e) Storing minerals such as calcium and vitamin D

COMPONENTS OF THE MUSCOSKELETON SYSTEM

1. **Bones** are the body's main form of structural support. Adults have 206 bones in their bodies.
2. **Muscles** help you do everything from walking, running and jumping to breathing and digesting. Human body has more than 600 muscles.
3. **Cartilage** is strong, flexible tissue that acts like a shock absorber in joints.
4. **Ligaments** are bands of tissue that connect bones to other bones.
5. **Tendons** are cords that connect muscles to bone.
6. **Joints** are any place two bones meet. They contains some of (or all) the pieces listed above.

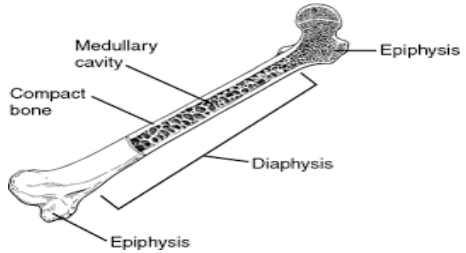


COMPOSITION OF THE SKELETAL SYSTEM

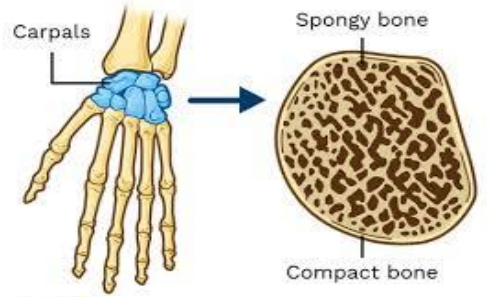
SECTION	NUMBER
Skull (Head)	29
Spine Vertebral Column (Backbone)	26
Thorax (Chest bone)	25
Upper limbs (hands)	32X2 = 64
Lower limbs (legs)	31X2 = 62
Total	206

FOUR TYPES OF BONES

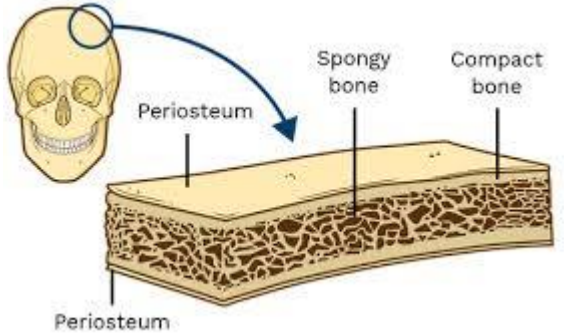
1. **Long Bones** consist of a long shaft with two bulky ends or extremities. Long bones include bones of the thigh, leg, arm, and forearm.



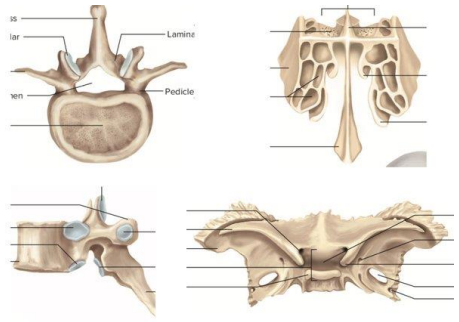
2. **Short bones** are shaped roughly as a cube and contain mostly spongy bone. Short bones include the carpal bones of the hands that allow movement of the wrist, and the tarsal bones of the feet that allow movement of the foot.



3. **Flat bones** have a flat shape, i.e not rounded. Examples include the shoulder blade, skull and rib bones. Flat bones have marrow, but they do not have a bone marrow cavity.

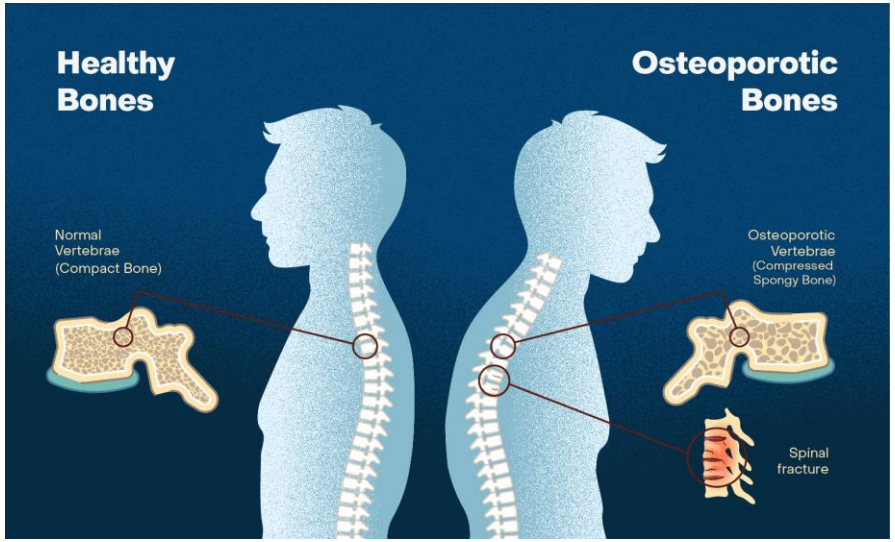


4. **Irregular Bones** consist of cancellous tissue enclosed within a thin layer of compact bone. Examples of irregular bones are: the vertebrae, sacrum, coccyx, temporal, sphenoid.



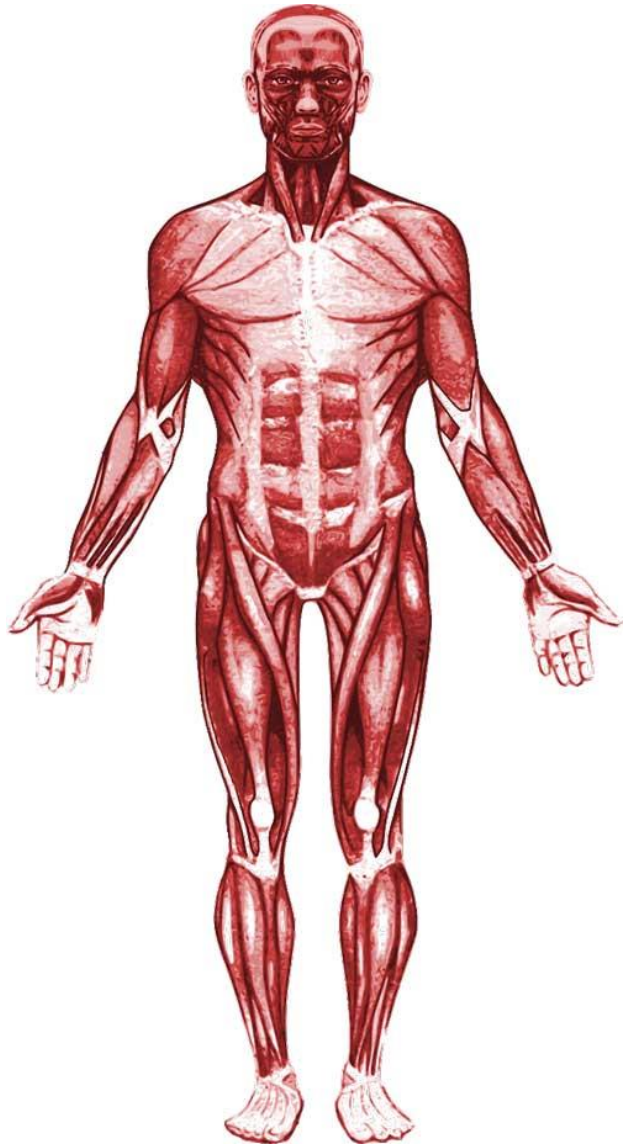
CONDITIONS & DISORDERS OF THE SKELETON SYSTEM

1. **Arthritis** is a disease that causes damage in your joints. Lots of people develop arthritis after that normal, lifelong wear and tear. Some types of arthritis happen after injuries that damage a joint.
2. **Osteoporosis** is condition in which bones become weak and brittle. The body constantly absorbs and replaces bone tissue. With osteoporosis, new bone creation doesn't keep up with old bone removal.



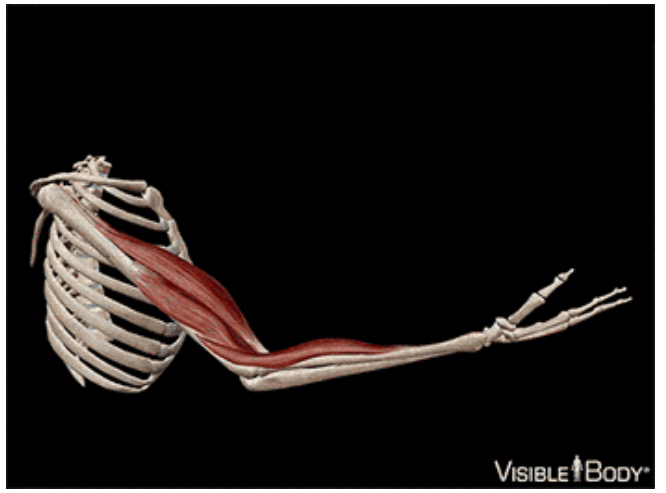
3. MUSCULAR SYSTEM

1. **Muscular system** is an organ system consisting of skeletal, smooth, and cardiac muscle.
2. Functions:
   a) **Producing movement** enabling us to respond quickly to changes in the external environment.
   b) **Maintaining posture** by making one tiny adjustment after another so that we can maintain an erect or seated posture despite the never-ending downward pull of gravity.
   c) **Stabilizing joints:** muscle tendons are extremely important in reinforcing and stabilizing joints that have poorly fitting articulating surfaces.
   d) **Generating heat** through body heat, is a by-product of muscle activity. Nearly three-quarters of its energy escape as heat and this heat is vital in maintaining normal body temperature.

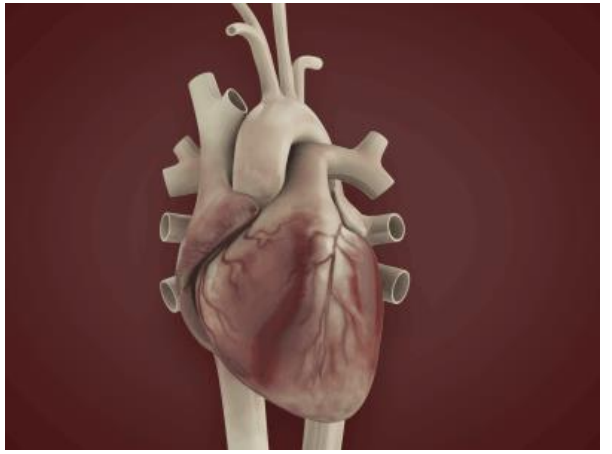


TYPES OF MUSCLES / 01

There are TWO types of muscles based on control:



1. **Voluntary muscles** are under our conscious control so we can move these muscles when we want to. These are the muscles we use to make all the movements needed in physical activity and sport.

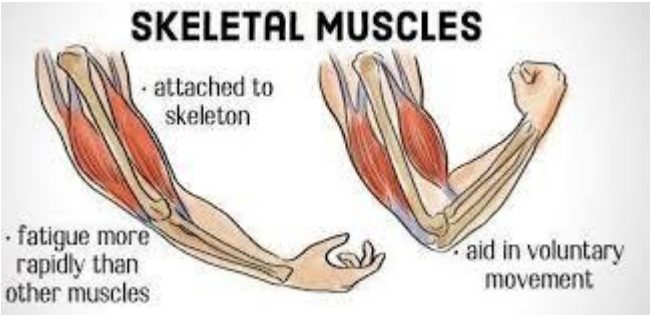


2. **Involuntary muscles** are not under our conscious control which means we can't make them contract when we think about it. Examples are muscles of the stomach and intestine.

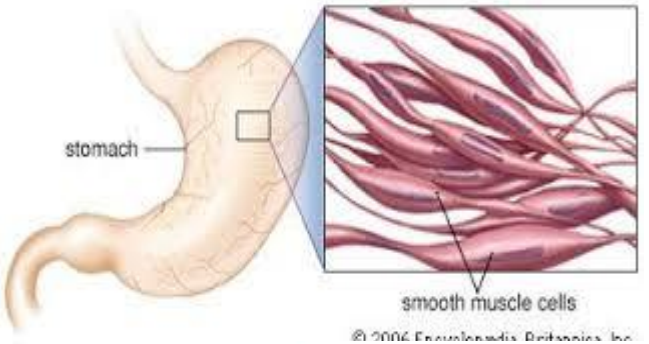
TYPES OF MUSCLES / 02

The THREE main types of muscle based on form:

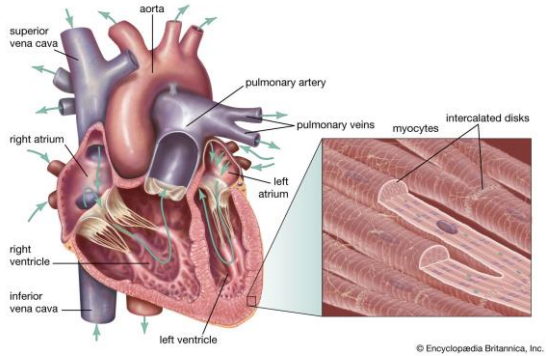
1. **Skeletal muscle** – the specialised tissue that is attached to bones and allows movement. Together, skeletal muscles and bones are called the **musculoskeletal system (also known as the locomotor system**). Generally skeletal muscle is grouped into opposing pairs such as the biceps and triceps on the front and back of the upper arm.



2. **Smooth muscle** are located in various internal structures including the digestive tract, uterus and blood vessels such as arteries. Smooth muscle is arranged in layered sheets that contract in waves along the length of the structure.

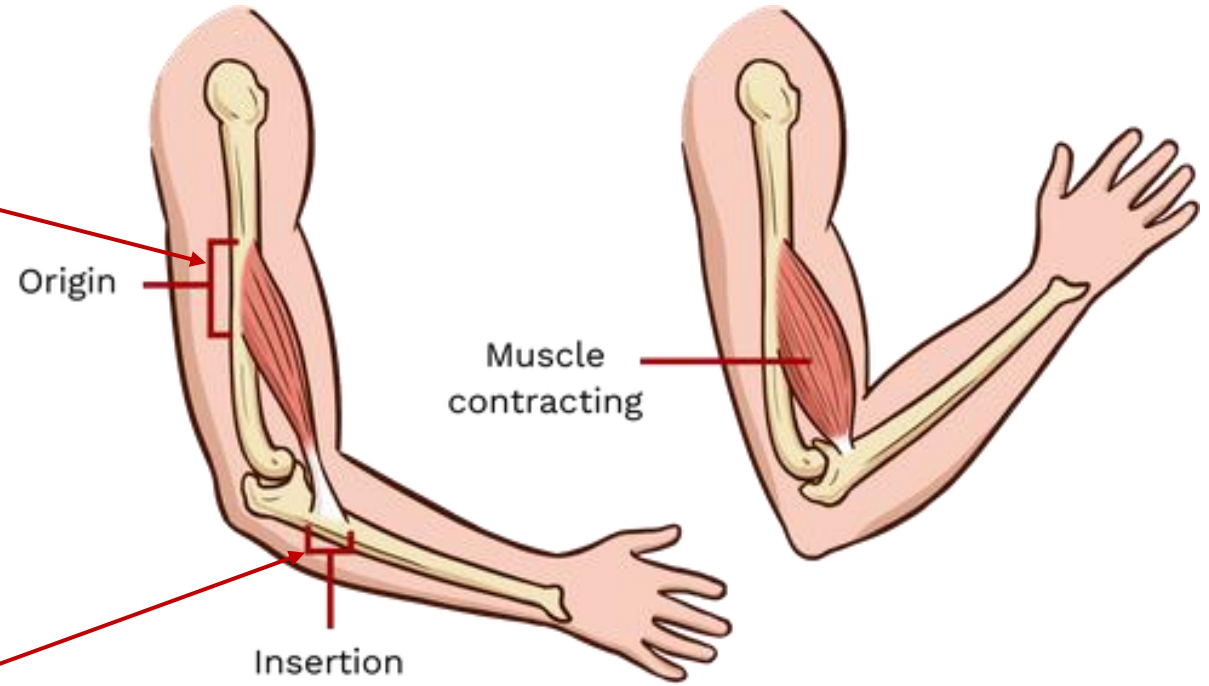


3. **Cardiac muscle** – the muscle specific to the heart. The heart contracts and relaxes without our conscious awareness.



ORIGIN, INSERTION & ACTION OF MUSCLE

Origin point is on the immovable bone



Insertion point is on the movable bone. When muscle contracts, it pulls the insertion point towards the origin point.

MEDICAL TERMS RELATING TO MOVEMENT

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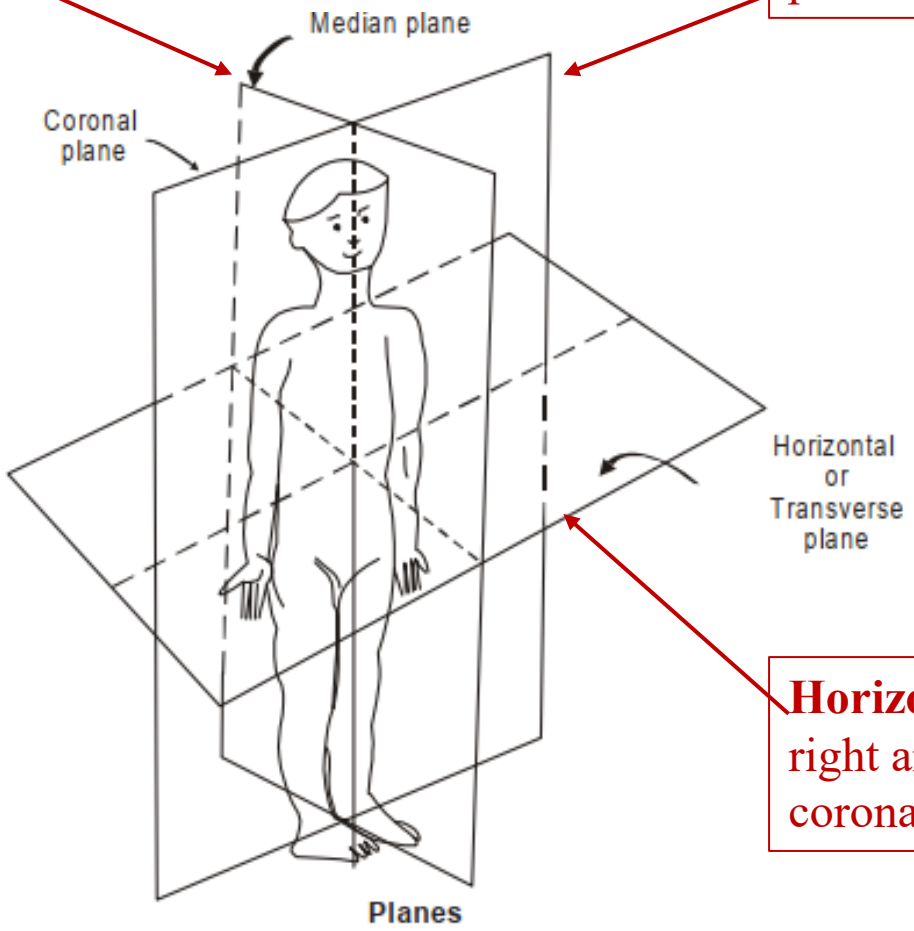
POSITIONS OF STRUCTURE IN HUMAN ANATOMY

1. **Median plane** is an imaginary vertical longitudinal line through the middle of the body from front to back, dividing the body into right and left halves.
2. **Sagittal plane** is any plane that is parallel to the median plane.

Coronal planes are imaginary planes at right angles to the median plane.

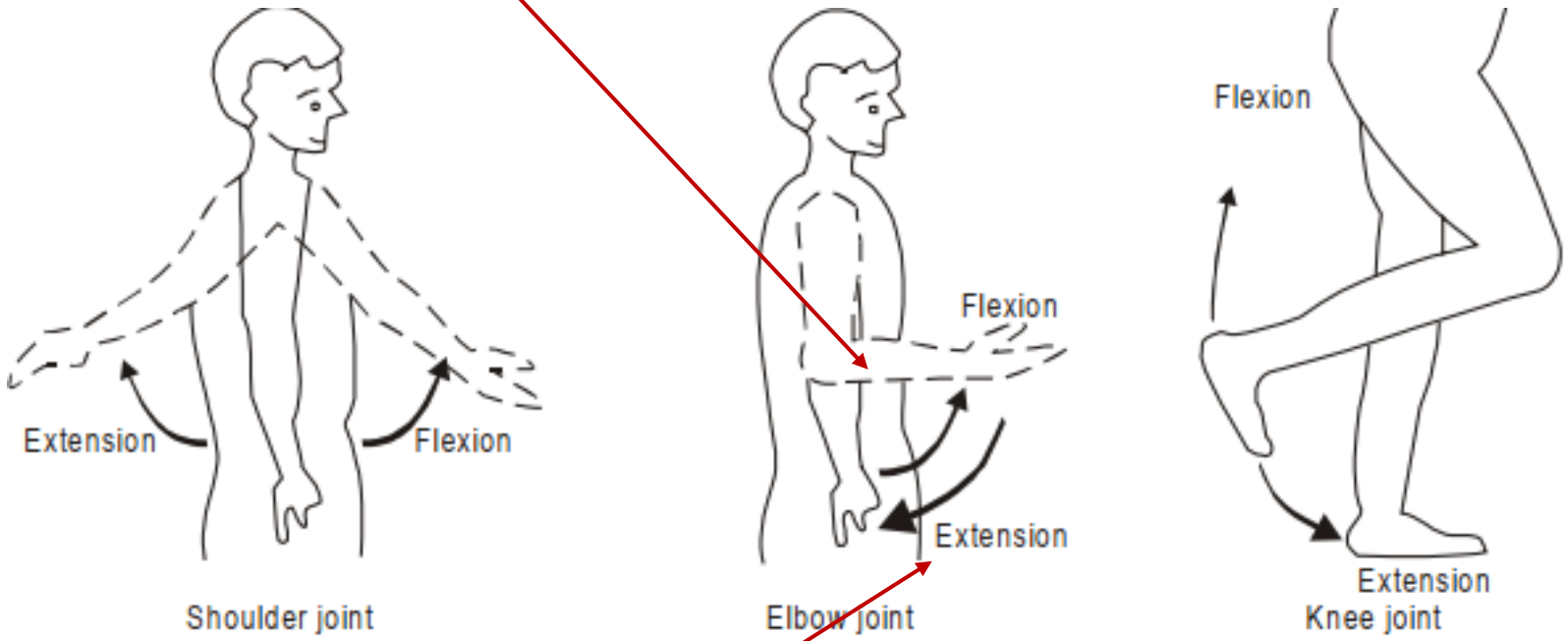


Horizontal or transverse planes are at right angles to both the median and coronal planes.

Further Reading:
ece331.elimu.com/Books/Fundamentals of Biomedical Engineering-NewAge.pdf

TERMS RELATED TO MOVEMENT

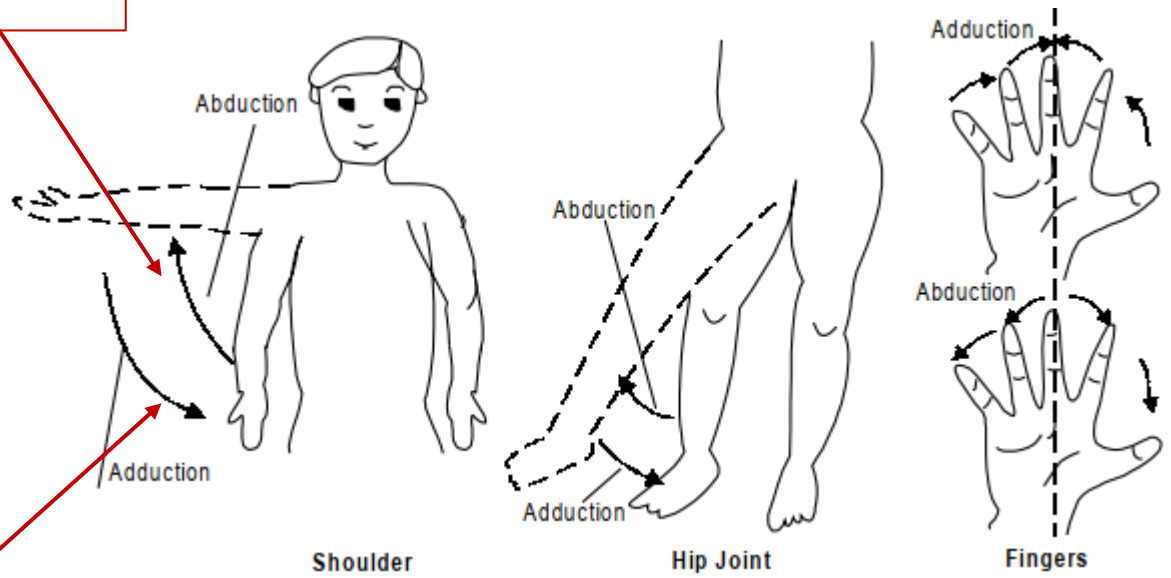
Flexion is a movement that takes place in a sagittal plane. It is the folding of the bones so as they may come nearer.



Extension means unfolding or straightening the joint. The movement usually takes place in a posterior direction.

ABDUCTION & ADDUCTION

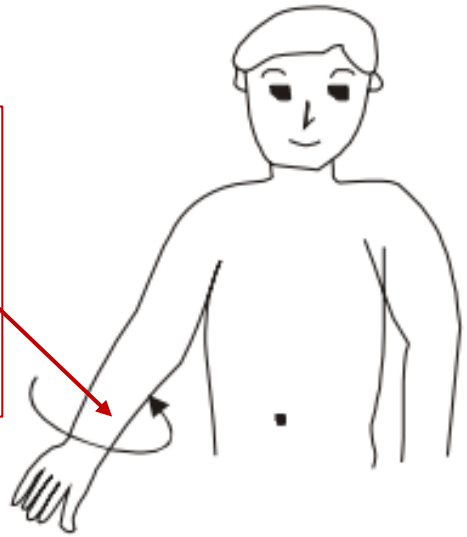
Abduction of a limb is the movement away from the midline of the body in the coronal plane.



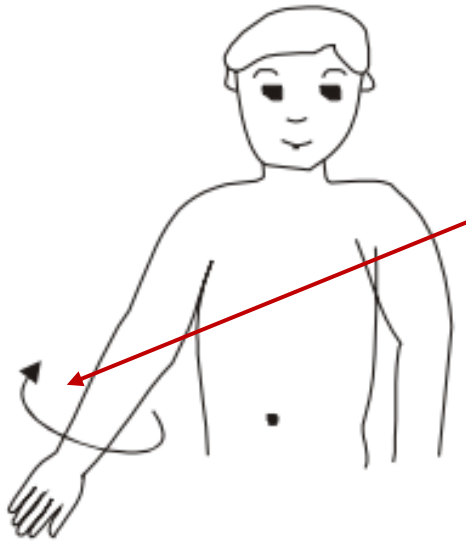
Adduction of a limb is the movement towards the body in the coronal plane.

PRONATION AND SUPINATION

Pronation of the forearm' is medial rotation of the forearm in such a manner that the palm faces posteriorly.



Pronation of Forearm



Supination of Forearm

Supination of the forearm', is a lateral rotation of forearm from the pronated position so that palm of the hand comes to face anteriorly.

SUMMARY OF TYPES OF BODY MOVEMENTS

There are FIVE types of body movements:

1. **Flexion** is a movement, generally in the sagittal plane, that decrease the angle of the joint and brings two bones closer together; it is a type of hinge joints, but it is also common at ball-and-socket joints.
2. **Extension** is the opposite of flexion, so it is a movement that increases the angle, or the distance, between two bones or parts of the body.
3. **Rotation** is movement of a bone around a longitudinal axis; it is a common movement of ball-and-socket joints.
4. **Abduction** is moving the limb away from the midline, or median plane, of the body.
5. **Adduction** is the opposite of abduction, so it is the movement of a limb toward the body midline.

THE NERVOUS SYSTEM

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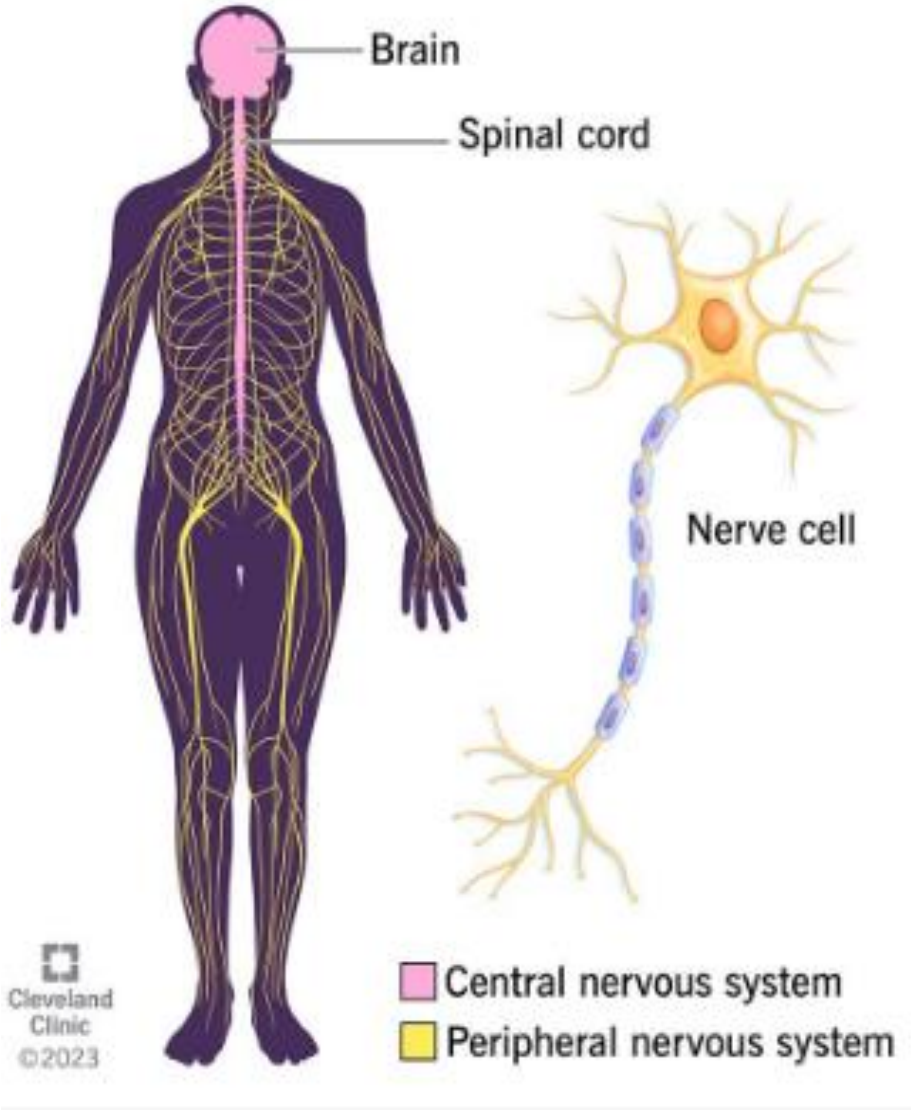
4. NERVOUS SYSTEM

1. **Nervous system** coordinates its actions and sensory information by transmitting signals to and from different parts of its body.
2. The three main parts of your nervous system are:
   a) Brain
   b) spinal cord
   c) nerves.
3. It contains the **central nervous system** and the **peripheral nervous system.**

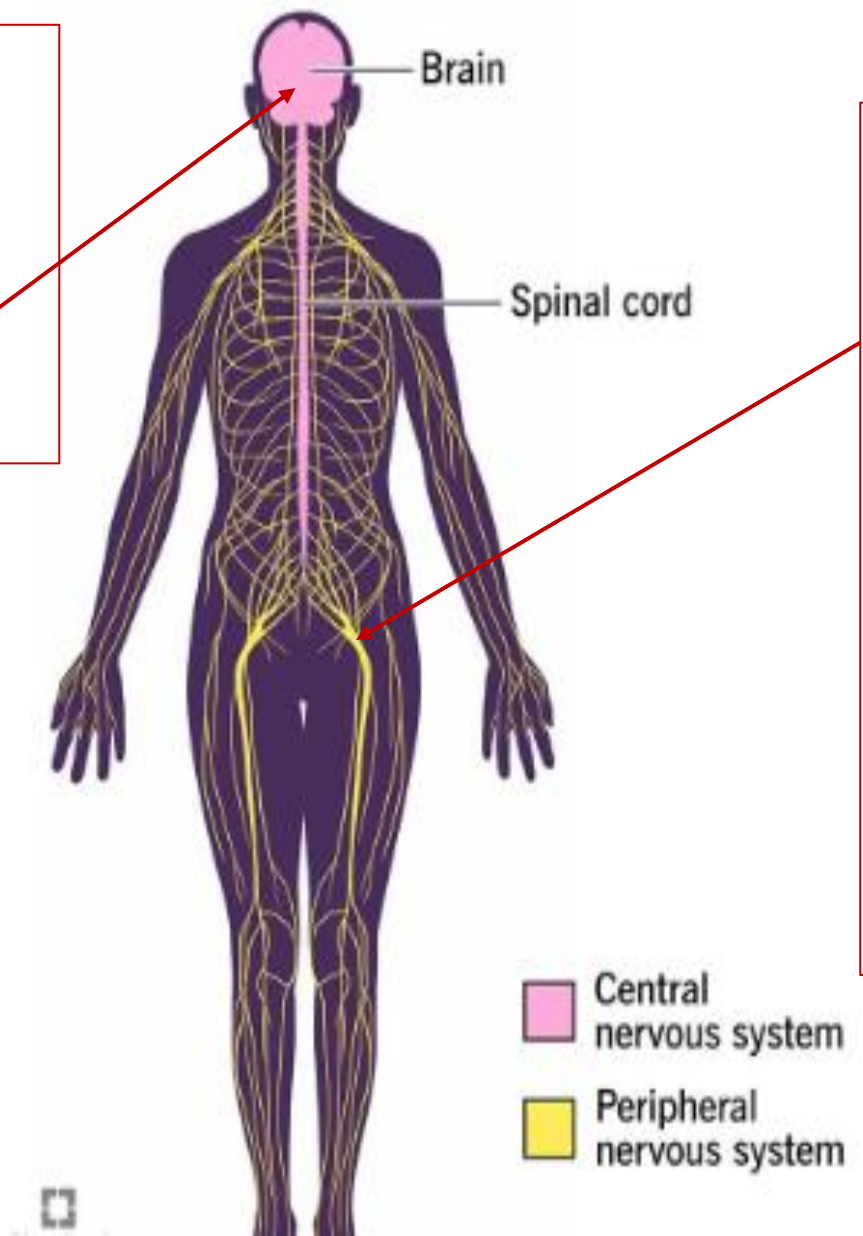


TYPES OF MESSAGES IN THE NERVOURS SYSTEM

1. Nervous system's main function is to send messages from various parts of the body from the brain, and from your brain back out to your body.
2. Types of messages:
   a) Thoughts, memory, learning and feelings.
   b) Movements (balance and coordination)
   c) Senses (how your brain interprets what you see, hear, taste, touch and feel).
   d) Wound healing.
   e) Sleep.
   f) Heartbeat and breathing patterns.
   g) Response to stressful situations, including sweat production.
   h) Digestion.
   i) Body processes, such as puberty and aging.

MAJOR PARTS OF THE NERVOUS SYSTEM

Central nervous system is composed of the brain and spinal cord. Your brain reads signals from your nerves to regulate how you think, move and feel.

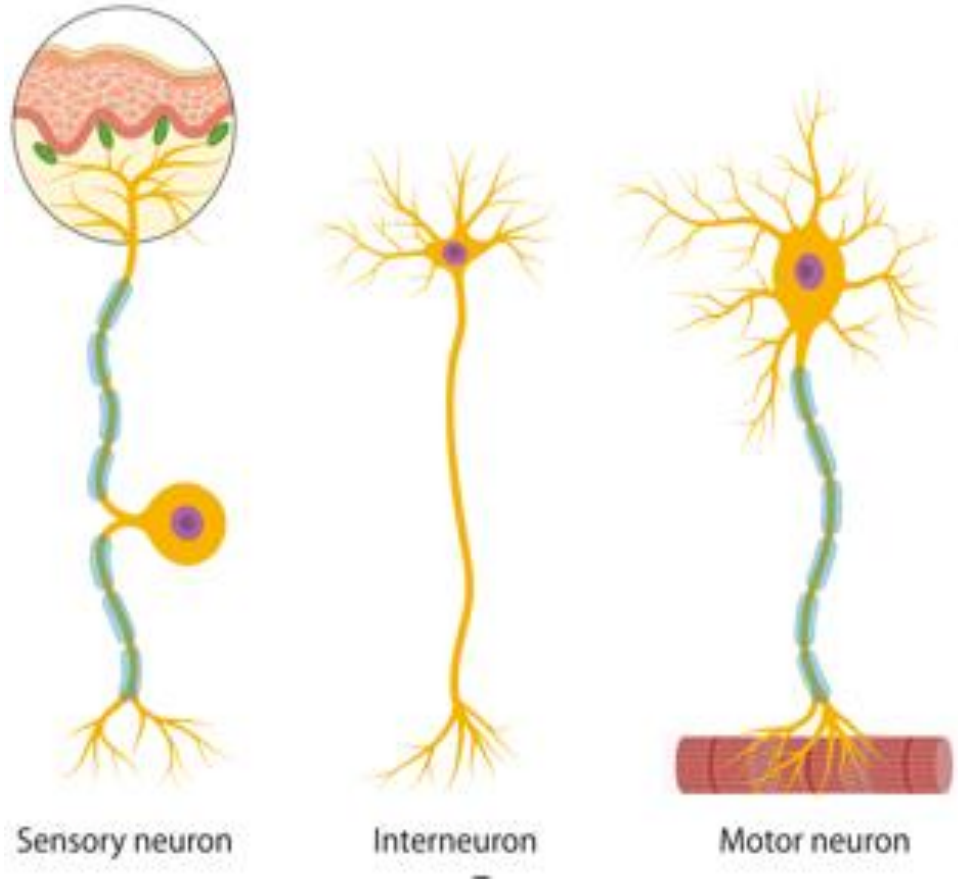


Peripheral nervous system is made up of a network of nerves. The nerves branch out from your spinal cord. This system relays information from your brain and spinal cord to your organs, arms, legs, fingers and toes.

TYPES OF NEURONS

There are THREE types of neurons. Each type of neuron has a different job:

1. **Motor neurons** take signals from your brain and spinal cord to your muscles. They help you move. They also assist with breathing, swallowing and speaking.
2. **Sensory neurons** take information from your senses (what you see, touch, taste, etc.) to your brain.
3. **Interneurons** communicate between motor and sensory neurons. These neurons regulate your movement in response to sensory information (like moving away from a hot surface) and play a role in how you learn, think and remember.



Further Reading:
Neurons (Nerve Cells): Structure, Function & Types (simplypsychology.org)

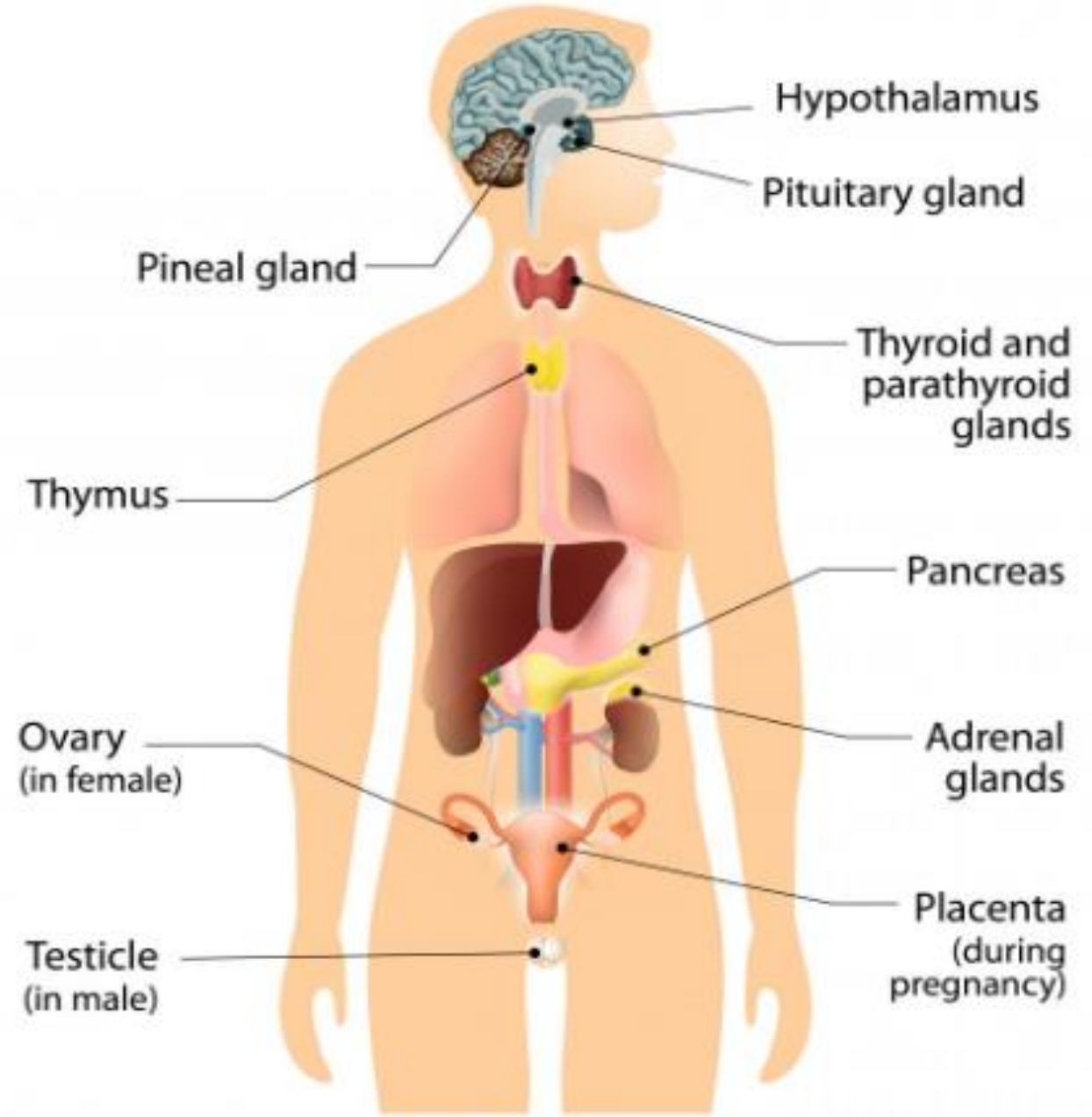
CONDITIONS & DISORDERS OF THE NERVOUS SYSTEM

Some common conditions and disorders of the nervous system are:

1. **Alzheimer's disease** causes a decline in memory, thinking, learning and organizing skills over time. It's the most common cause of dementia and usually affects people over the age of 65.
2. **Stroke happen** when blood vessels are blocked or because of bleeding in your brain. Strokes are a life-threatening emergency, and immediate medical attention is critical to prevent permanent damage or death.
3. **Traumatic brain injury** usually results from a violent blow or jolt to the head or body. An object that goes through brain tissue, such as a bullet or shattered piece of skull, also can cause traumatic brain injury.
4. **Cerebral palsy** happens when there's damage to brain areas that control muscle movement, or when those areas don't develop as they should.
5. **Epilepsy** is a brain disease where nerve cells don't signal properly, which causes seizures. Seizures are uncontrolled bursts of electrical activities that change sensations, behaviors, awareness and muscle movements.
6. **Meningitis** is an inflammation of the protective layers surrounding your brain and spinal cord caused by bacteria and viruses. Symptoms include fever, severe headache, neck stiffness, nausea, vomiting.

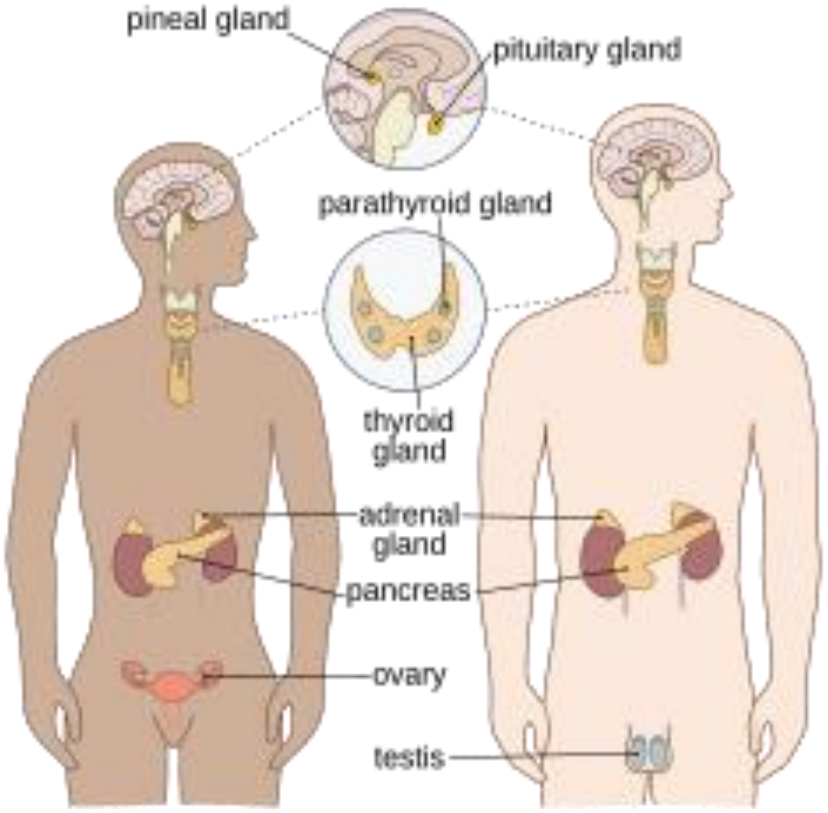
5. ENDOCRINE SYSTEM

1. **Endocrine system** is a complex network of glands and organs which uses hormones to control and coordinate your body's metabolism, energy level, reproduction, growth and development, and response to injury, stress, and mood.
2. The endocrine system consists of:
   a) **Glands** located throughout the body;
   b) **Hormones** made by the glands and released into the bloodstream or the fluid surrounding cells;
   c) **Receptors** in various organs and tissues that recognize and respond to the hormones.



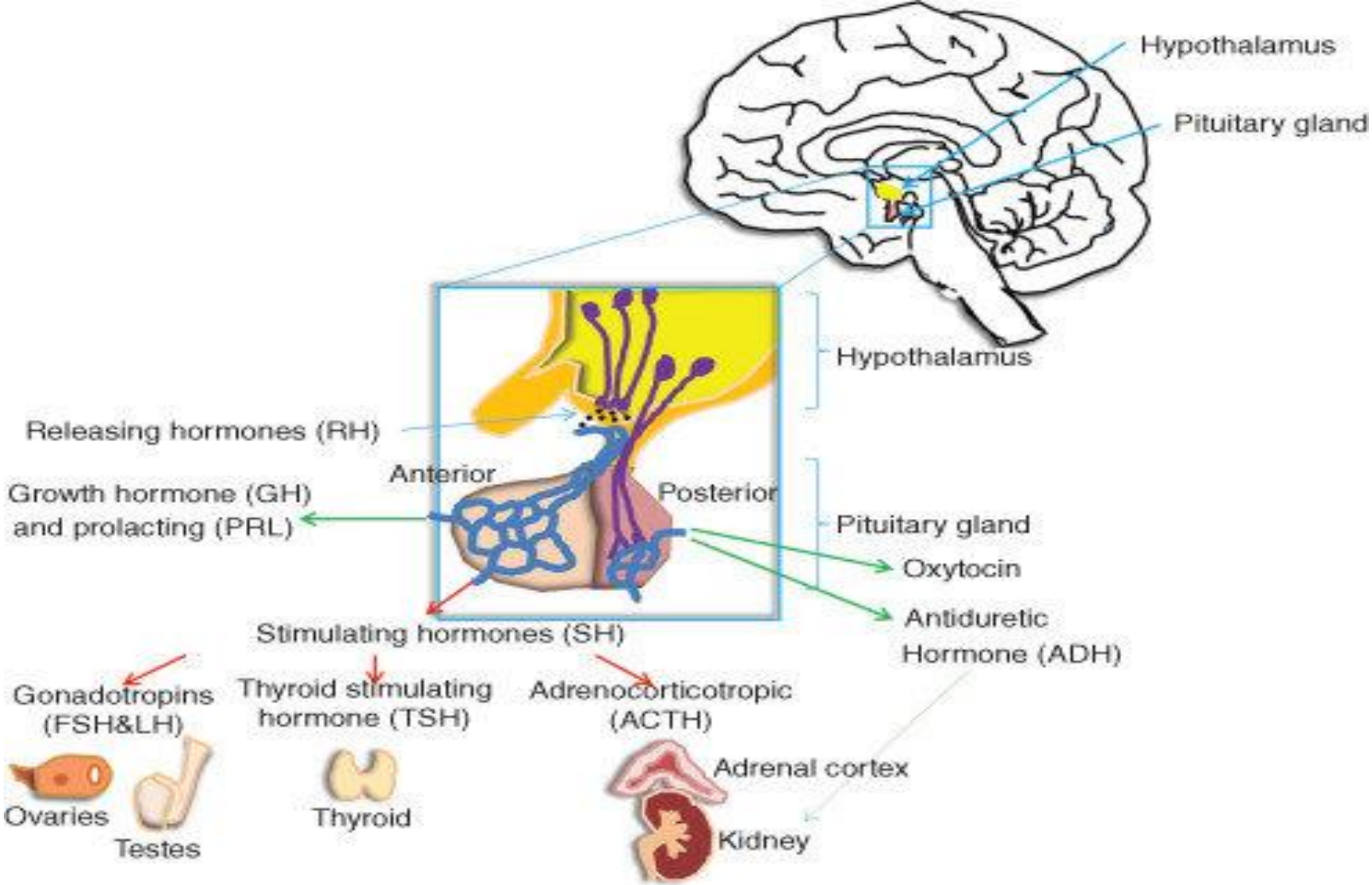
5.1 ORIGIN OF THE WORD ENDOCRINE

1. **The word endocrine** is derived from the Greek terms **"endo," meaning within,** and **"krine," meaning to separate or secrete**.
2. **Endocrine glands do not have ducts to carry their products.** They are called ductless glands.
3. **Endocrinology** is a specialized medicine covering a sub-specialty of internal medicine dealing with the diagnosis and treatment of diseases related to hormones.



5.1 HYPOTHALAMUS-PITUITARY COMPLEX

1. **Hypothalamus-pituitary** that serves as your brain's central command center to control vital bodily functions.
2. The functions of the hypothalamus are:
   a) To sends messages to the autonomic nervous system, which controls things like blood pressure, heart rate and breathing.
   b) To signal the pituitary gland to produce and release hormones that affect other areas of your body.


Hypothalamus
Pituitary gland
Hypothalamus
Releasing hormones (RH)
Anterior
Posterior
Growth hormone (GH)
and prolacting (PRL)
Pituitary gland
Oxytocin
Antiduretic
Hormone (ADH)
Stimulating hormones (SH)
Gonadotropins
(FSH&LH)
Thyroid stimulating
hormone (TSH)
Adrenocorticotropic
(ACTH)
Adrenal cortex
Ovaries
Testes
Thyroid
Kidney

CONDITIONS & DISORDERS RELATED TO HYPOTHALAMUS-PITUITARY COMPLEX

1. **Pituitary adenomas** are benign tumors on the pituitary gland. Although noncancerous, they can interfere with normal pituitary function and cause certain health conditions.
2. **Hypopituitarism** is an underactivity of the pituitary gland leading to deficiency of one or multiple hormones. Symptoms, diagnosis and treatment of hypopituitarism depend on which hormones are lacking.
3. **Hyperpituitarism** is an overactive pituitary gland making the gland produce too much or too little of the hormones that control growth, reproduction and metabolism leading to disorders like gigantism in children to hyperthyroidism in adults

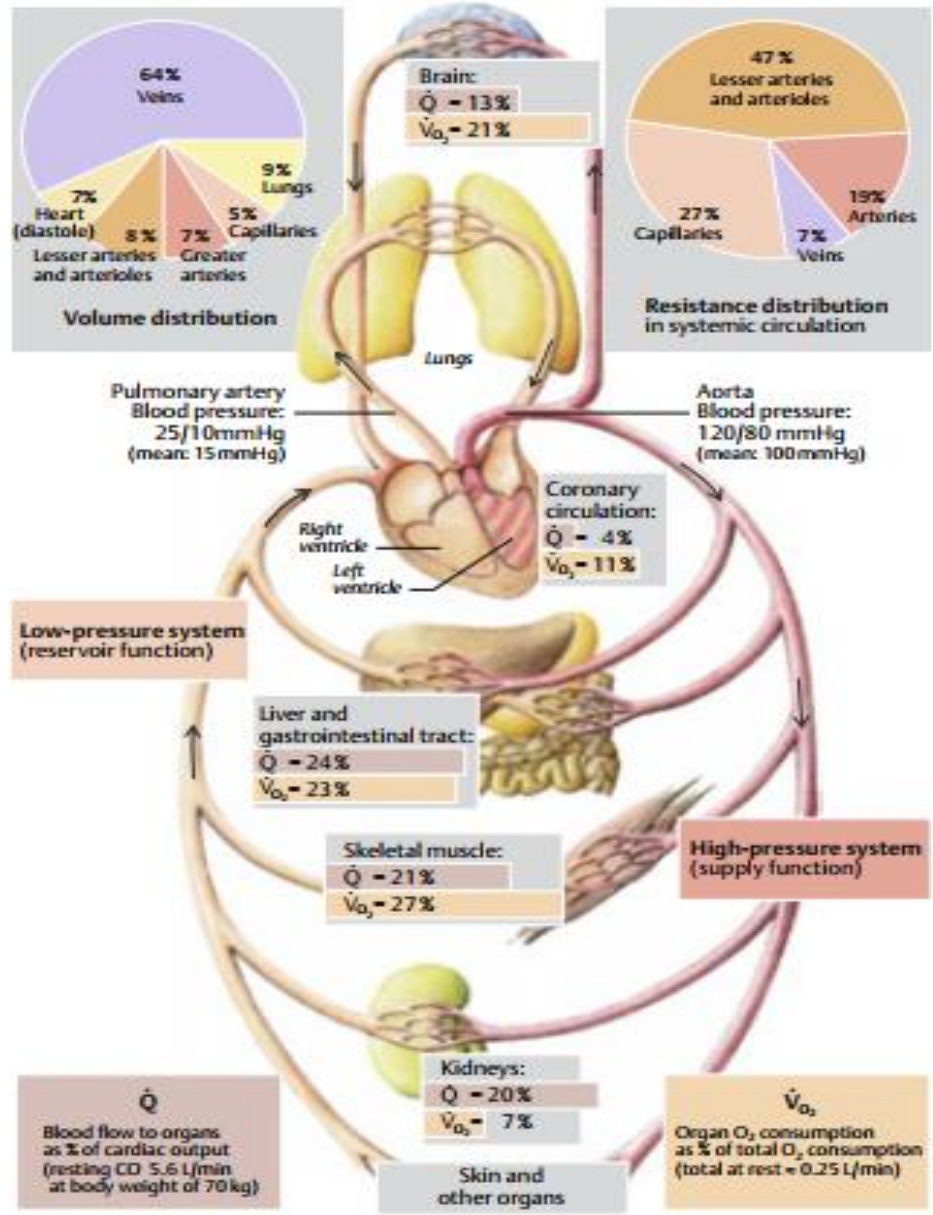
6. CARDIOVASCULAR SYSTEM

1. **Cardiovascular system** includes the heart, blood vessels, and blood which is circulated throughout the entire body .
2. Function of the cardiovascular system are:
    1. Supplies your body's organs with oxygen and nutrients
    2. Keep your temperature at a normal level

BLOOD CIRCULATION OVERVIEW

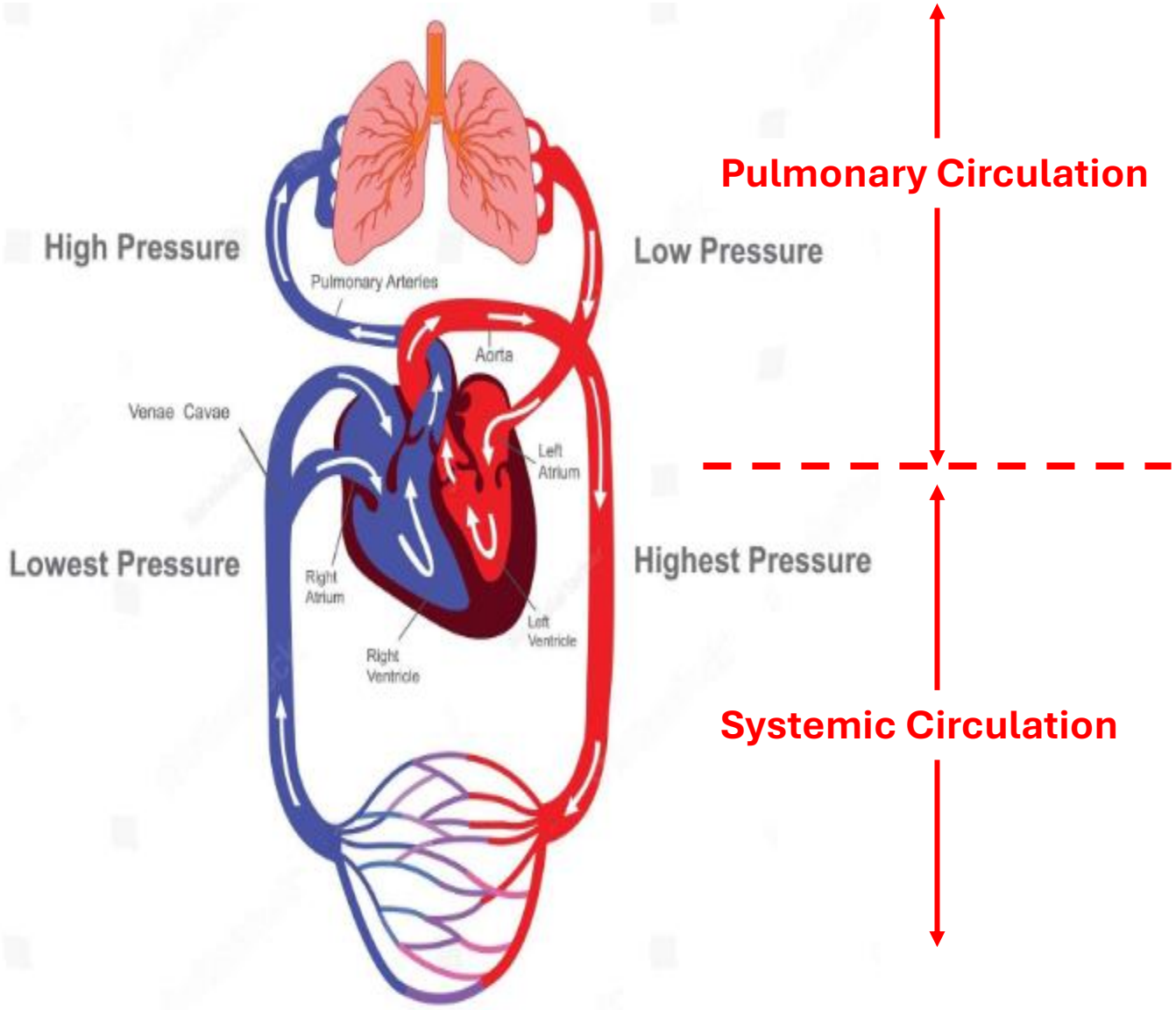
1. **Blood** is pumped from the left ventricle of the heart to capillaries in the periphery via the arterial vessels of the **systemic (or greater)** circulation and returns via the veins to the right heart.
2. It is then expelled from the right ventricle to the lungs via the **pulmonary (or lesser) circulation** and returns to the left heart.

3. **Total Blood volume is roughly 4–5L** (7% of the fat-free body mass)
4. **Approx 80% of the blood** circulates through the veins, right heart and pulmonary vessels, which are jointly referred to as the low pressure system.


64%
Veins
9%
Lungs
7%
Heart
(diastole)
5%
Capillaries
8%
Lesser arteries
and arterioles
7%
Greater
arteries
Volume distribution
47%
Lesser arteries
and arterioles
19%
Arteries
27%
Capillaries
7%
Veins
Resistance distribution
in systemic circulation
Brain:
$\dot{Q}$ = 13%
$\dot{V}_{O_2}$ = 21%
Lungs
Pulmonary artery
Blood pressure:
25/10 mmHg
(mean: 15 mmHg)
Aorta
Blood pressure:
120/80 mmHg
(mean: 100 mmHg)
Coronary
circulation:
$\dot{Q}$ = 4%
$\dot{V}_{O_2}$ = 11%
Right
ventricle
Left
ventricle
Low-pressure system
(reservoir function)
Liver and
gastrointestinal tract:
$\dot{Q}$ = 24%
$\dot{V}_{O_2}$ = 23%
Skeletal muscle:
$\dot{Q}$ = 21%
$\dot{V}_{O_2}$ = 27%
High-pressure system
(supply function)
Kidneys:
$\dot{Q}$ = 20%
$\dot{V}_{O_2}$ = 7%
Skin and
other organs
$\dot{Q}$
Blood flow to organs
as % of cardiac output
(resting CO 5.6 L/min
at body weight of 70 kg)
$\dot{V}_{O_2}$
Organ O_2 consumption
as % of total O_2 consumption
(total at rest = 0.25 L/min)

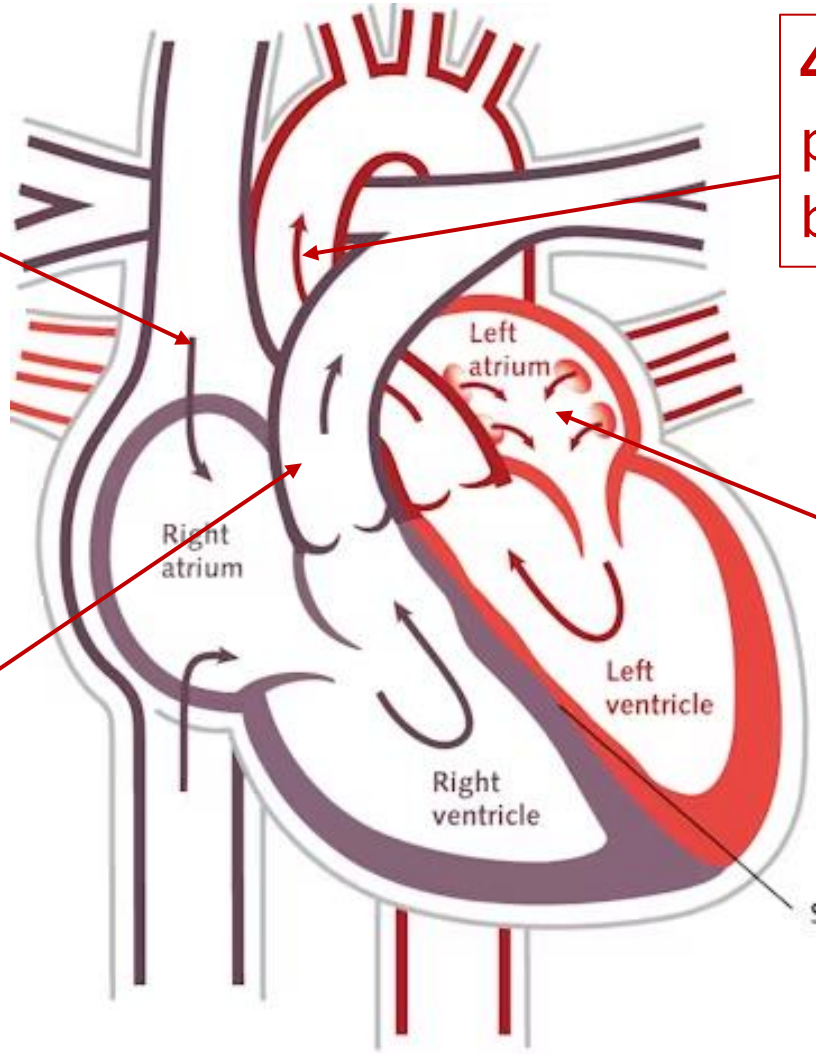
6.1 CIRCULATION PROCESSES

1. **Pulmonary circulation:** Blood without oxygen comes into the right side of your heart and is sent to the lungs to get oxygen and get rid of carbon dioxide. Then the oxygenated blood comes back through the left side of your heart.
2. **Systemic circulation:** Blood that has just gotten oxygen from the lungs and returned through your heart's left side is pushed out to the rest of your body's cells so they can receive oxygen and nutrients.



PULMONARY CIRCULATION

1. Oxygen-poor blood enters the right atrium and then flows to the right ventricle.



4. Oxygen-rich blood is pumped to the rest of the body through the aorta.

3. Oxygen-rich blood returns from the lungs and enters the left atrium and then flows to the left ventricle.

2. Oxygen-poor blood is pumped to the lungs through the pulmonary arteries.

6.2 VALVES IN THE HUMAN HEART

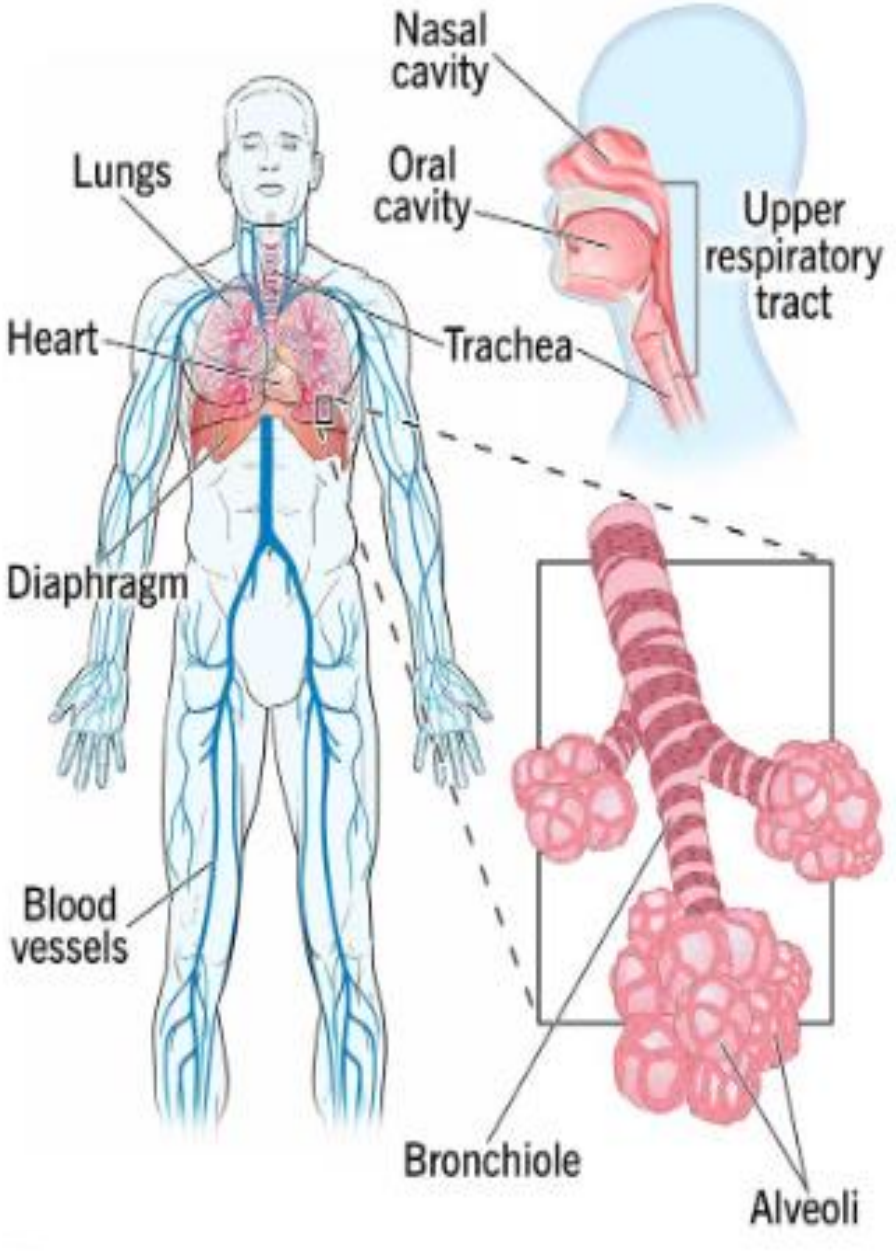
1. **Four valves** in your heart make sure blood flows in only one direction through your heart. Your heart's valves are:
    1. **Mitral** (between your left atrium and left ventricle).
    2. **Tricuspid** (between your right atrium and right ventricle).
    3. **Aortic** (between your left ventricle and aorta).
    4. **Pulmonary** (between your right ventricle and pulmonary artery).

6.2 CONDITIONS & DISORDERS OF THE CARDIOVASCULAR SYSTEM

- **Arrhythmia (abnormal heart rhythm)** refers to the condition where the heart is beating too fast when you're at rest or just not beating in a regular pattern.
- **Heart attack (myocardial infarction)** is a medical emergency where your heart muscle begins to die due to low blood flow. A blockage in the arteries that supply blood to your heart usually causes this. If a healthcare provider doesn't restore blood flow quickly, a heart attack can cause permanent heart damage and death.
- **Heart valve disease** refers to any of several conditions that prevent one or more of the valves in your heart from working correctly.
- Heart failure

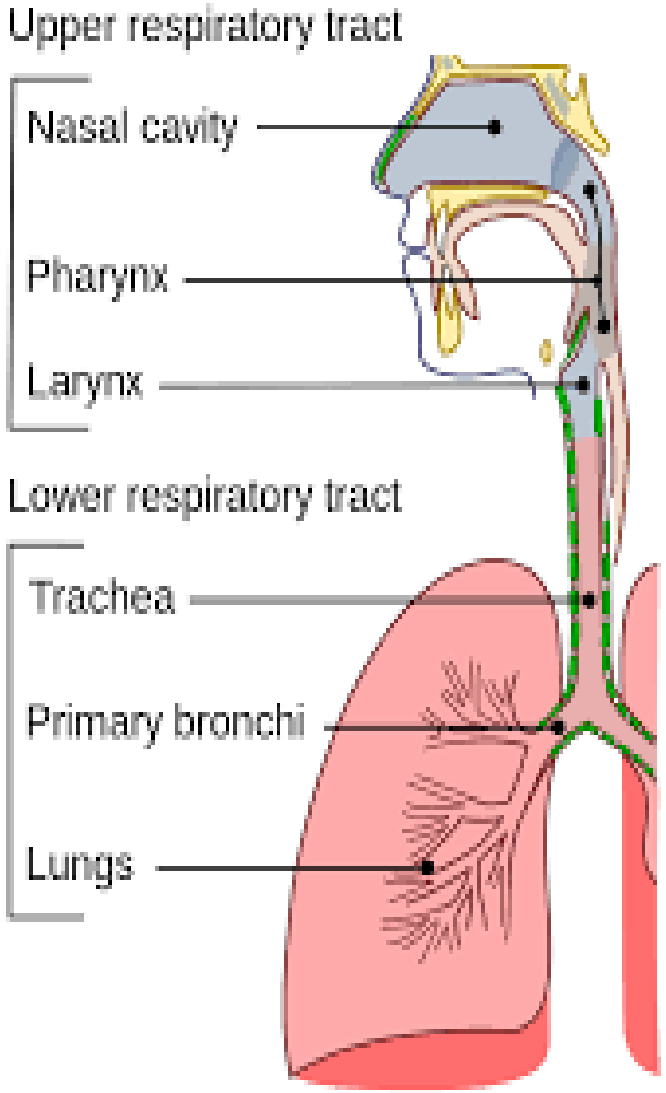
7. RESPIRATORY SYSTEM

1. **Respiratory system** is made up of your lungs, airways (trachea, bronchi and bronchioles), diaphragm, voice box, throat, nose and mouth.
2. **The respiratory system** works with the circulatory system to provide this oxygen and to remove the waste products of metabolism.
3. **Other functions:**
   a) Warms and adds moisture to the air you breathe in to match the temperature & humidity level required.
   b) Helps protect you from harmful particles and germs
   c) It allows body to smell and speak.
   d) Too much carbon dioxide lowers blood's pH, making it acidic. By removing CO_2, respiratory system helps maintain the acid-base balance



7.1 UPPER RESPIRATORY TRACT

1. **Upper respiratory tract starts** with the nose and mouth, where air is pulled to your body. Other parts of your upper respiratory tract include your nasal cavity, sinuses (hollow areas in your cheeks and forehead) and larynx.
2. **Functions of upper respiratory tract:**
   a) draws air into your body and helps move it toward your lungs.
   b) It adds moisture to the air breathe.



7.2 UPPER RESPIRATORY TRACT

Nasal Cavity

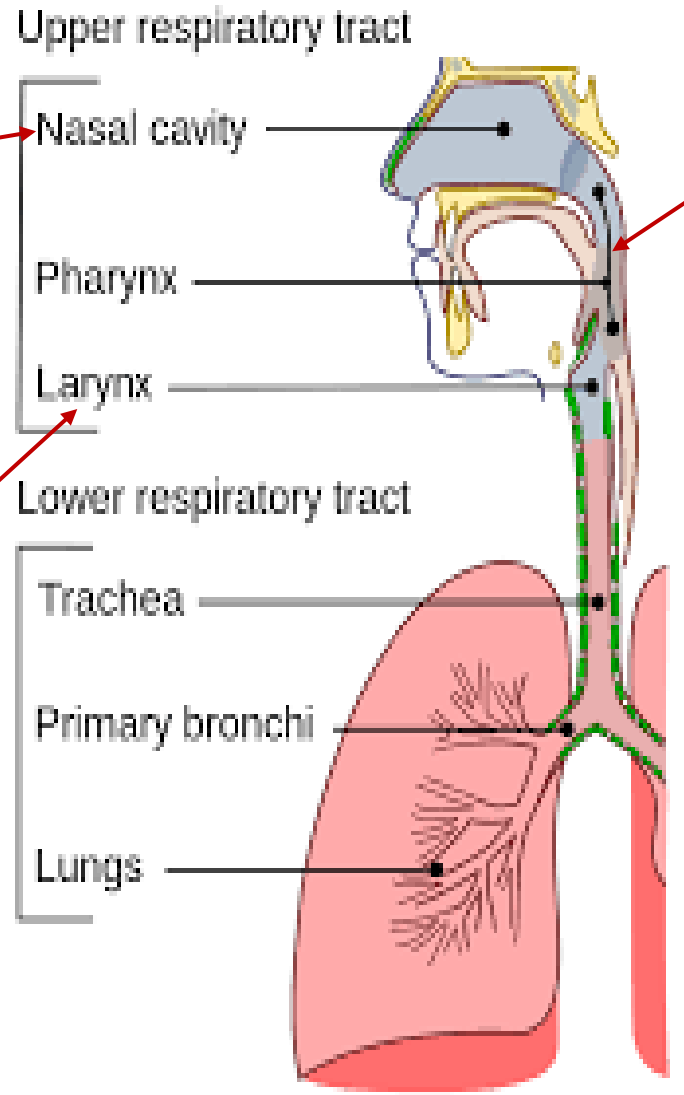
The role of the nasal cavity is:

1. humidify and warm the inspired air.
2. remove minute airborne particles and other debris before the air reaches the lower airways.

Larynx

The function of the larynx in humans and other vertebrates is:

1. to protect the lower respiratory tract from aspirating food into the trachea while breathing.
2. functions as a voice box for producing sounds, i.e., phonation.



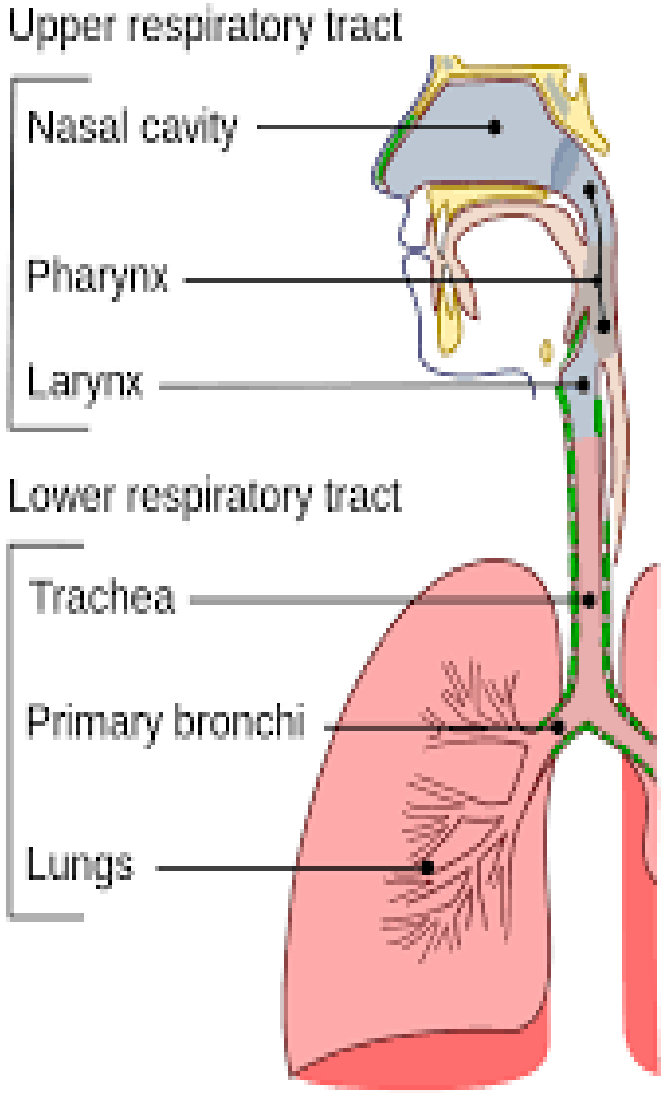
Pharynx:

The role of the pharynx is to:

1. Route air coming in your nose and mouth down to your larynx (voice box), which, in turn, moves air to your trachea and lungs.
2. Deliver food and liquid to your esophagus, which sends them on to your stomach.

7.3 LOWER RESPIRATORY TRACT

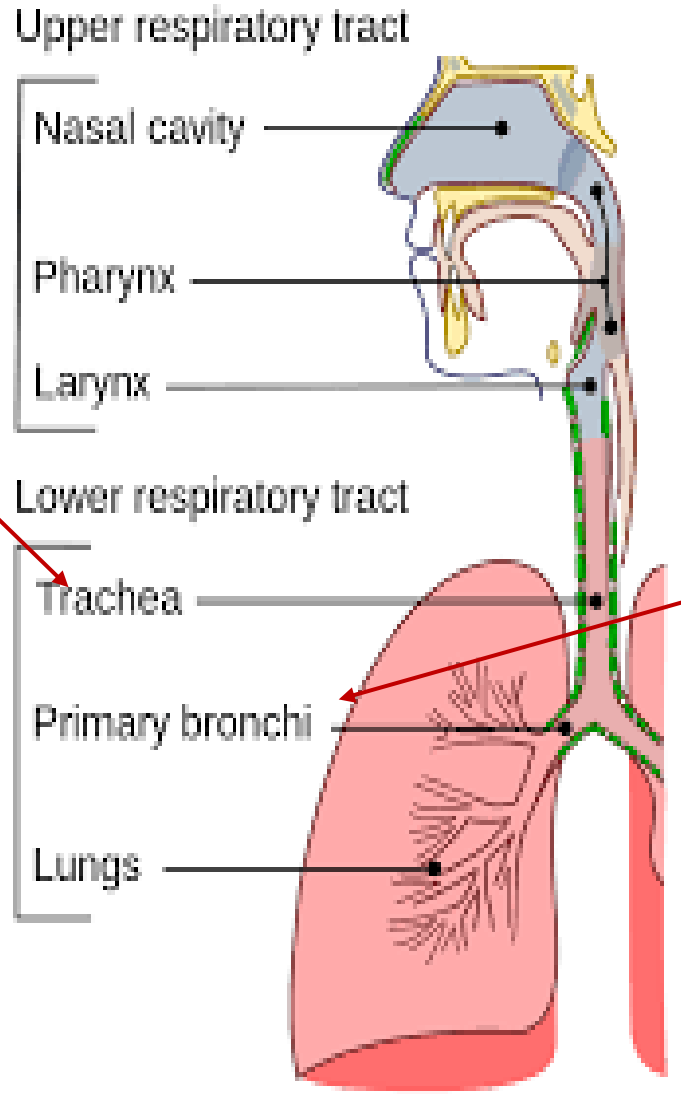
1. **Lower respiratory tract** include the windpipe (trachea) and within the lungs, the bronchi, bronchioles, and alveoli. Deep in the lungs, each bronchus divides into secondary and tertiary bronchi, which continue to branch to smaller airways called the bronchioles..
2. **Functions of lower respiratory tract:**
   a) draw in air from the upper respiratory system
   b) absorb the oxygen
   c) release carbon dioxide.



7.4 LOWER RESPIRATORY TRACT

Trachea has three functions:

1. Provide a safe, sturdy passageway for air to travel from the mouth or nose to the lungs.
2. Prevent the passage of foreign objects into the respiratory system.
3. Regulate the temperature and humidity of air passing into the lungs



Bronchi carry air to and from your lungs.

Bronchi help moisturize the air you breathe and screen out foreign particles.

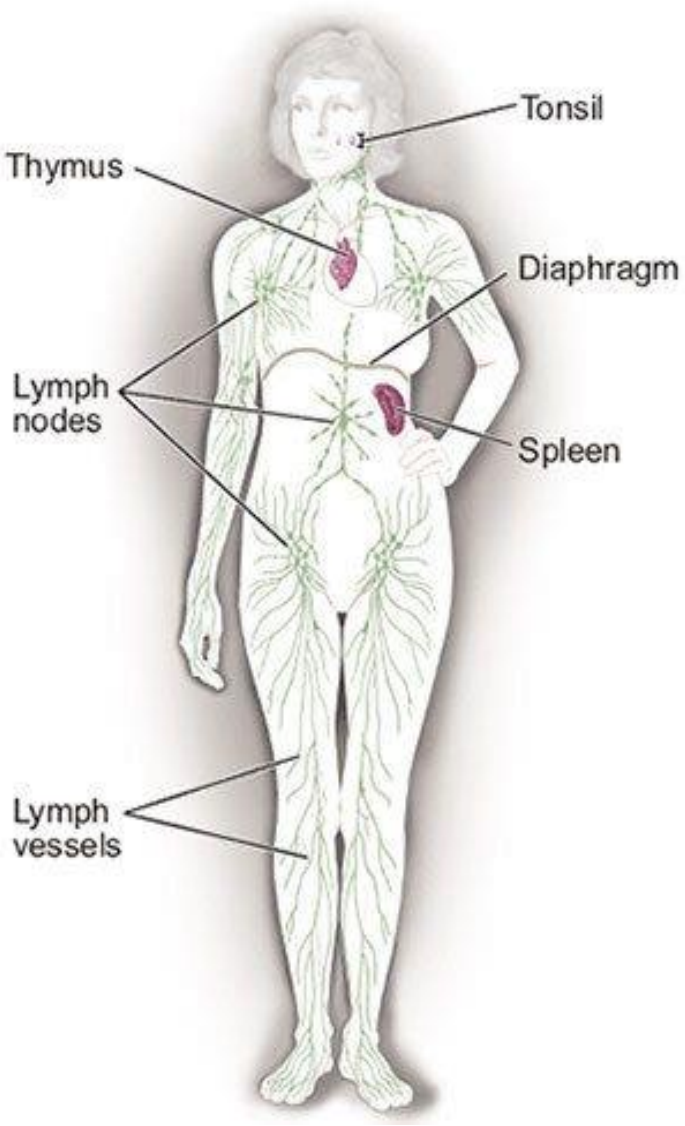
Bronchi are lined with cells that create mucus. The mucus keeps your airways moist. It also traps bacteria, viruses, fungi and other particles to protect your lungs and prevent infection.

7.5 CONDITIONS & DISORDERS OF THE RESIRATORY SYSTEM

1. **Asthma:** Chronic inflammation in your airways that makes it difficult to breathe.
2. **Bronchiectasis:** When your bronchi widen and scar, causing you to cough up mucus.
3. **Bronchitis:** Inflammation or infection in your bronchi that may be short-term (acute) or long-lasting (chronic).
4. **Bronchiolitis:** A viral lung infection of the bronchioles.
5. **Bronchopulmonary dysplasia:** A breathing condition that occurs when an infant's lungs do not develop properly.

8. LYMPHATIC SYSTEM

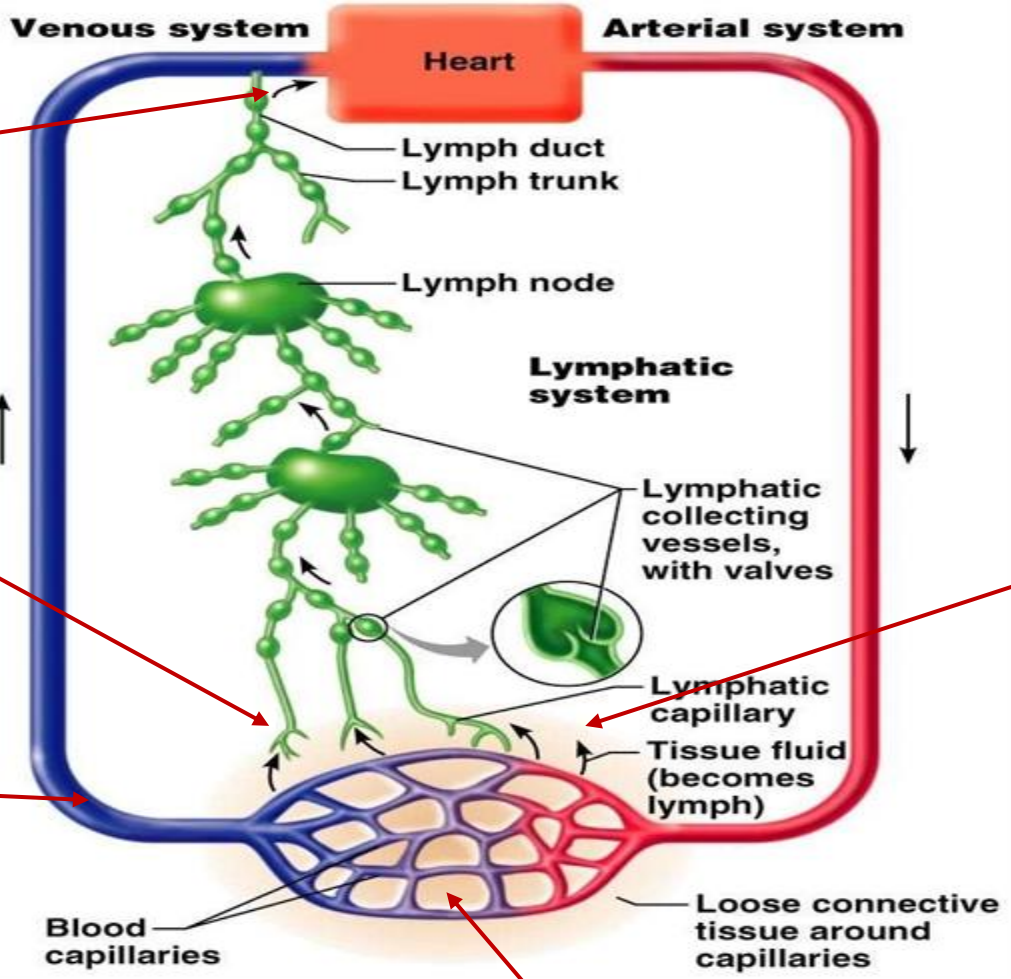
1. **Lymphatic system (or lymphoid system)** is a group of organs, vessels and tissues that protect you from infection and keep a healthy balance of fluids throughout your body.
2. It consists of a large network of lymphatic vessels, lymph nodes, lymphoid organs, lymphatic tissue and lymph.
3. **Functions of the lymphatic system are:**
   a) **Collecting excess fluid from your body's tissues** and returning it to your bloodstream. Lymphatic system also filters out waste products and abnormal cells from this fluid.
   b) **Helping your body absorb fats**. Most nutrients can travel through tiny openings (pores) in the walls of your capillaries, and your body can then absorb and use them. But certain fats and other molecules are too large to travel in this way. The lymphatic system collects such nutrients from the intestines into the bloodstream.
   c) **Protecting your body against invaders**. The lymphatic system immune system produces and releases lymphocytes (a type of white blood cell) and other immune cells. These cells look for and destroy invaders, e.g. bacteria, viruses, parasites and fungi.



6. Lymph is emptied into the subclavian veins and re-enters the blood circulation system.

5. Lymphatic capillaries pick up this remaining 3 litres of fluid (now called lymph) from the tissues.

4. About 17 liters of plasma return to your bloodstream in this way.



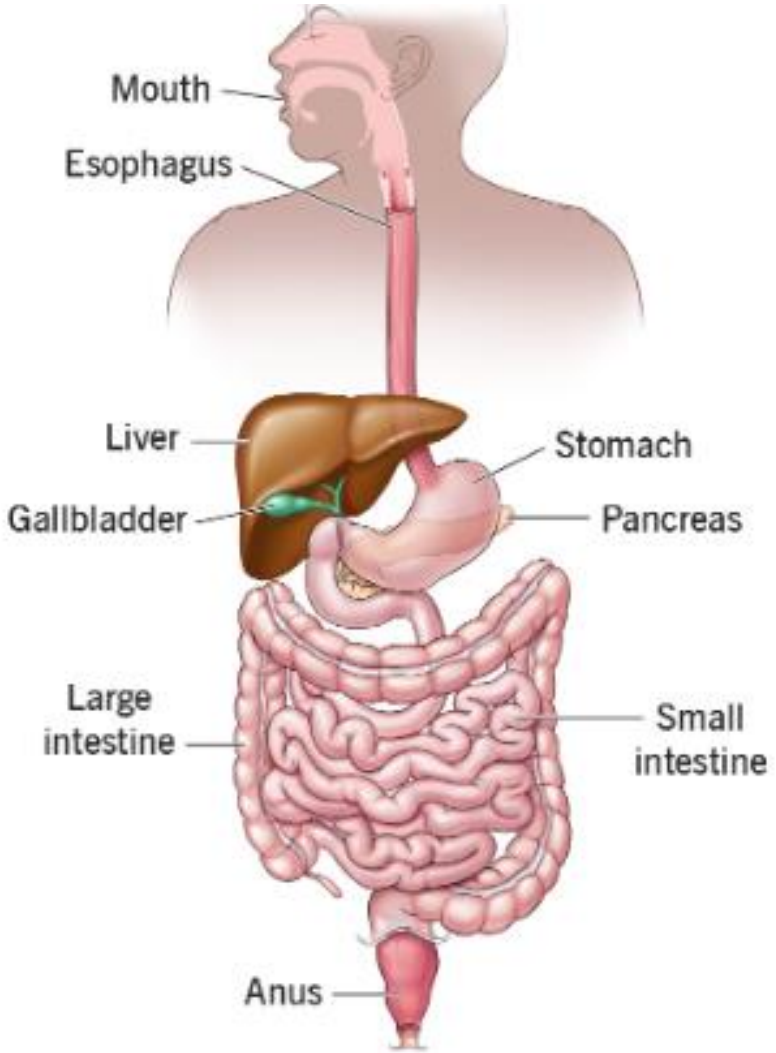
1. Every day, about 20 liters of plasma (the liquid part of your blood) flow out of tiny pores in the thin walls of your capillaries.

2. The tissues soak up the nutrients while leaving behind waste.

3. Plasma picks up the waste and returns it to the bloodstream the same way it came, i.e by flowing back through the pores in your capillary walls.

9. DIGESTIVE SYSTEM

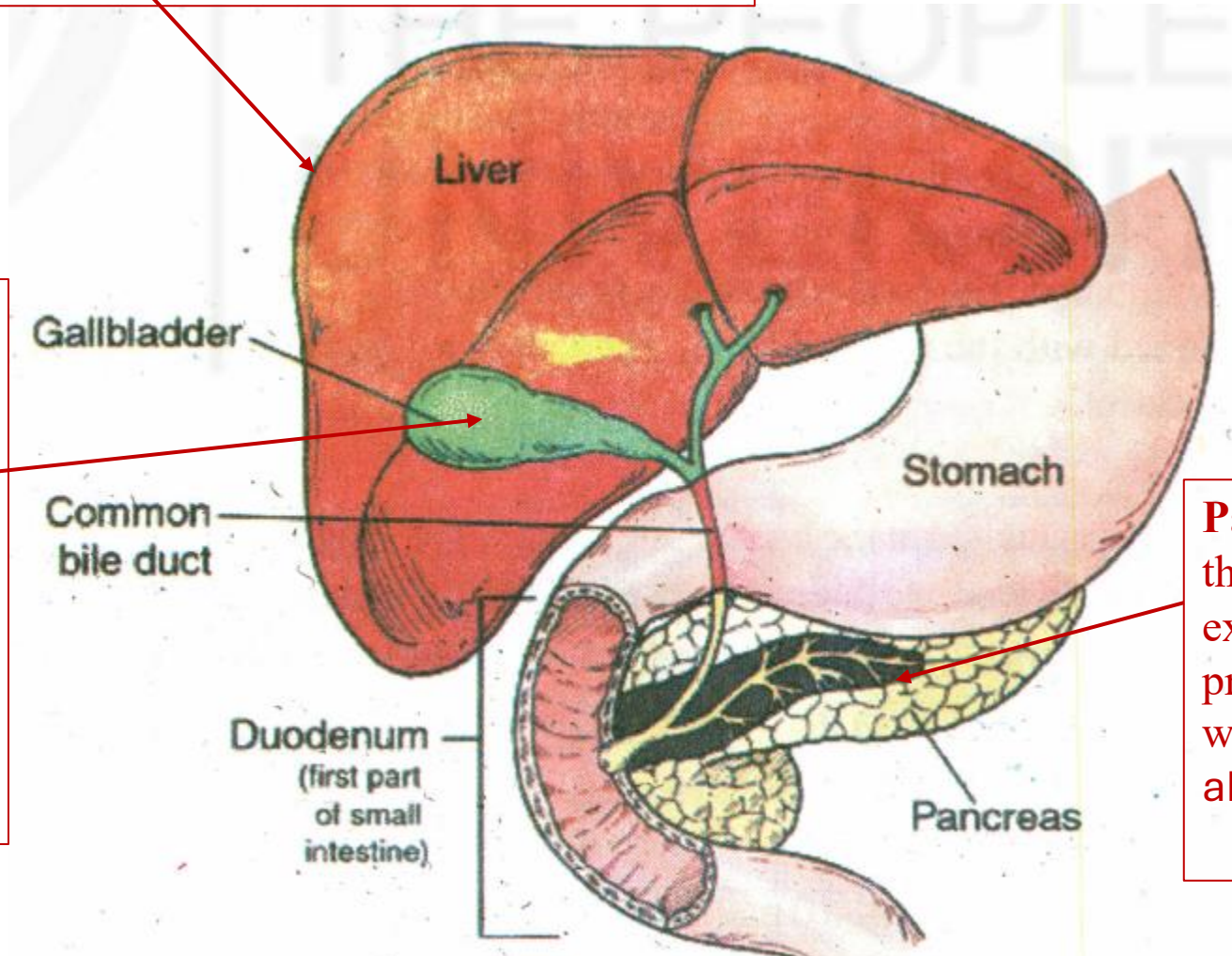
1. **Digestive system** is a network of organs that help you digest and absorb nutrition from your food. It includes:
   a) Gastrointestinal (GI) tract
   b) Biliary system.
2. **Gastrointestinal tract (GI)** is a series of hollow organs that are all connected to each other, leading from your mouth to your anus.
3. **Biliary system** is a network of organs that deliver bile and enzymes through the bile ducts to the GI tract . Biliary system includes your liver, gallbladder, pancreas and bile ducts.



THE BILLIARY ORGANS-LIVER, GALL BLAGGER & PANCREAS

- **Liver** is the largest gland in the body situated in the upper most part of the abdominal cavity on the right side below the diaphram.
- **Bile** is formed in the liver cells and passes through the bile duct to the gall bladder.

1. **Gall bladder** acts as a store house of bile.
2. With the help of contraction of gall bladder the bile is poured into the middle part of the small intestines which helps in dissolving the fats during digestion.



Pancreas is responsible for the production of insulin and exocrine function is production of pancreatic juice which helps in digestion. It is about 7 inches long.

DIGESTIVE CONDITIONS & DISORDER – SHORT TERM /01

Short-term or temporary conditions that affect the digestive system include:

1. **Constipation:** Constipation generally happens when you go poop (have a bowel movement) less frequently than you normally do. When you're constipated, your poop is often dry and hard and it's difficult and painful for your poop to pass.
2. **Diarrhea:** Diarrhea is when you have loose or watery poop. Diarrhea can be caused by many things, including bacteria.
3. **Heartburn**: Although it has "heart" in its name, heartburn is actually a digestive issue. Heartburn is an uncomfortable burning feeling in your chest that can move up your neck and throat. It happens when acidic digestive juices from your stomach go back up your esophagus.
4. **Hemorrhoids:** Hemorrhoids are swollen, enlarged veins that form inside and outside of your anus and rectum. They can be painful, uncomfortable and cause rectal bleeding.

DIGESTIVE CONDITIONS & DISORDER – SHORT TERM /02

6. **Stomach flu (gastroenteritis):** The stomach flu is an infection of the stomach and upper part of the small intestine usually caused by a virus. It usually lasts less than a week. Millions of people get the stomach flu every year.

7. **Ulcers:** An ulcer is a sore that develops on the lining of the esophagus, stomach or small intestine. The most common causes of ulcers are infection with a bacteria called Helicobacter pylori (H. pylori) and long-term use of anti-inflammatory drugs such as ibuprofen.
8. **Gallstones:** Gallstones are small pieces of solid material formed from digestive fluid that form in your gallbladder, a small organ under your liver.