Shri Swami Vivekanand Shikshan Sanstha's

Vivekanand College, Kolhapur (Empowered Autonomous)

Department of Zoology

INDEX

Dr. Sneha Sampatrao Desai

M.Sc. Ph.D. SET

Department of Zoology

Vivekanand College Kolhapur (Empowered Autonomous)

BLOOD AND ITS COMPOSITION

DR. SNEHA S. DESAI

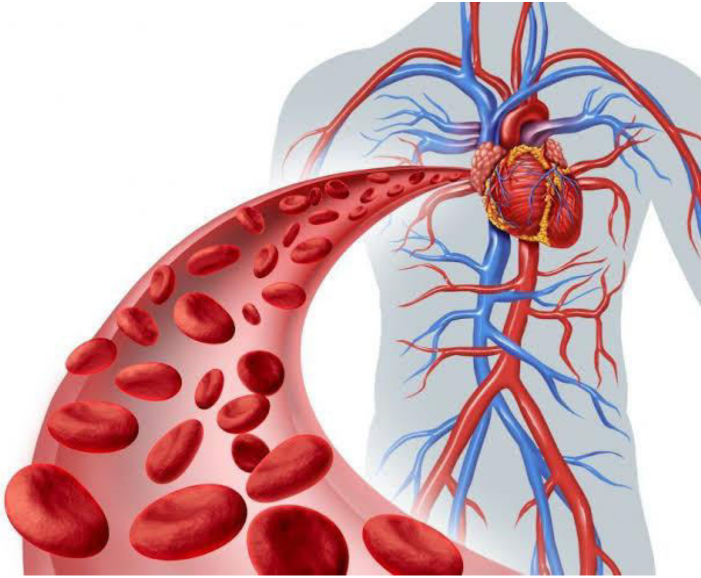
M.Sc. Ph.D. SET

Department of Zoology

Vivekanand College Kolhapur (Empowered Autonomous)

BLOOD

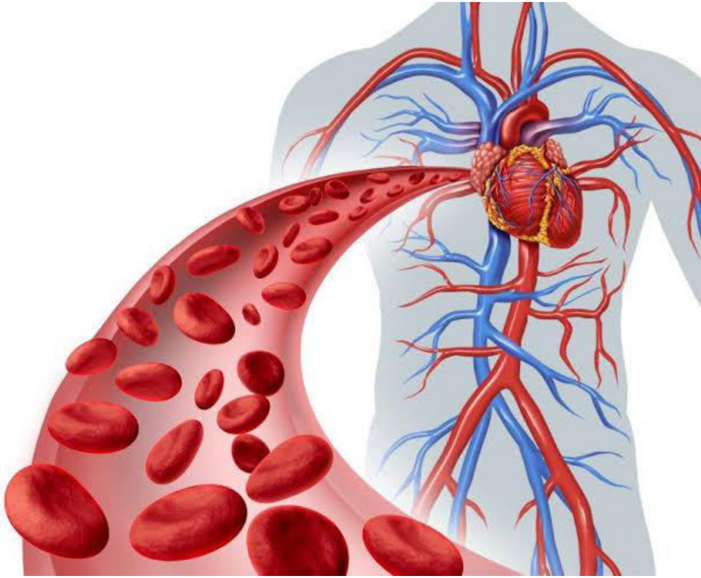
- Blood is fluid connective tissue. It is consider as fluid of life because it carries oxygen from lungs to all parts of the body and carbon dioxide from all parts of body to the lungs.



- It is known as fluid of growth because it carries nutritive substances from the digestive system and hormones from endocrine gland to all the tissue

- The blood is also called the fluid of health because it protects the body against the diseases and get rid of waste products and unwanted substances by transporting them to the excretory organ like kidney.

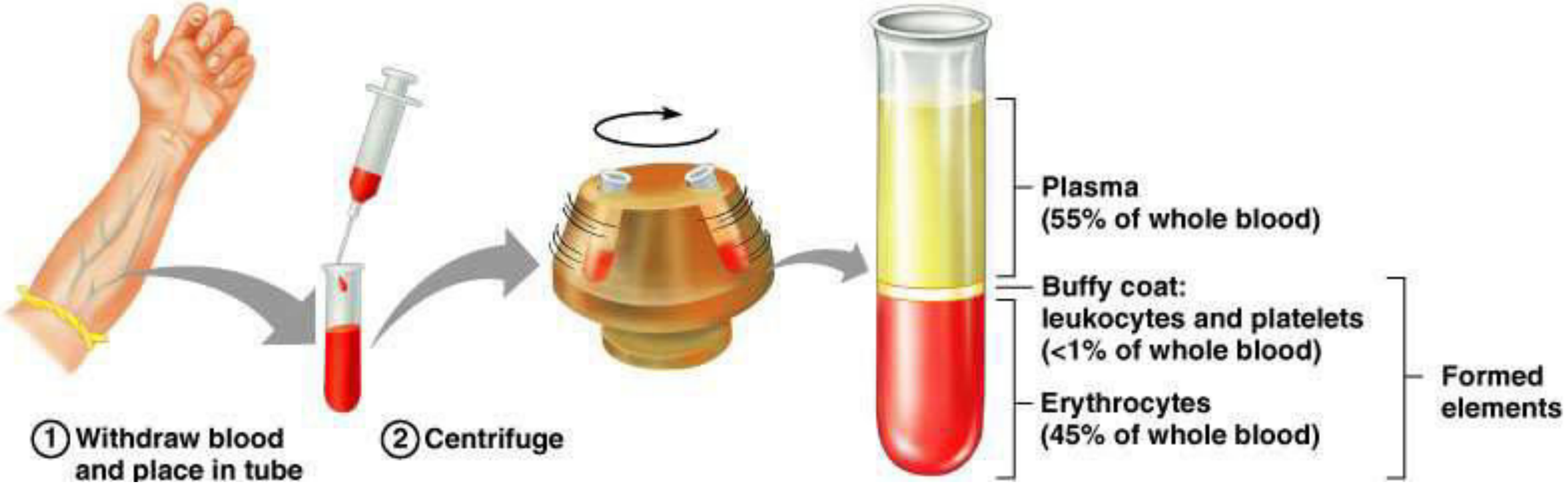
- Color: Scarlet red and Purple red
- Volume: In new born-450 ml
- Normal healthy adult-5-6 L
- pH: Slightly alkaline 7.35-7.45
- Viscosity: 5 times more than water, it is mainly due to red blood cells and plasma protein
- 8% of total body weight
- Study of blood is called haematology

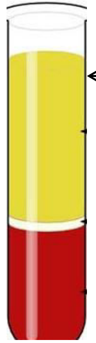


Component of blood

Blood plasma

Formed elements





55%

Blood Plasma

- 90-92% Water
- 8-10% Solutes

Protein- 7%
- Synthesized in liver
- Albumin-54%
- Globulins-38%
- Fibrinogen-4%

Gases
- Oxygen
- Carbon dioxide

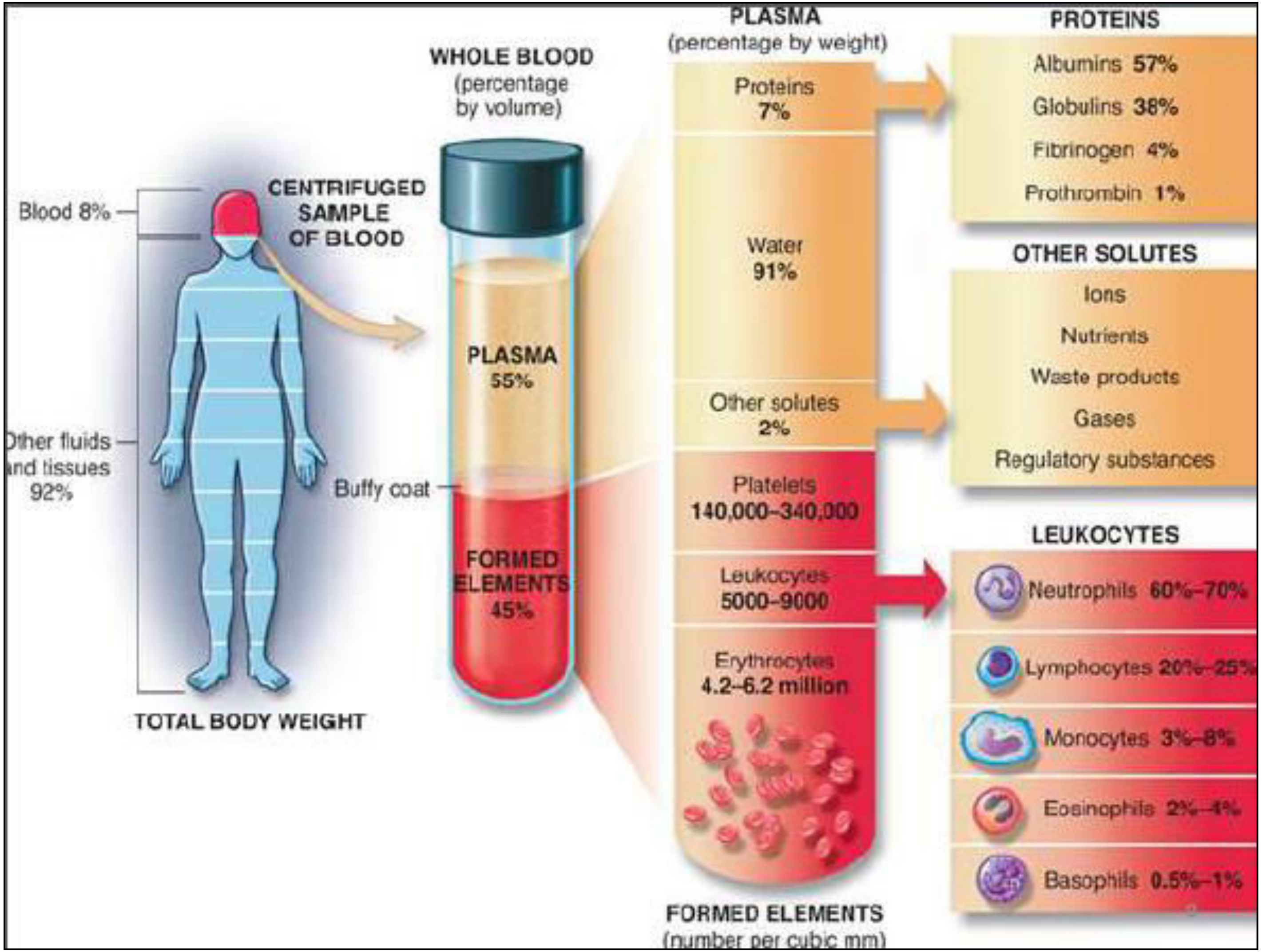
Nutrients
- Glucose
- Amino acids
- Fatty acids

Nitrogenous waste
- Urea
- Uric acid
- Creatinine

Regulators
- Hormones
- Vitamins

- Salts

Serum=Plasma- fibronogen



Blood 8%
Other fluids and tissues 92%
TOTAL BODY WEIGHT
CENTRIFUGED SAMPLE OF BLOOD
WHOLE BLOOD (percentage by volume)
PLASMA 55%
Buffy coat
FORMED ELEMENTS 45%
PLASMA (percentage by weight)
Proteins 7%
Water 91%
Other solutes 2%
Platelets 140,000–340,000
Leukocytes 5000–9000
Erythrocytes 4.2–6.2 million
FORMED ELEMENTS (number per cubic mm)
PROTEINS
Albumins 57%
Globulins 38%
Fibrinogen 4%
Prothrombin 1%
OTHER SOLUTES
Ions
Nutrients
Waste products
Gases
Regulatory substances
LEUKOCYTES
Neutrophils 60%–70%
Lymphocytes 20%–25%
Monocytes 3%–8%
Eosinophils 2%–4%
Basophils 0.5%–1%

Functions of Plasma Proteins

•Role in blood coagulation (Fibrinogen).

•Role in Defense Mechanism: γ-globulins act as antibodies, also called immunoglobulins

•Role in transport mechanism: Albumin, α and β- globulins are responsible for the transport of hormones and enzymes, lipids

Role in viscosity of blood: Plasma proteins provide viscosity which is essential for maintaining BP. Albumin provides maximum viscosity.

•Role as reserve proteins: Act as last source of energy in case of starving or inadequate food intake

Formed Element 45%

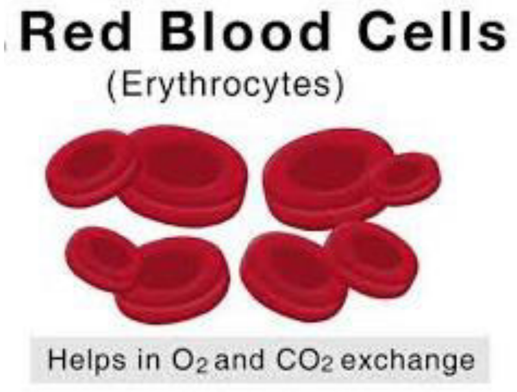
1. Red Blood Cells (RBCs)
2. White blood cells (WBCs)
3. Platelets

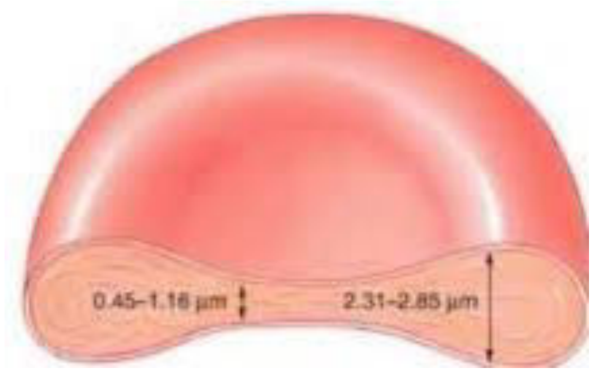
The process by which the formed elements of blood develop is called **hemopoiesis** or **hematopoiesis.**

- Before birth- first occur in yolk sac of embryo & later in liver, spleen, thymus and lymph nodes of fetus
- Last three month before birth and in adult- Red bone marrow

Red Blood Cells (RBCs)

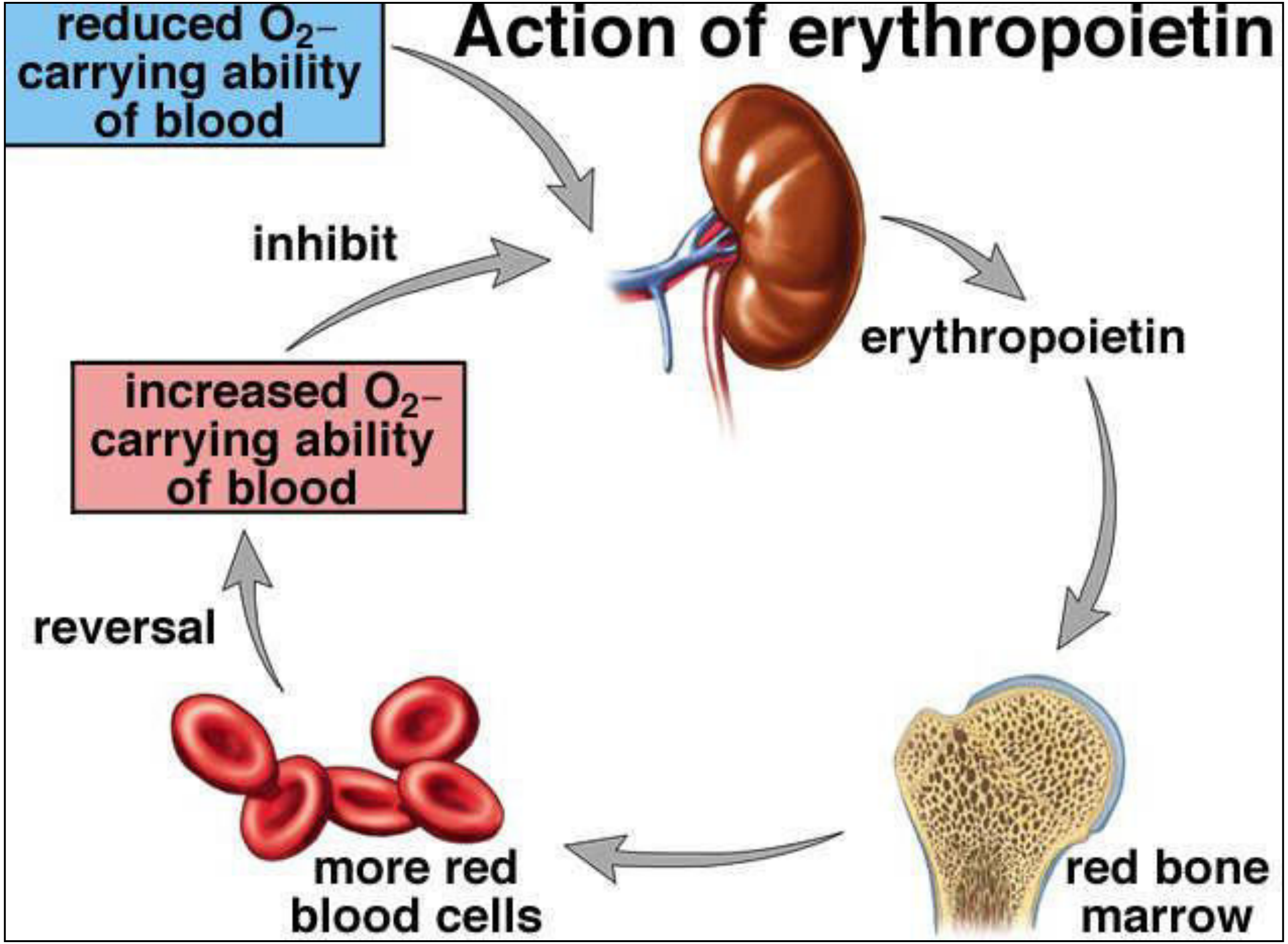
- Also called erythrocytes, Dimeter-7.2µ
- Shape-circular, biconcave and enucleated i.e. mature RBCs does not contain nucleus
- Cytosol of RBCs contain oxygen carring protein- Hemoglobin
- Adult Male- 5.4 million RBCs per microlitre
- Adult female- 4.8 million RBCs per microlitre
- Life span- 120 days





- The process of formation of RBCs- Erythropoiesis
- The hormone Erythropoietin produced by kidney stimulates the bone marrow for production of RBCs.
- Before birth- liver & spleen
- Adult-Red bone marrow
- Destroy- liver and spleen (graveyard of RBCs)
- Increase in number of RBCs- Polycythemia
- Decrease in number of RBCs- Erythrocytopenia

Action of erythropoietin



White blood cells (WBCs)

- Also called leukocytes
- They are colurless, nucleated and amoeboid cells larger than RBCs
- Average-5000 to 11000 WBCs per mm3
- Increase in WBCs- leucocytosis; more than 11,000 cells/mm3 indicates infection
- Decrease in number WBCs- leucopenia; abnormally low, usually due to corticosteroids and chemotherapy.
- Body increases amount of WBCs in response to infection
- Diapedesis: Due to their amoeboid movement they can move out of the capillary walls
- Life span- 3 to 5 days

❖Functions of WBC's

- WBC's generally play an important role in the defense mechanism of the body.
- In the defense mechanism each type of WBC's act in a different way

❖Leukemia:

- Characterized by abnormal and uncontrolled increase in WBC's, above 1000,000/cumm.
- Also called blood cancer.
- All the WBC's may not increase at one time.

Types of WBCs

Granulocytes

WBCs with a granular cytoplasm

Lobulated nuclei in different shapes

72% of total WBCs

Formed from myeloid stem cell

- **Neutrophils**
- **Basophils**
- **Eosinophils**

Agranulocytes

WBCs without granular cytoplasm

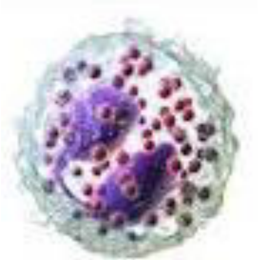
Nuclei are larger in size but not lobulated

28% of total WBCs

Formed from lymphoid stem cell

- **Monocytes**
- **Lymphocytes**





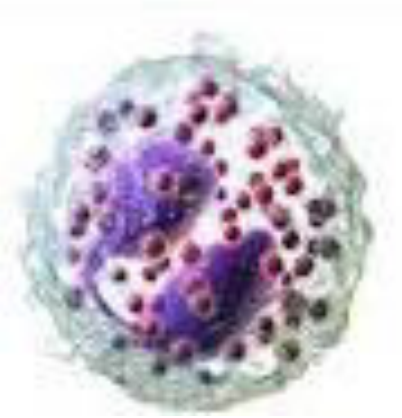
NEUTROPHILS

- Also known as polymorphonuclear leucocytes because the nucleus is multilobed. The number of lobes varies from 1-6
- Granules are very fine, large in number, evenly distributed
- Stained with neutral stain
- About 60-70% total WBCs
- Function- Phagocytosis
- Diameter= 10-12μ
- Neutrophils provide Ist line of defense.
- They wander freely through out the body.
- Released in large number from the blood.

BASOPHILS

- Cells have few granules of large size
- Stain with basic stain- methylene blue
- Nucleus is bilobed
- Diameter = 8-10μ
- 05-1% of total WBCs
- Function- Allergic reaction
- Basophils execute functions by releasing important substances from their granules such as heparin and histamines, serotonin, proteases and myeloperoxidases and interleukin-4- inflammatory responses

EOSINOPHILS



- Granules stained with acidic stained like eosin
- 1-3 % of total WBCs
- Nucleus is bilobed
- Diameter=10-14µ
- Antihistamine property
- Provides defense **against parasitic infections and allergic conditions**.
- They are responsible for detoxification, disintegration and removal of foreign proteins.

LYMPHOCYTES

- Smallest of all WBCs, Cytoplasm clear without granules
- Large spherical, bean or kidney shaped nucleus
- 20-25% of total WBCs
- Depending upon functions they are further divided into: 2 types

a. B lymphocytes   b. T lymphocytes

- B lymphocytes- Formed & mature in bone marrow, involved in antibody production

  -concerned with humoral immunity

- T lymphocytes-Formed in bone marrow but mature in thymus

  - concerned with cellular immunity

- These are responsible for development of immunity.

MONOCYTES

- Largest of all WBCs, Diameter = 14-18μ
- Cytoplasm clear without granules
- Large bean or kidney shaped nucleus
- 3-5% of total WBCs
- Matured monocytes stay in blood for few hours.
- After which they enter the tissues and become tissue macrophages.
- Monocytes differentiated into macrophages
- Function- Mainly phagocytic and destroy the bacteria and dead or damaged tissue by phagocytosis

PLATELETS

- Also called thrombocytes
- Formed from large cell megakaryocytes
- Small, oval shaped cell fragment without nucleus
- Normal count- 1.5-3.5 lakh/mm3
- Decrease number- thrombocytopenia
- **function- blood clotting**
- They also seal the ruptured blood vessels by formation of platelet plug/ thrombus
- They secrete serotonin a local vasoconstrictor
- Circulation in blood – 8-12 days

THROMBOPOIESIS

- Platelets are produced in bone marrow, by budding off from megakaryocytes.
- Megakaryocyte and platelet production is regulated by thrombopoietin, a hormone. It is usually produced by the liver and kidneys
- Each megakaryocyte produces between 5,000 and 10,000 platelets.
- Old platelets are destroyed by phagocytosis in the spleen and by Kupffer cells in the liver

THANK YOU

HEMOGLOBIN STRUCTURE AND FUNCTION

DR. SNEHA SAMPATRAO DESAI

M.Sc. Ph.D. SET

Department of Zoology

Vivekanand College Kolhapur (Empowered Autonomous)

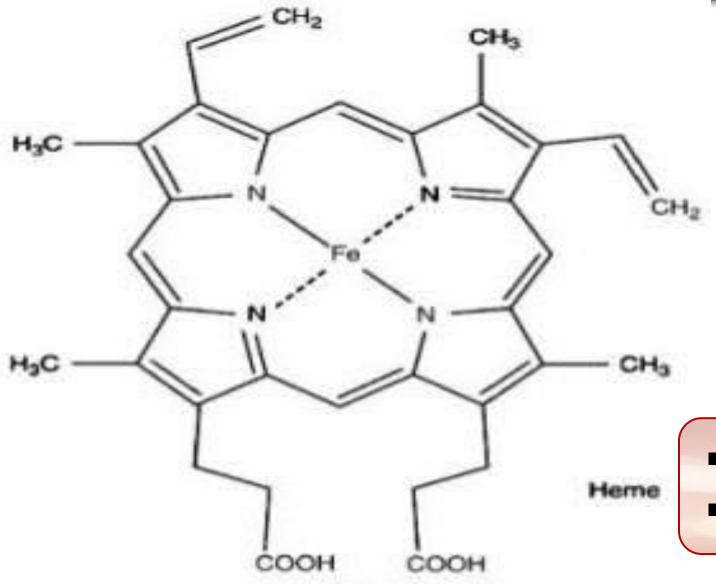
HEMOGLOBIN

- Hemoglobin is iron containing protein present in RBCs.
- It is chromoprotein
- Function of Hemoglobin to carry respiratory gases i.e. O2 and CO2
- It also act as buffer

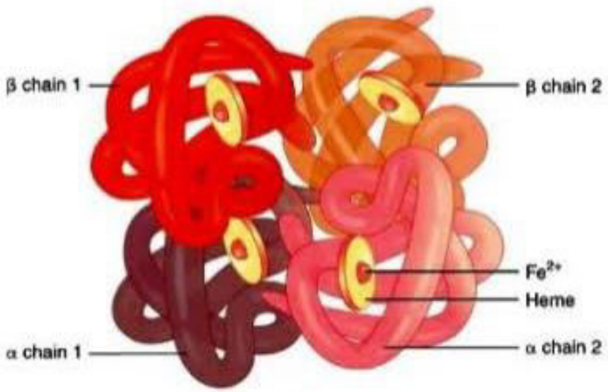
Age	Hb content
Birth	25gm/dl
After 3 month	20gm/dl
1 yr	17gm/dl
Puberty onward	14-16gm/dl

Hemoglobin

- Heme — Pigment part
  - Iron (Ferrous form Fe++)
  - Porphyrin — Tetra-pyrol e linked to Fe++
- Globin — Protein part
  - 2 α — 141 amino acid
  - 2β — 146 amino acid



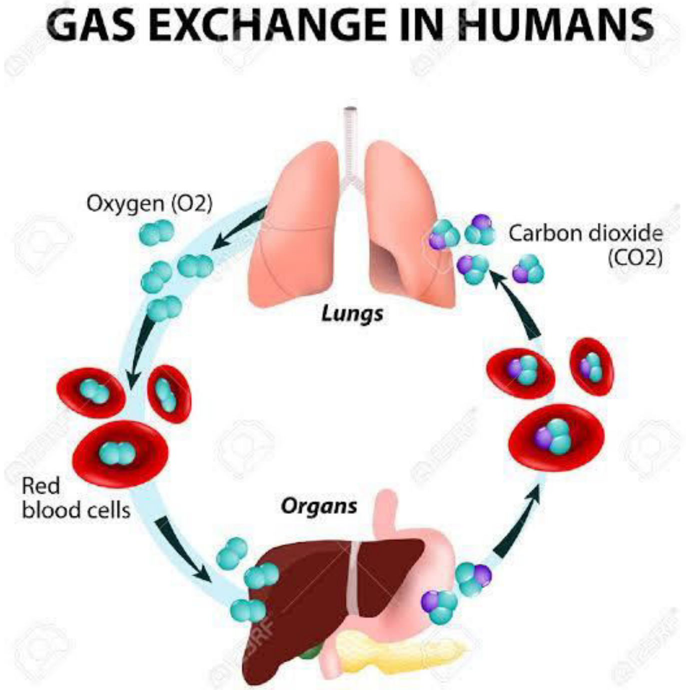
Heme



- 1 hemoglobin carry 4 oxygen molecule
- Each RBCs contain 250 -280million Hemoglobin molecule

Oxygenation of hemoglobin

$$Hb + O_2 \underset{\text{tissues}}{\overset{\text{lungs}}{\rightleftharpoons}} HbO_2$$



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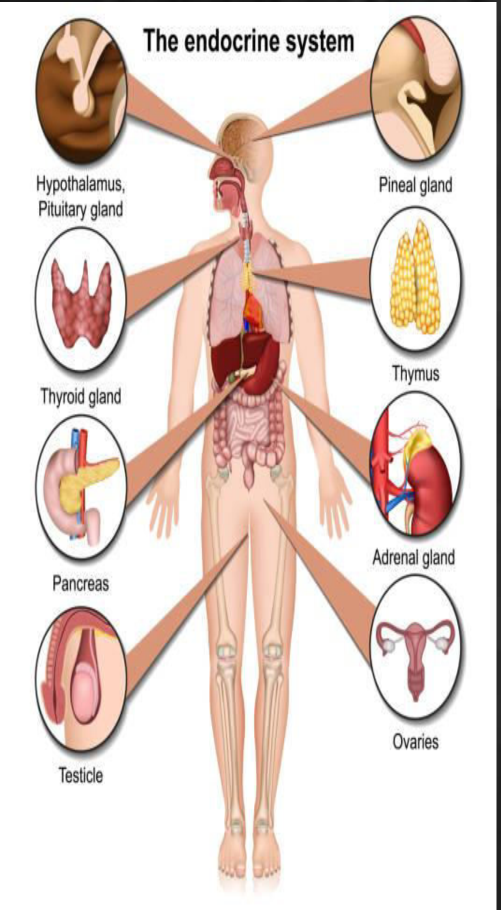
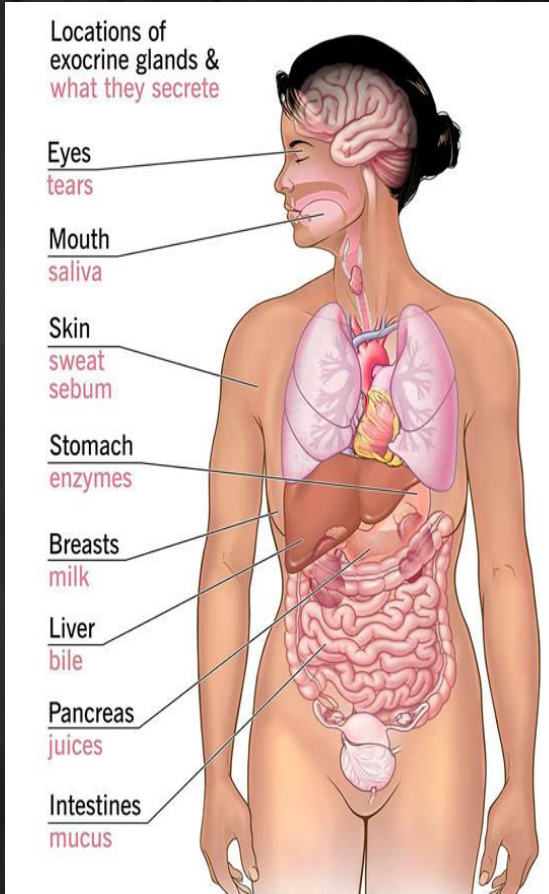
Gland and its types



DR. SNEHA SAMPATRAO DESAI
M.Sc. Ph.D. SET
Department of Zoology
Vivekanand College Kolhapur
(Empowered Autonomous)



Gland and its types

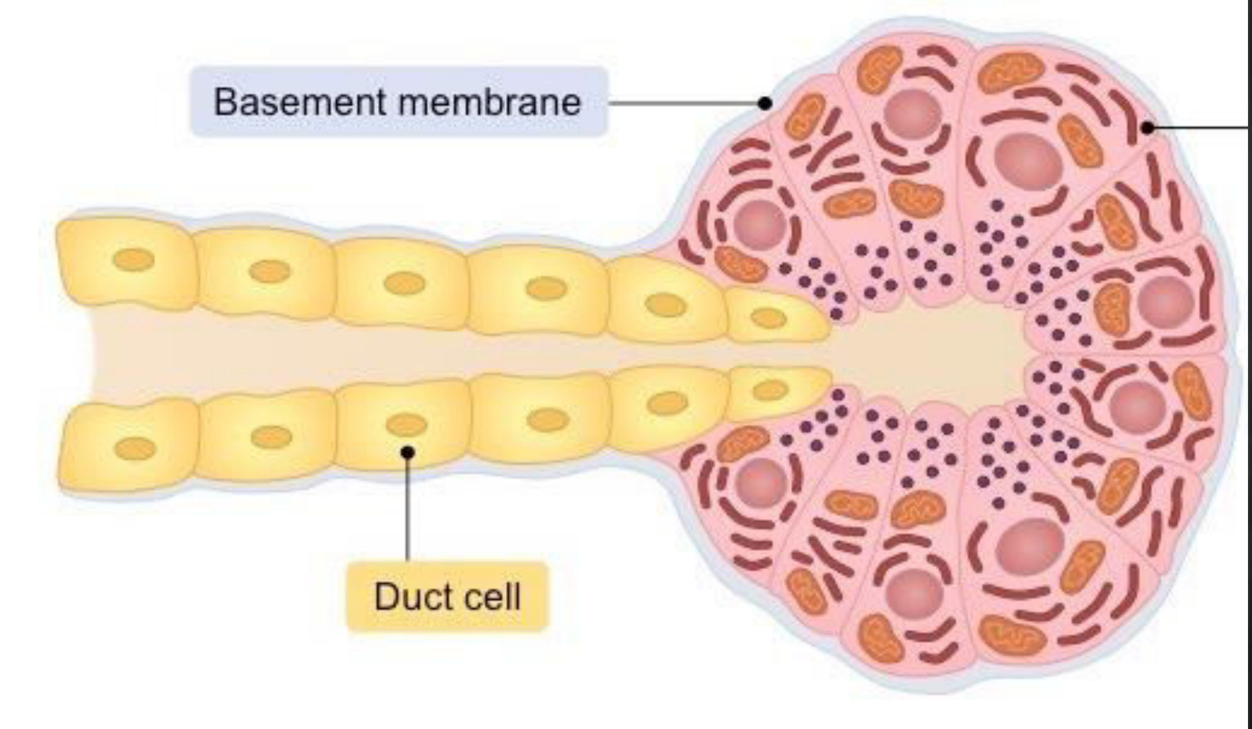
❑. Gland is specialized cell or organ that synthesize chemical substances and secreted them either in duct or directly in bloodstream

Gland types

Exocrine gland

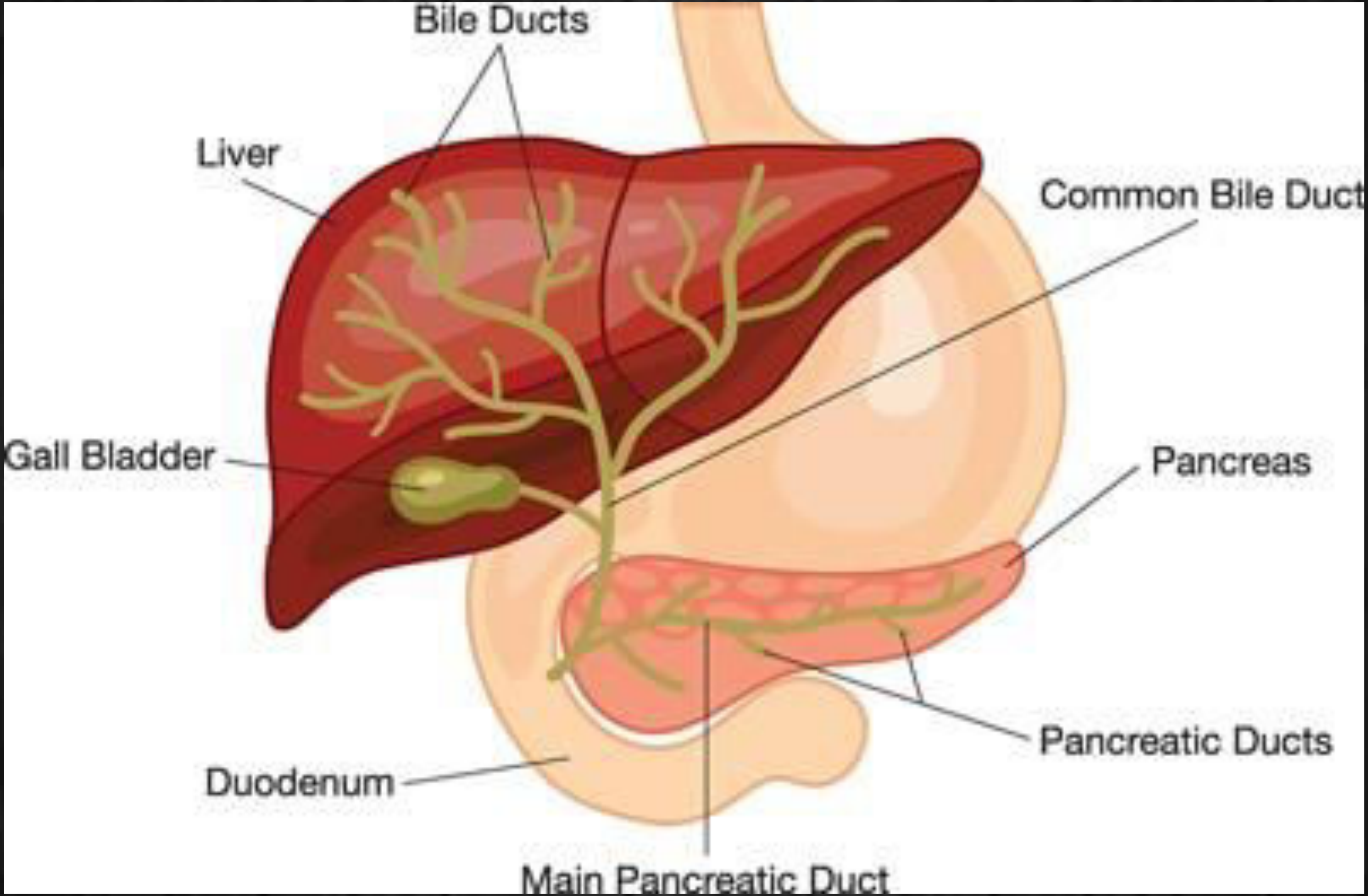
Endocrine gland

Exocrine gland

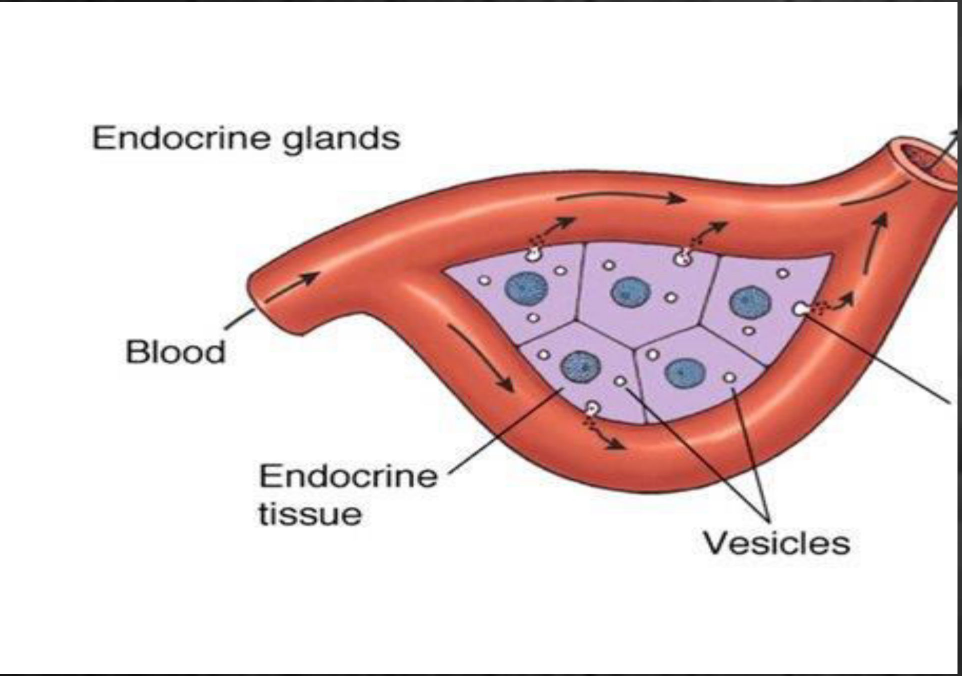


- Secretion via duct

- Secretion -Enzymes

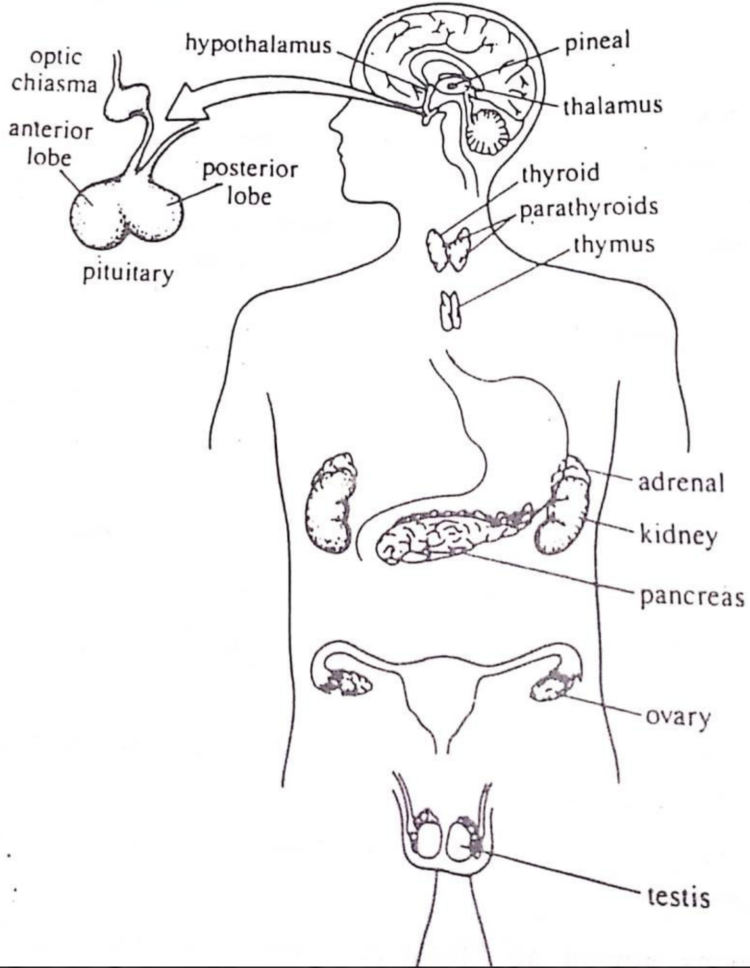

Bile Ducts
Liver
Common Bile Duct
Gall Bladder
Pancreas
Pancreatic Ducts
Duodenum
Main Pancreatic Duct

Endocrine gland

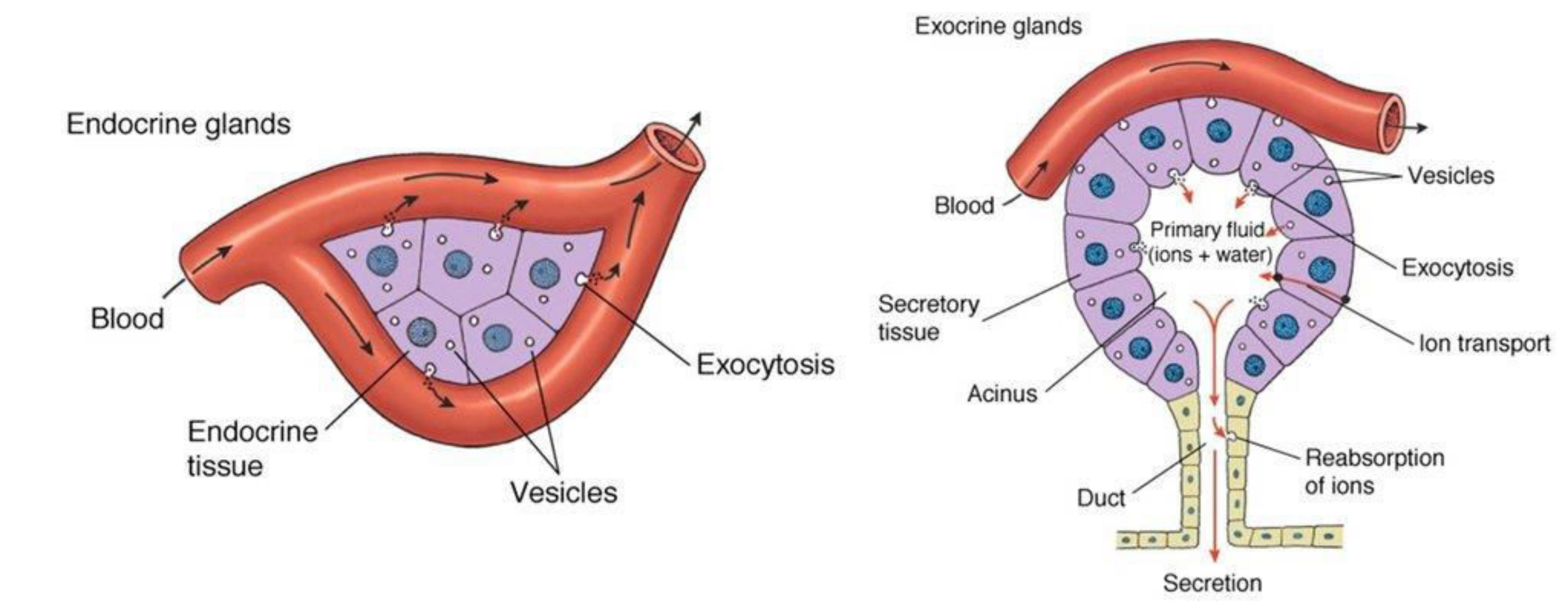


- Secretion directly into blood

- Secretion- Hormones


optic
chiasma
hypothalamus
pineal
thalamus
anterior
lobe
posterior
lobe
pituitary
thyroid
parathyroids
thymus
adrenal
kidney
pancreas
ovary
testis

Difference between exocrine and Endocrine gland



THANK YOU

IMMUNE SYSTEM

DR. SNEHA SAMPATRAO DESAI

M.Sc. Ph.D. SET

Department of Zoology

Vivekanand College Kolhapur (Empowered Autonomous)

IMMUNE SYSTEM

Definition	Immunology is the science that is concerned with immune responses to foreign challenges
Antigen	Any foreign substance invading body and capable of stimulating immune responses
Antibody	The protective chemicals produced by immune cells in response to antigen

Immunity (L. immunis-exempt or freedom): refers to the general ability of a body to recognize, neutralize/ destroy and eliminate foreign substances or resist particular infection or disease

Types

Innate Immunity	Acquired immunity
•Also called natural immunity •Present from birth •Inborn capacity to resist the pathogen •Non-specific response	•Immunity acquired during life •Also called adaptive immunity or specific immunity •Characteristics of vertebrates

1. Innate Immunity

- This type of immunity is present in an organism **by birth.**

- **Non specific immunity**

- Innate immunity includes **certain barriers and defence mechanisms** that keep foreign particles out of the body.

- Innate immunity refers to the body's **first line defence system.**

Innate Immunity Barrier

Anatomical/ Physical barrier

- Skin
- Mucous membrane

Physiological barriers

- Temperature
- pH
- Tear
- Interferons

Cellular barrier

- Neutrophils
- Macrophage

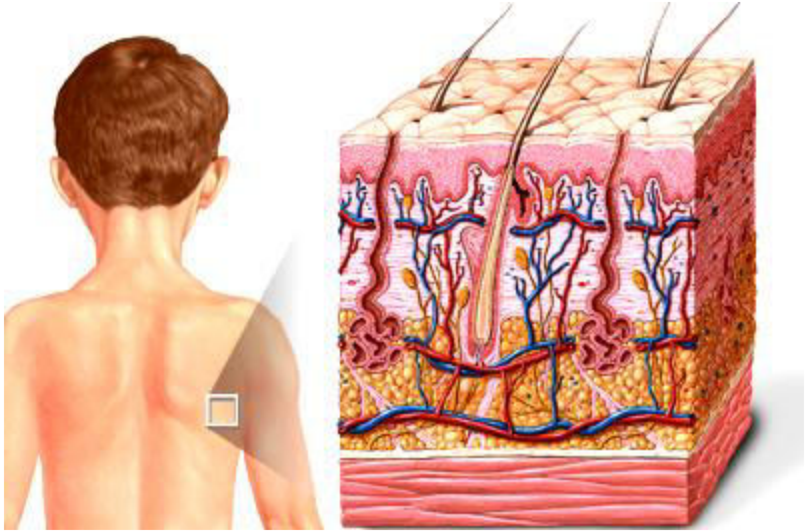
Inflammatory barrier

- Histamines
- Prostaglandins

Anatomical/ Physical barrier

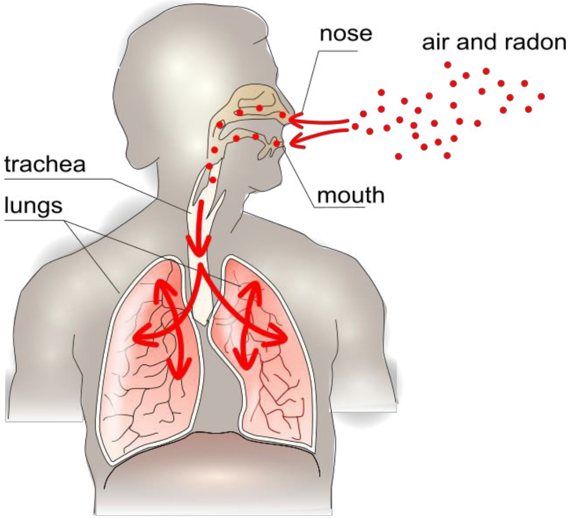
1. Skin-

- Intact
- Sweat gland
- Sebaceous gland



2. Mucous membrane-

- Mucosal epithelial cells-mucos
- Respiratory, gastrointestinal, Urinogenital tracks
-

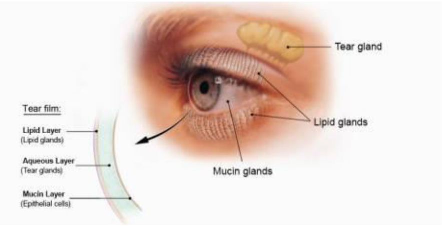


Physiological barriers

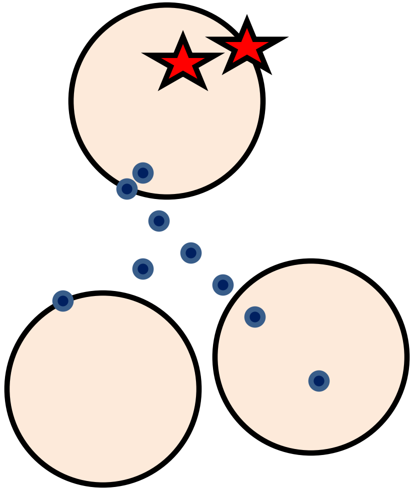
- Temperature

- pH

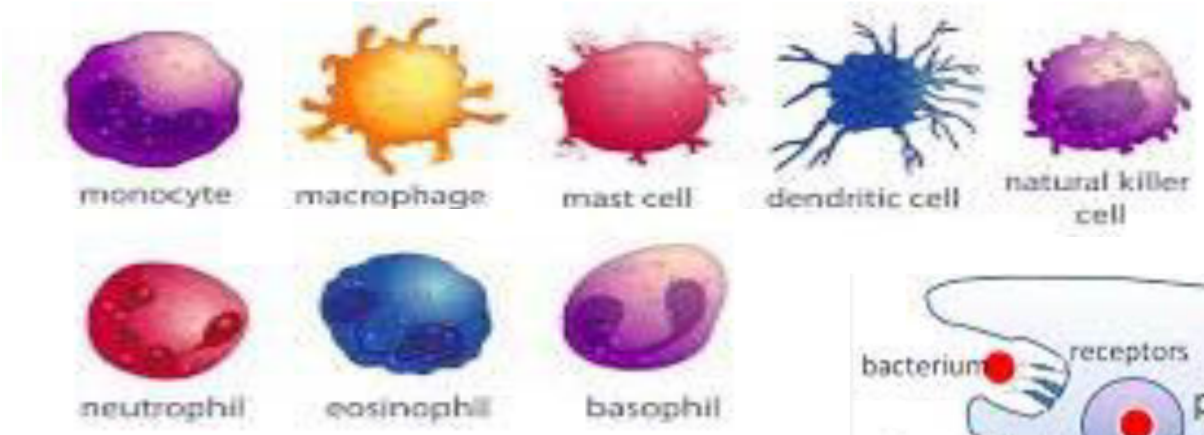
- Tear

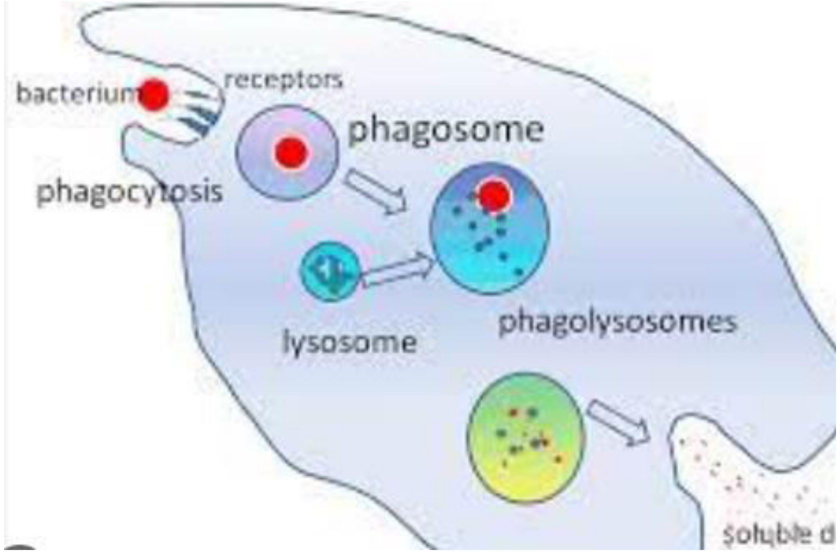


- Interferons



Cellular barrier





Inflammatory barrier

- Redness, pain, swelling and heat
- Histamines and Prostaglandins released by damaged mast cells and basophils

Innate Immunity Barrier

Anatomical/ Physical barrier

- Skin
- Mucous membrane

Physiological barriers

- Temperature
- pH
- Tear
- Interferons

Cellular barrier

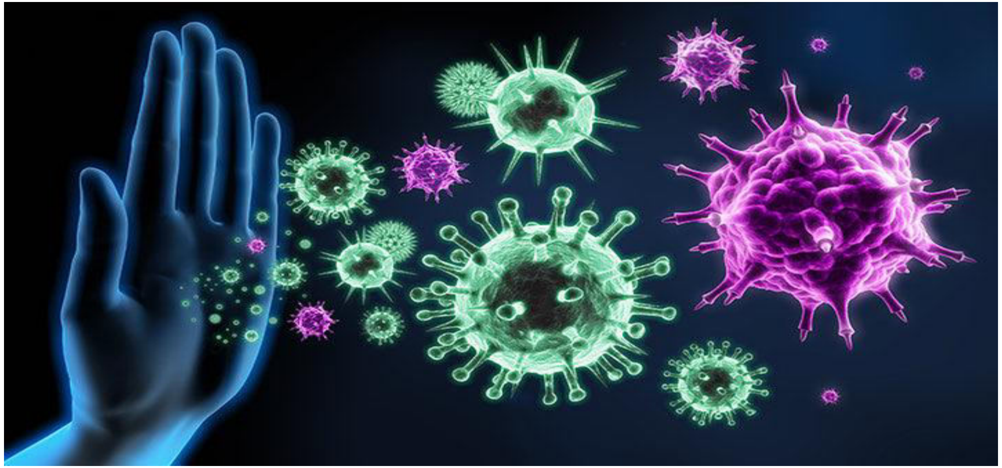
- Neutrophils
- Macrophage

Inflammatory barrier

- Histamines
- Prostaglandins

THANK
YOU

ACQUIRED IMMUNITY



Dr. Sneha S. Desai

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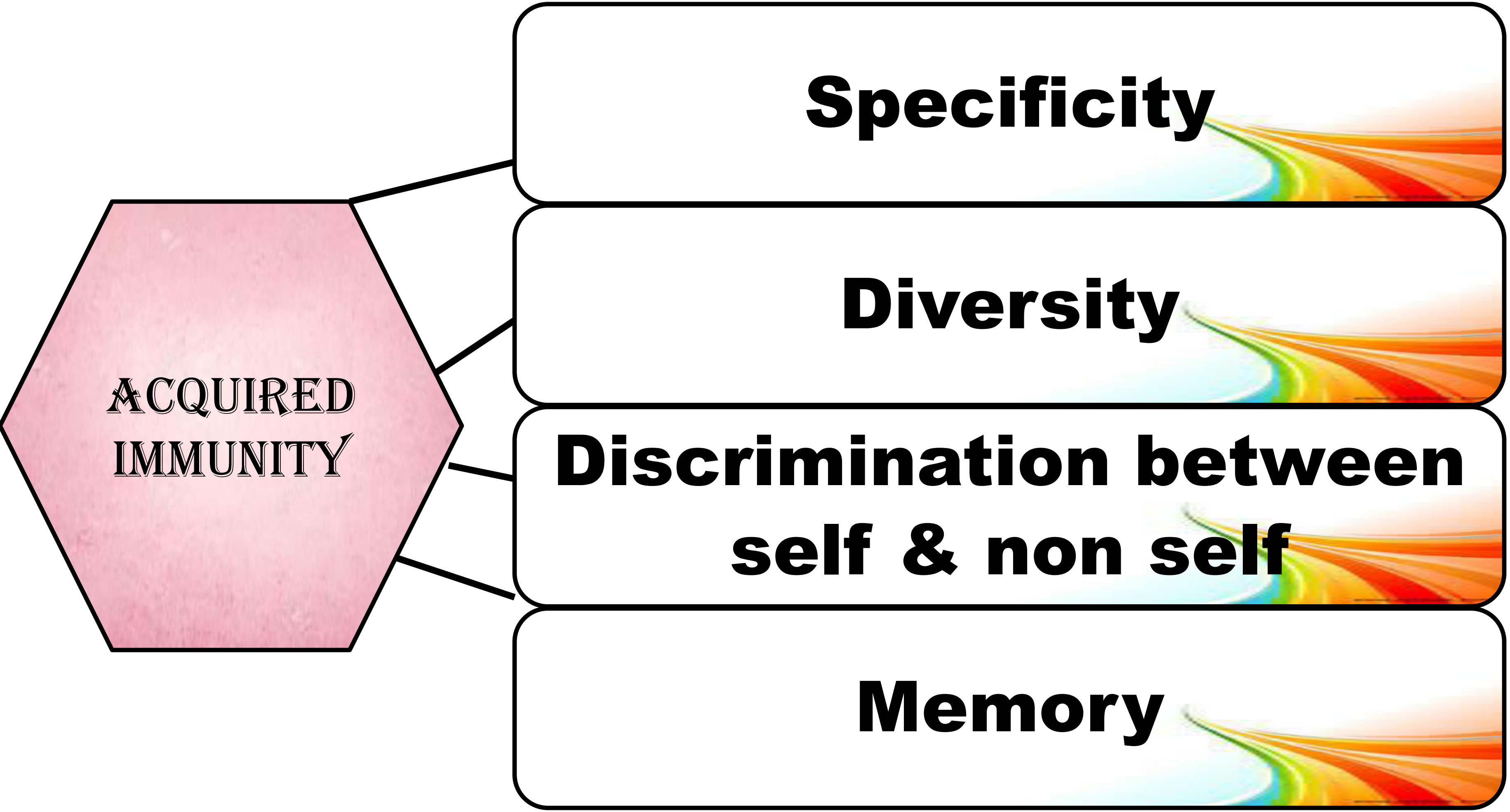
- Acquired immunity or adaptive immunity is the immunity that our **body acquires or gains over time**. Unlike the innate immunity, this is not present by birth.

- The ability of the immune system to adapt itself to disease and to generate pathogen-specific immunity is termed as acquired immunity. It is also known as adaptive immunity.

- It is specific and mediated by antibodies or lymphocytes which make the antigen harmless.

- The main function of acquired immunity is to relieve the victim of the infectious disease and also prevent its attack in future.

- It mainly consists of an advanced lymphatic defence system which functions by recognizing the own body cells and not reacting to them.


ACQUIRED IMMUNITY
Specificity
Diversity
Discrimination between self & non self
Memory

Features of Acquired Immunity

Specificity: Our body has the ability to differentiate between different types of pathogens, whether it is harmful or not, and devise ways to destroy them.

Diversity: Our body can detect vast varieties of pathogens, ranging from protozoa to viruses.

Differentiate between self and non-self: Our body has the unique ability to differentiate between its own cells and foreign cells. It immediately starts rejecting any foreign cell in the body.

Memory: Once our body encounters a pathogen, it activates the immune system to destroy it. It also remembers what antibodies were released in response to that pathogen, so that, the next time it enters, a similar procedure is followed by the body to eliminate it.

Types of Acquired Immunity

Acquired Active Immunity

Natural

- Immunity acquired due to infection
- Developed after entry of pathogen in the body

Artificial

- Immunity acquired artificially by vaccination
- Eg. Polio vaccine, BCG vaccine

Acquired Passive immunity

Natural

- Antibody pass from mother to fetus via placenta or mother milk
- IgG and IgA

Artificial

- Immunity is developed by injecting previously prepared antibodies

THANK YOU