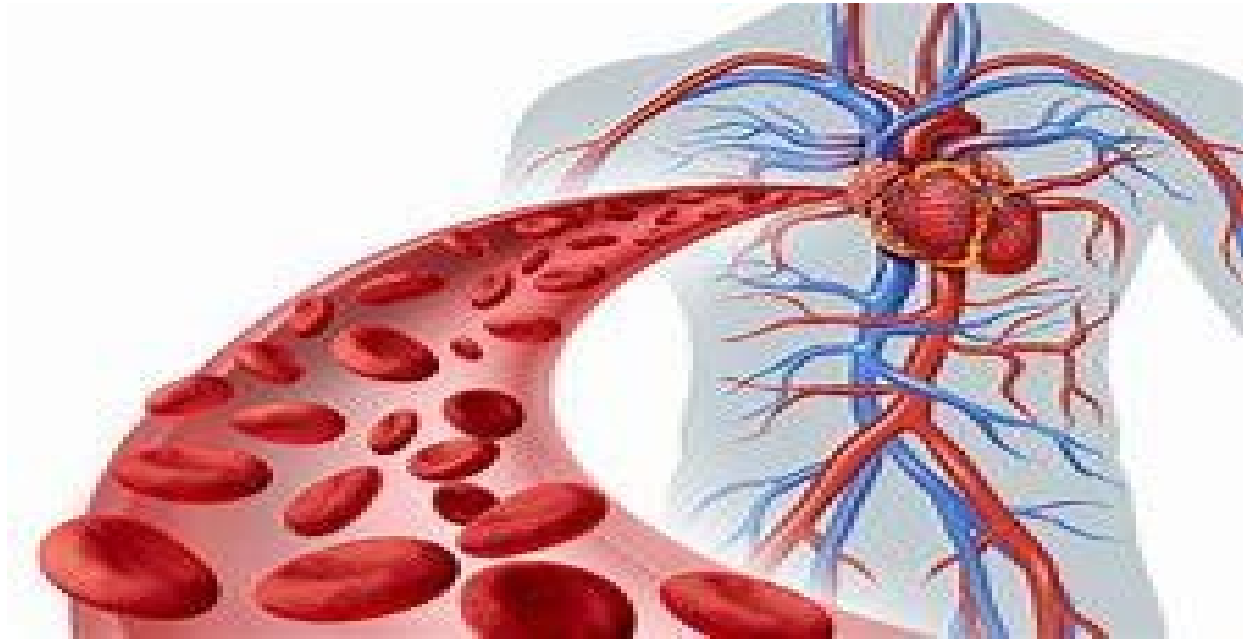


# BLOOD SYSTEM



BY,  
MRS.S.LAVANYA DEVI

# SYNOPSIS

**DEFINITION**

**BLOOD**

**PLASMA**

**TYPES OF BLOOD**

**FUNCTIONS OF BLOOD**

**COMPOSITION AND FORMATION OF BLOOD**

**ORIGINATION OF BLOOD CELLS**

**PATHOLOGY**

**DISORDERS**

**DIAGNOSIS**

**TERMINOLOGY**

**ABBREVIATIONS**

# BLOOD

- **Blood** is a constantly circulating fluid providing the body with nutrition, oxygen, and waste removal.
- Blood is mostly liquid, with numerous cells and proteins suspended in it, making blood "thicker" than pure water.
- The average person has about 5 liters (more than a gallon) of blood.

# PLASMA

- **A liquid called plasma** makes up about half of the content of blood.
- **Plasma contains proteins that help blood to clot, transport substances through the blood, and perform other functions.**
- **Blood plasma also contains glucose and other dissolved nutrients.**

# TYPES OF BLOOD

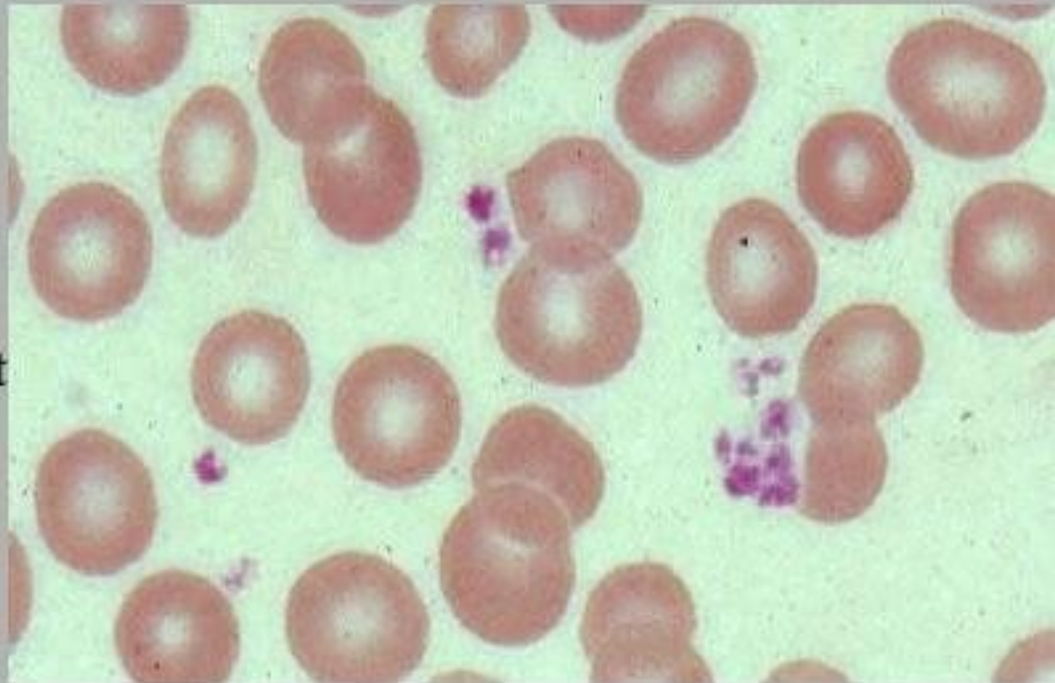
- About half of blood volume is composed of blood cells:
  - **Red blood cells, which carry oxygen to the tissues**
  - **White blood cells, which fight infections**
  - **Platelets, smaller cells that help blood to clot**
- Blood is conducted through blood vessels (**arteries and veins**). Blood is prevented from clotting in the blood vessels by their smoothness, and the finely tuned balance of clotting factors.

# Major Functions of Blood

- The body contains 4 to 6 liters of blood with an average pH of 7.35 to 7.45.

## Functions include:

- Transport Oxygen, Carbon Dioxide, Nutrients, Hormones, Heat, and Metabolic Wastes
- Regulation of pH, Body temperature, and water content of cells
- Protection against blood loss through clotting
- Protection against diseases through phagocytic white blood cells and antibodies



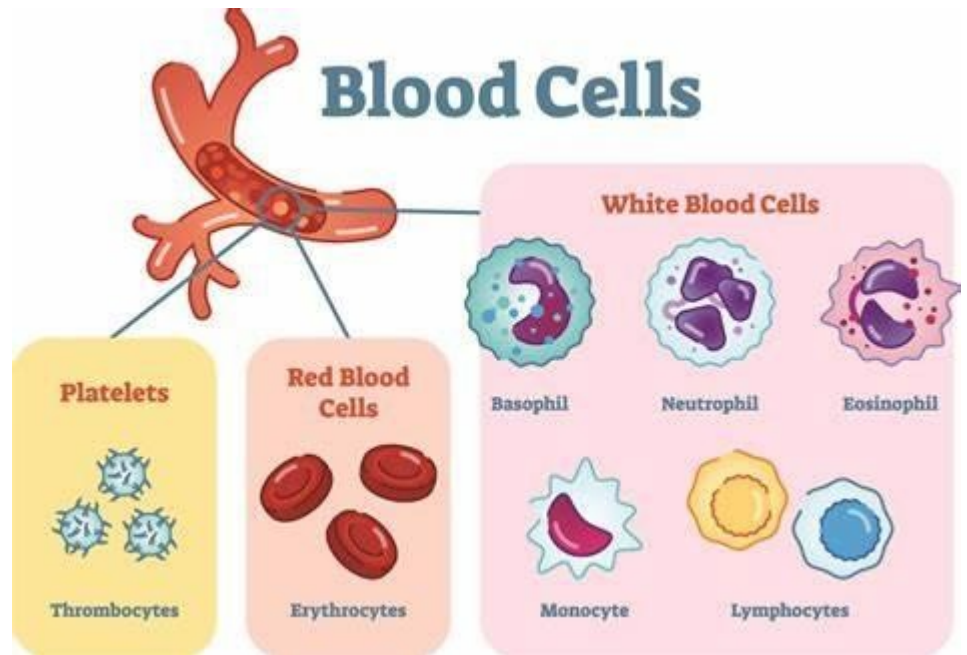
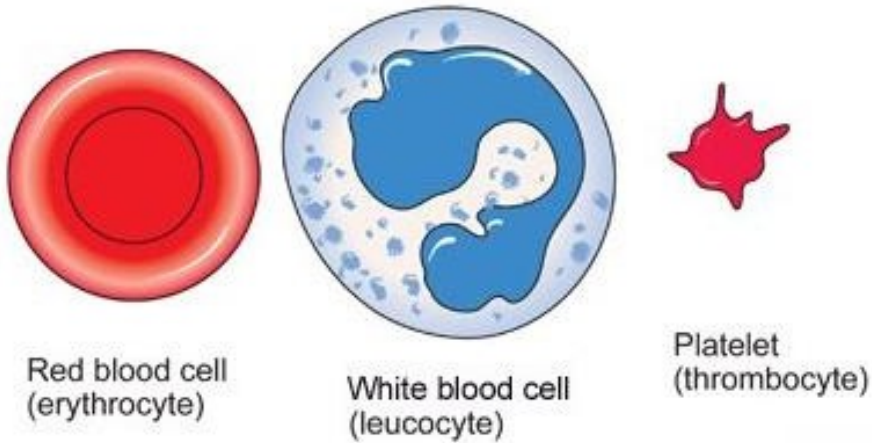
# FUNCTIONS

- **Maintains a constant environment for the other living tissues of the body.**
- **Transports chemical messengers called hormones from their sites of secretion in glands.**
- **Blood contains proteins, white blood cells and antibodies that fight infection, and platelets (thrombocytes) and other proteins that help the blood to clot.**

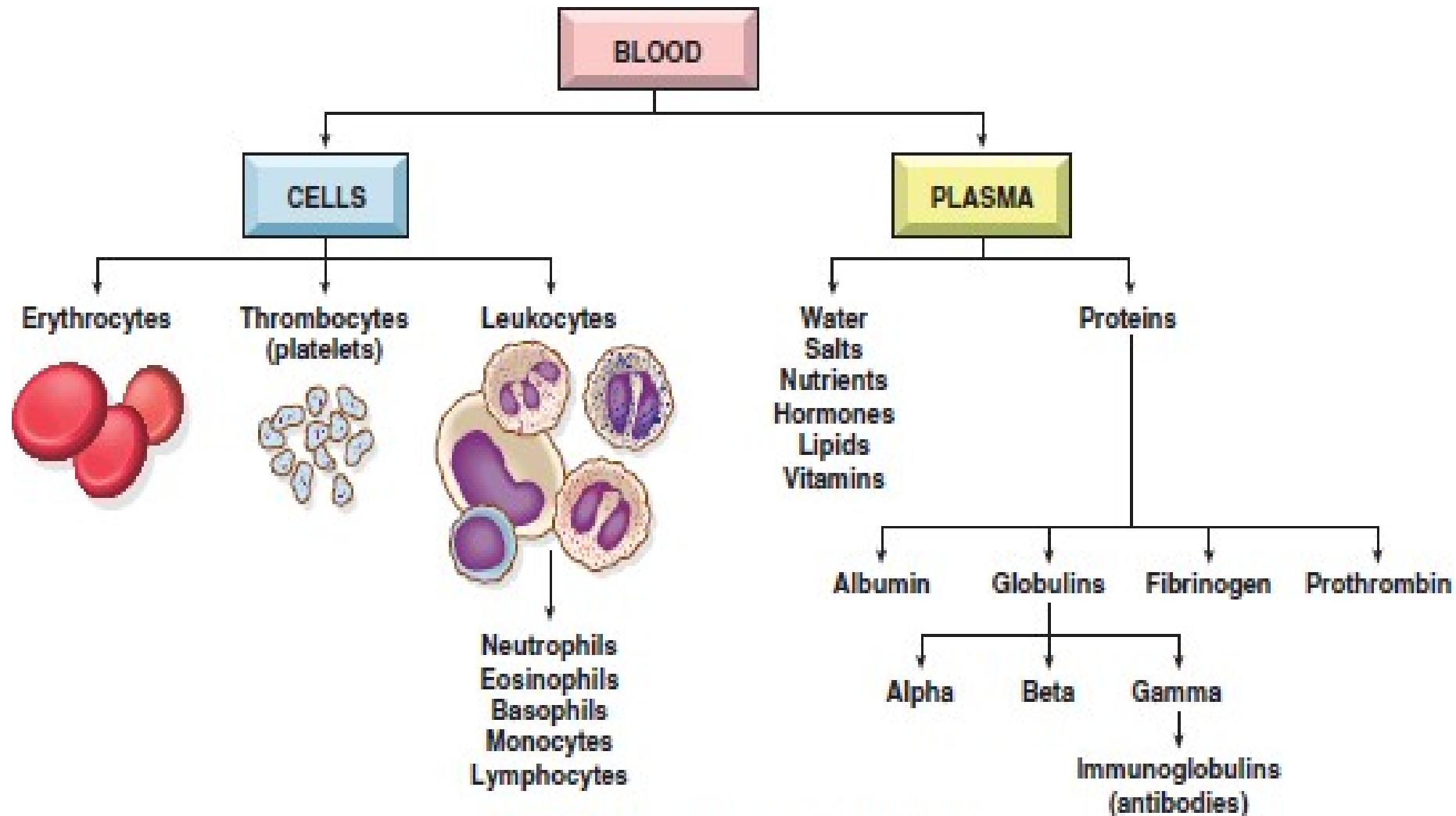
# COMPOSITION AND FORMATION OF BLOOD

- Blood is composed of cells, or formed elements, suspended in a clear, straw-colored liquid called **plasma**.
- **The cells normally constitute 45%** of the blood volume and include **erythrocytes (red blood cells)**, **leukocytes (white blood cells)**, and **platelets or thrombocytes (clotting cells)**.
- The remaining **55% of blood is plasma**, a solution of water, proteins, sugar, salts, hormones, lipids, and vitamins.

# BLOOD CELLS



# COMPOSITION OF BLOOD

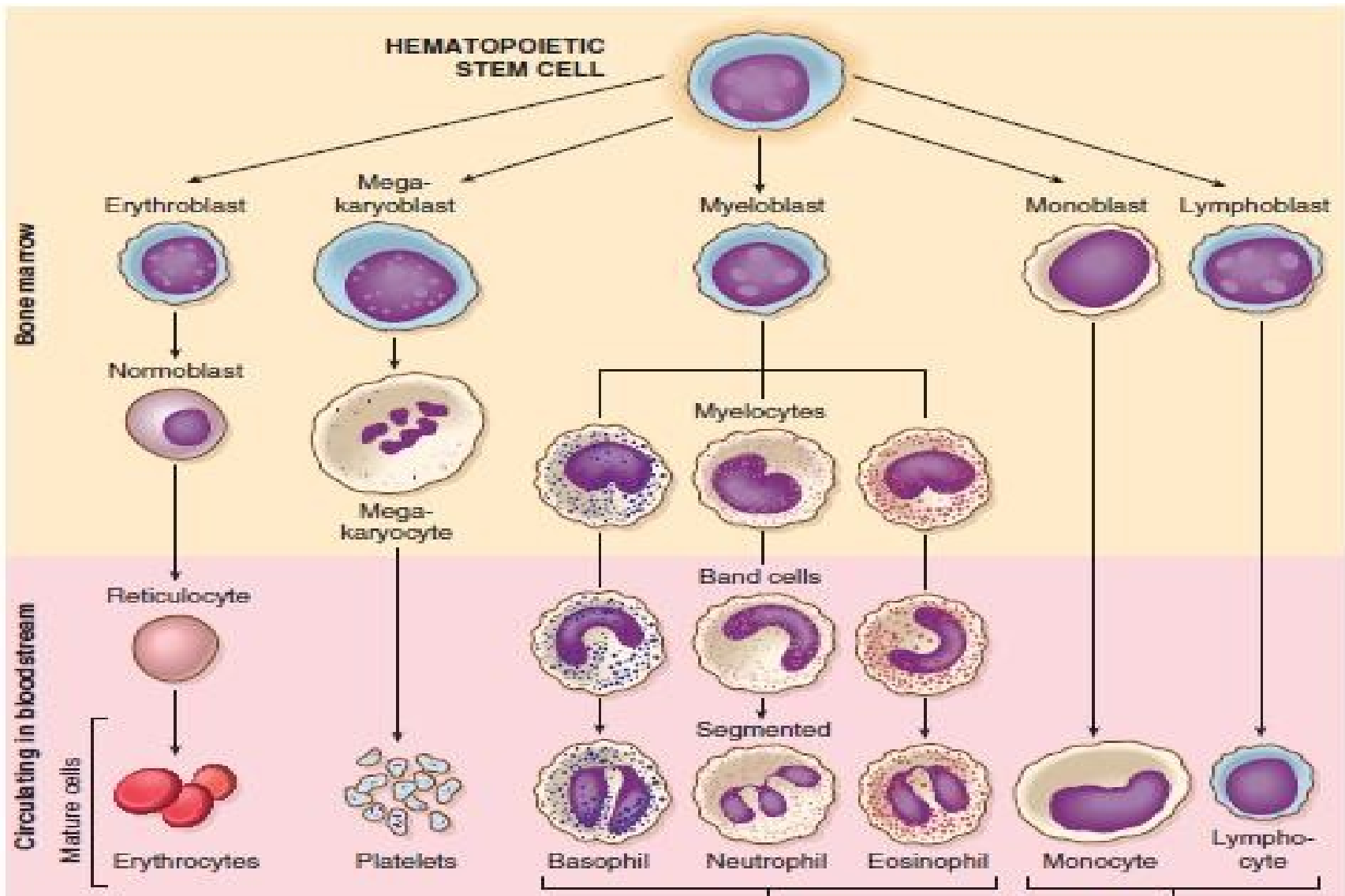


**FIGURE 13-7** The composition of blood.

# ORIGINATION OF BLOOD CELLS

- All blood cells originate in the **marrow cavity of bones**.
- Arise from the same **blood-forming or hematopoietic stem cells**.
- Under the influence of proteins in the blood and bone marrow, stem cells change their size and shape to become specialized or differentiated.
- In this process, the cells change in size from large (immature cells) to small (mature forms), and the cell nucleus shrinks (in red cells, the nucleus actually disappears).

# HEMATOPOIESIS

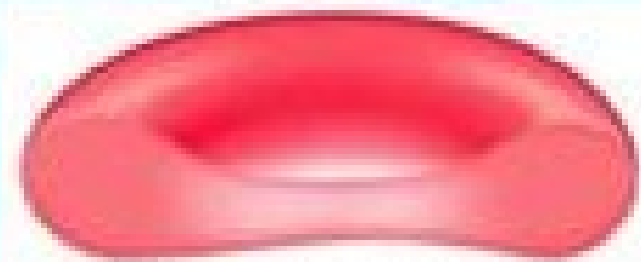


# RBC / ERYTHROCYTES

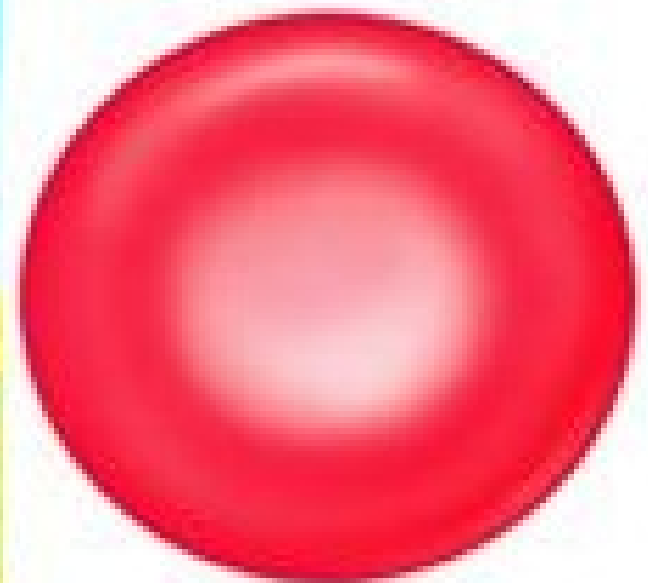
- Shape of a **biconcave disk** (a depressed or hollow surface on each side of the cell, resembling a cough drop with a thin central portion).
- **No nucleus**
- Contains unique protein **hemoglobin**
  - composed of **heme (iron-containing pigment)**
  - **globin (protein)**.
  - Hemoglobin enables the erythrocyte to **carry oxygen**.
  - The combination of oxygen and hemoglobin (**oxyhemoglobin**) produces the **bright red color** of blood.

# RBC Structure And Function

- Have no organelles or nuclei.
- It contains Hemoglobin – oxygen carrying protein pigment. Each RBC has about 280 million hemoglobin molecules.
- Biconcave shape – 30% more surface area. Thin center and thick edges.
- It accounts for more than one third of cell volume.

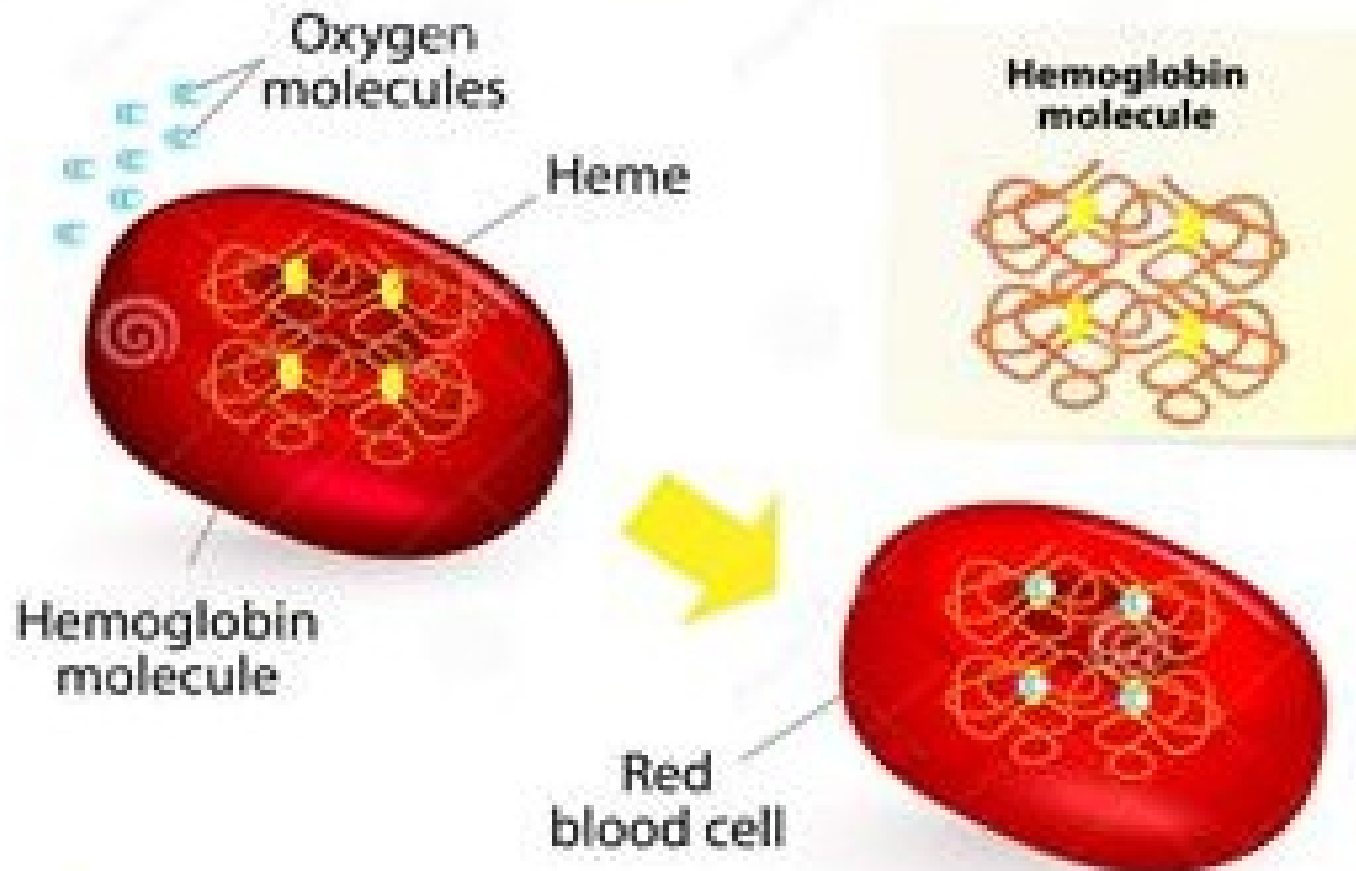


Cross-sectional view



Top view

# HUMAN HEMOGLOBIN

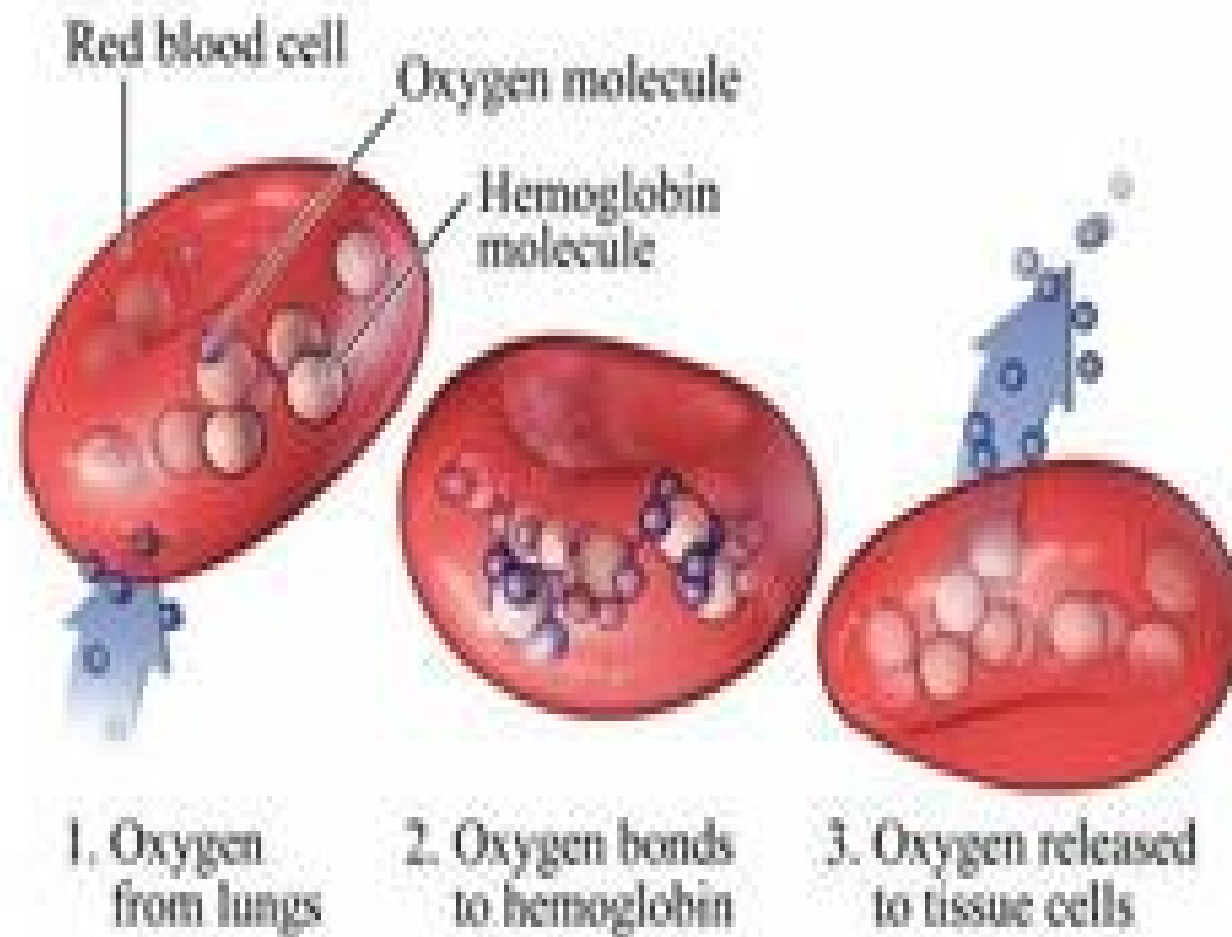


Download from  
Dynamilis.com

The world's largest open access repository of research papers

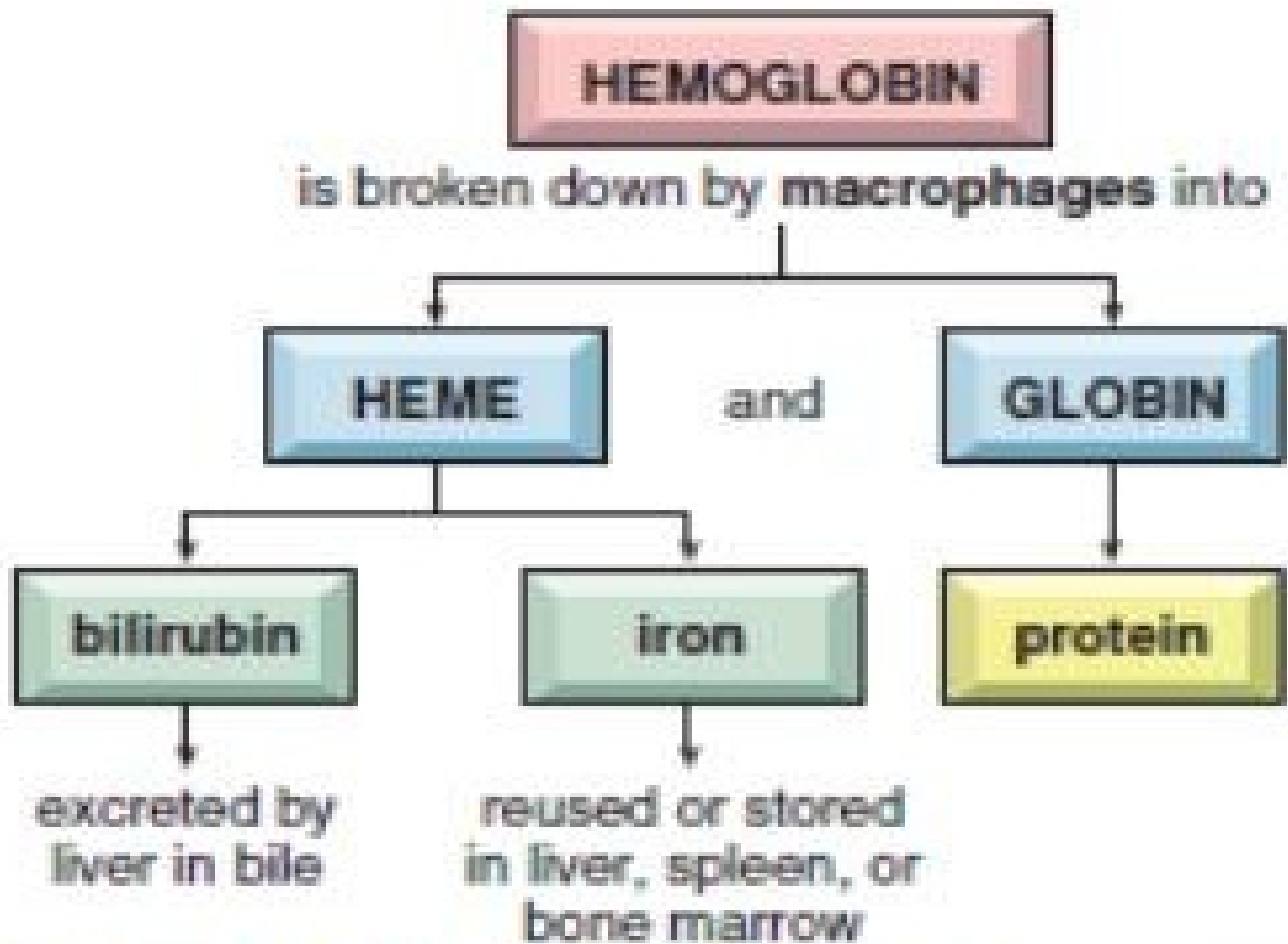


License  
Copyright © Dynamilis.com



# RBC & HB BREAKDOWN

- Originates in the **bone marrow**.
- The hormone called **erythropoietin (secreted by the kidneys)** stimulates their production (-poiesis means formation).
- Role of transporting gases for about **120 days** in the bloodstream.
- **Macrophages** (in the spleen, liver, and bone marrow) destroy the worn-out erythrocytes. This process is called **hemolysis**.
- **4 to 6 million per  $\mu\text{L}$  of blood**.
- Macrophages break down erythrocytes and hemoglobin into **heme and globin** (protein) portions.
- The **heme releases iron** and decomposes to **bilirubin (a yellow-orange pigment)**.
- The iron in hemoglobin - forms new red cells or is stored in the spleen, liver, or bone marrow.
- Bilirubin is excreted into **bile by the liver** - enters the small intestine via the common bile duct.
- Finally , **excreted in the stool**, where its color changes to **brown**.



**FIGURE 13-3** The breakdown of hemoglobin.

# WBC / LEUKOCYTES

- White blood cells (7000 to 9000 cells per  $\mu\text{L}$  of blood)
- 2 TYPES OF WBC – GRANULOCYTES AND AGRANULOCYTES
- 3 polymorphonuclear **granulocytic leukocytes (neutrophil, eosinophil, and basophil)**
- 2 mononuclear **agranulocytic leukocytes (lymphocyte and monocyte).**
- The granulocytes, or polymorphonuclear leukocytes (PMNs), are the most numerous (about 60%).

# POLYMORPHONUCLEAR GRANULOCYTES

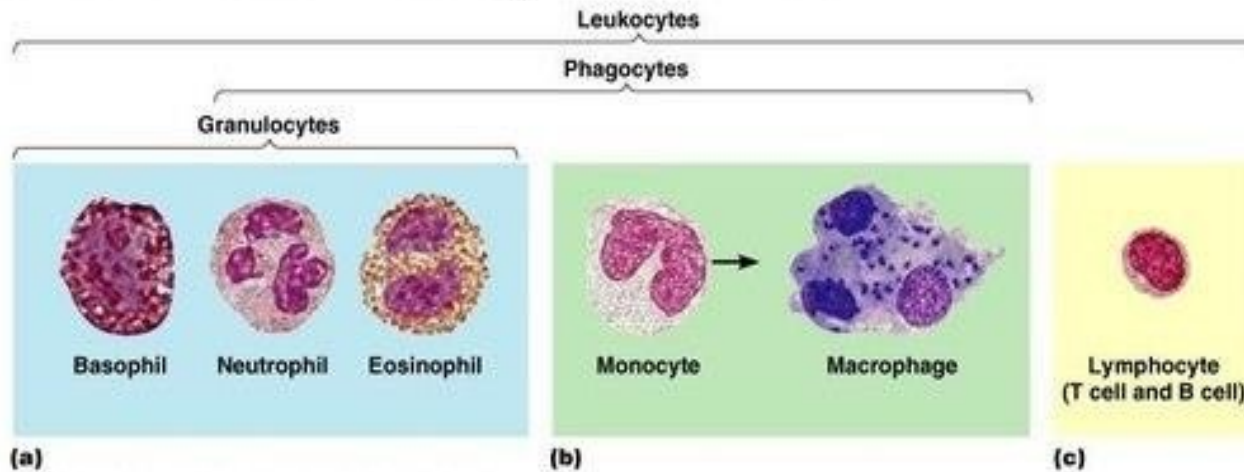
- **Basophils** contain granules - stain dark blue with a basic (alkaline) dye.- contain heparin (an anticlotting substance)
- And histamine (a chemical released in allergic responses)
- **Eosinophils** contain granules - stain with eosin, a red acidic dye.  
<https://join.skype.com/join/EkORyJfz1rM>
- - increase in allergic responses and engulf substances that trigger the allergies.
- **Neutrophils** contain granules - neutral -pale color.
- **phagocytes** (phag/o means to eat or swallow)
- Specific proteins called **colony-stimulating factors** (CSFs) promote the growth of granulocytes in bone marrow.

# MONONUCLEAR LEUKOCYTES

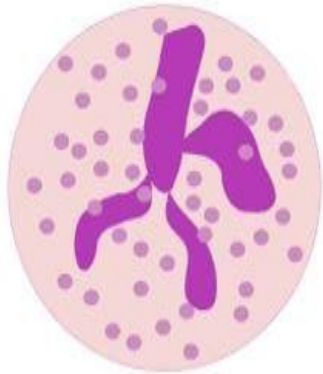
- **Mononuclear leukocytes - one large nucleus- a few granules**  
**-lymphocytes and monocytes**
- **Lymphocytes** - bone marrow and lymph nodes- circulate both in the bloodstream and the lymphatic system.
- **Lymphocytes** - role in the immune response - against infection.
  - directly attack foreign matter –produce antibodies that neutralize and can lead to the destruction of foreign antigens (bacteria and viruses).
- **Monocytes**
  - phagocytic cells
  - also fight disease.
  - they move from the bloodstream into tissues & dispose of dead and dying cells, tissue debris by phagocytosis.

# Leukocytes Structure

- WBCs have a nucleus and other organelles.
- WBCs can undergo diapedesis using amoeboid motion when in the tissues
- Use chemical chemotaxis to follow trail to infection or damaged tissue.

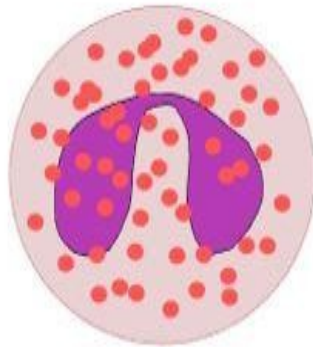


# WHITE BLOOD CELLS



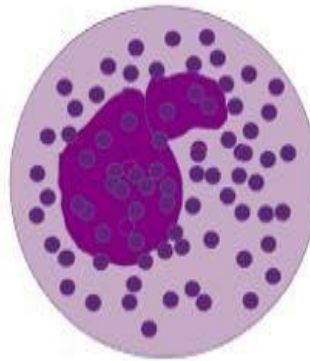
## NEUTROPHIL

- Multi-lobed Nucleus
- Pale Red and Blue Cytoplasmic Granules



## EOSINOPHIL

- Bi-lobed Nucleus
- Dark Pink Stained Cytoplasmic Granules



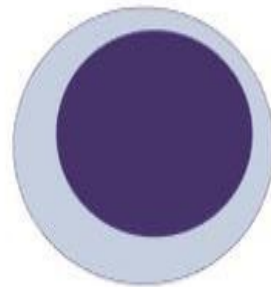
## BASOPHIL

- Bi-lobed Nucleus  
*(usually can't be seen)*
- Lots of Dark Purple Stained Cytoplasmic Granules that Take up the Entire Cell



## MONOCYTE

- Kidney-Shaped Nucleus that May Appear Lobed
- No Granules
- Cytoplasm is Very Faintly Stained Blue



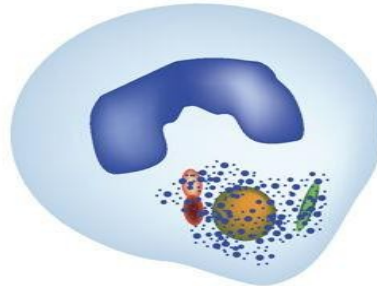
## LYMPHOCYTE

- Large Spherical Nucleus
- No Granules
- Thin Outer Rim of Faintly Blue-Stained Cytoplasm

# Phagocytosis



Leukocyte  
absorbs  
bacteria



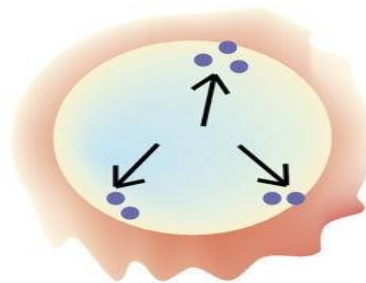
Leukocyte  
ingests  
bacteria



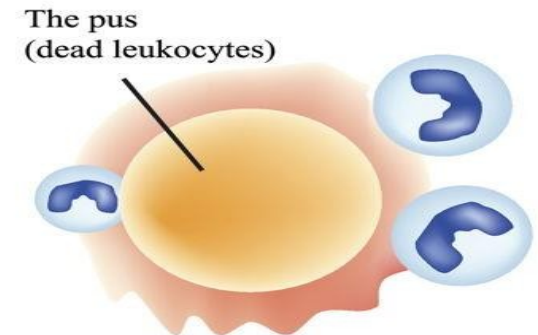
Leukocyte expands  
from ingesting large  
numbers of bacteria



and lyses



White blood cells lyse  
releasing cytokines  
(chemical signals) which  
cause local inflammatory  
reaction (cascading) including  
swelling, redness and fever



Cytokines attract new  
leukocytes to fight bacteria

# PLATELETS (THROMBOCYTES)

- **Platelets** - blood cell fragments
  - bone marrow
  - originate from giant cells multilobed nuclei called **megakaryocytes** (large bone marrow cell)
- Tiny fragments of a megakaryocyte break off to form platelets. The main function of platelets is to help **blood to clot.**

# PLATELET STRUCTURE:

Normal human platelets are:

Size: Small in size ( $0.5 \times 3.0 \mu\text{m}$ )

Shape:

- Discoid in shape have a mean volume of 7–11 fL.
- Anucleated.

Number: They circulate in relatively high numbers (between  $150$  and  $400 \times 10^9 /\text{L}$ ).

Life span: Their lifespan is approximately 10 days (9 – 12 days).

# PLATELETS



# Functions of Platelets

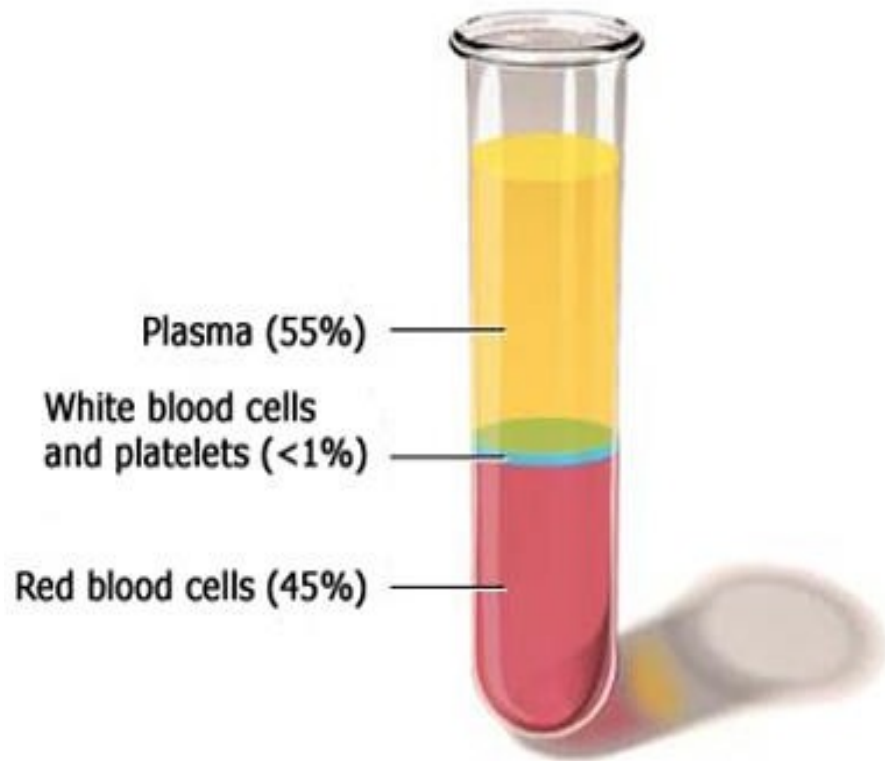
---

- Role in haemostasis.
  - Vasoconstriction.
  - Temporary haemostatic plug.
  - Definitive haemostatic plug.
- Role in clot formation.
- Role in clot retraction.
- Role in repair of injured blood vessels - PDGF.
- Role in defence mechanism.
- Transport and storage function.
  - ADP, Thromboxane A<sub>2</sub>


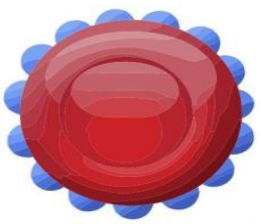
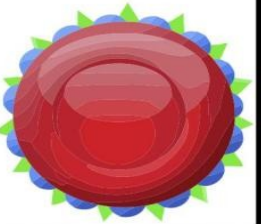







# PLASMA

- Plasma, the **liquid part** of the blood, consists of water, dissolved proteins, sugar, wastes, salts, hormones, and other substances.
- The four major plasma proteins are **albumin**, **globulins**, **fibrinogen**, and **prothrombin** (the last two are clotting proteins).
- **Albumin** maintains the proper proportion (and concentration) of water in the blood.

- **Globulins** - plasma protein.
- There are alpha, beta, and gamma globulins.
- **Immunoglobulins (gamma glob)**.
- Examples : immunoglobulin antibodies are **IgG (found in high concentration in plasma)**
- **IgA (found in breast milk, saliva, tears, and respiratory mucus).**
- Other immunoglobulins are **IgM, IgD, and IgE.**
- **Plasmapheresis** (-apheresis means to remove) is the process of separating plasma from cells and then removing the plasma from the patient.

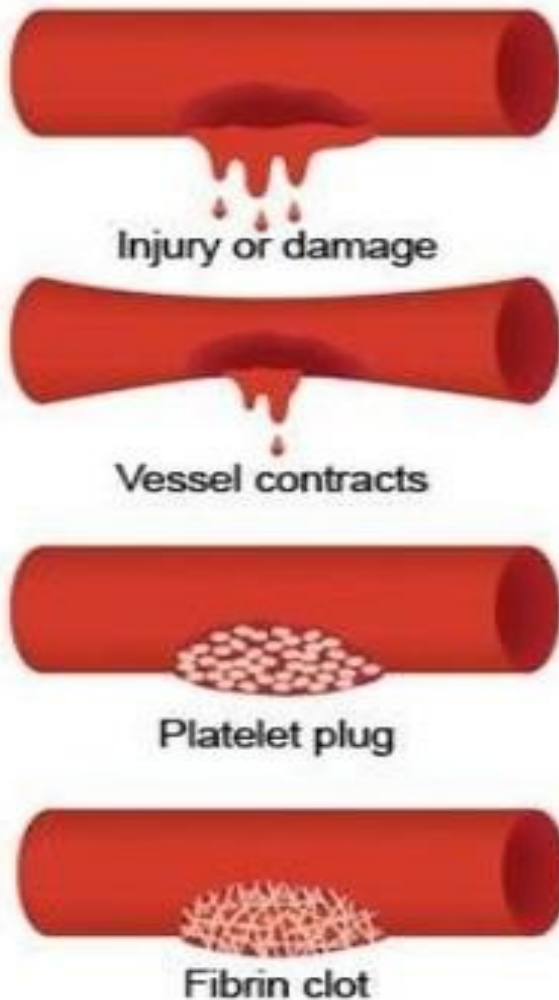


# THE ABO BLOOD GROUP

	Group A	Group B	Group AB	Group 0
Red blood cell type				
Antibodies present	 Anti-B	 Anti-A	None	 Anti-B and Anti-A
Antigens present	 A antigen	 B antigen	 A and B antigens	None

UNIVERSAL DONOR ? UNIVERSAL RECEPTOR?

# BLOOD CLOTTING MECHANISM



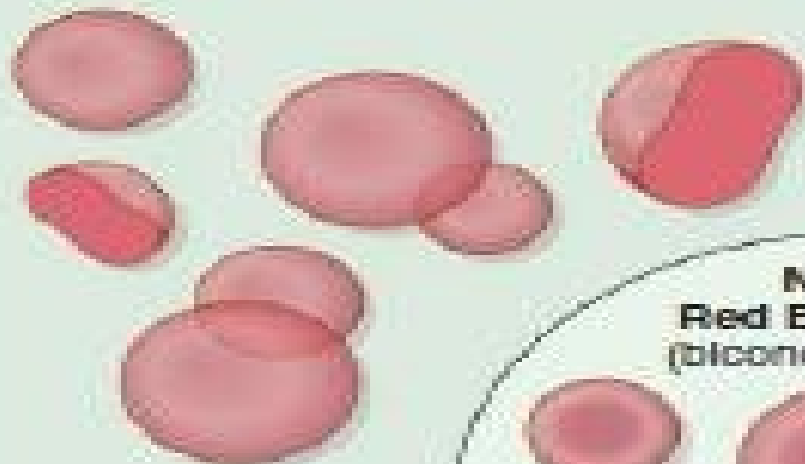
## Process

- Injury/ rupture to blood vessel
- Blood vessel around wound constrict - reduce blood flow to the damaged area.
- Activated Platelets stick to injury site
- Platelets become sticky and clump together to form platelet plug.
- Platelets & damaged tissue release clotting factors (eg. Factor VIII)
- Blood clotting mechanism to form Fibrin which acts like a mesh to stop the bleeding.

# PATHOLOGY

- Any abnormal or pathologic condition of the blood - **blood dyscrasia (disease)**.
- **Anemia** - Deficiency in erythrocytes or hemoglobin.
  - **Aplastic anemia** - Failure of blood cell production in the bone marrow – Pancytopenia
  - **Hemolytic anemia** - Reduction in red cells due to excessive destruction – Eg : congenital spherocytic anemia (hereditary spherocytosis)
  - **Pernicious anemia** - Lack of mature erythrocytes caused by inability to absorb vitamin B12 into the bloodstream.
  - **Sickle cell anemia** - Hereditary disorder of abnormal hemoglobin producing sickle-shaped erythrocytes and hemolysis.
  - **Thalassemia** - Inherited defect in ability to produce hemoglobin, leading to hypochromia. *Thalassa* is a Greek word meaning sea.
- **Hemochromatosis** - Excess iron deposits throughout the body.
- **Polycythemia vera** - General increase in red blood cells (erythremia).

**Hereditary Spherocytosis**  
(red cells are less biconcave and fragile)



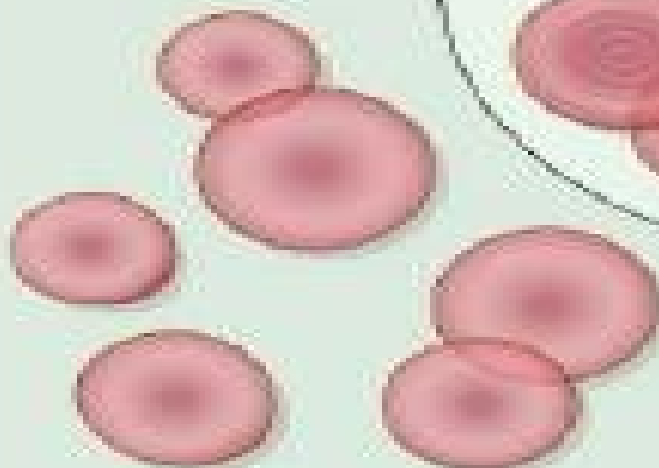
**Pernicious Anemia**  
(large, immature megaloblasts)



**Normal  
Red Blood Cells**  
(biconcave shape)



**Thalassemia [target cells]**  
(hemoglobin concentration is low)



**Sickle Cell Anemia**  
(crescent-shaped, distorted, fragile cells)



# DISORDERS OF BLOOD CLOTTING

- **Hemophilia** - Excessive bleeding caused by hereditary lack of blood clotting factors (factor VIII or IX) necessary for blood clotting.
- **Purpura** - Multiple pinpoint hemorrhages and accumulation of blood under the skin
- **Petechiae** - are tiny purple or red flat spots appearing on the skin as a result of hemorrhages.
- **Ecchymoses** - are larger blue or purplish patches on the skin (bruises)
- **Purpura** - can be caused by having too few platelets (**thrombocytopenia**). The cause may be immunologic, meaning the body produces an antiplatelet factor that harms its own platelets.
- **Autoimmune thrombocytopenic purpura** - is a condition in which a patient makes an antibody that destroys platelets. Bleeding time is prolonged; splenectomy (the spleen is the site of platelet destruction) and drug therapy with corticosteroids are common treatment.



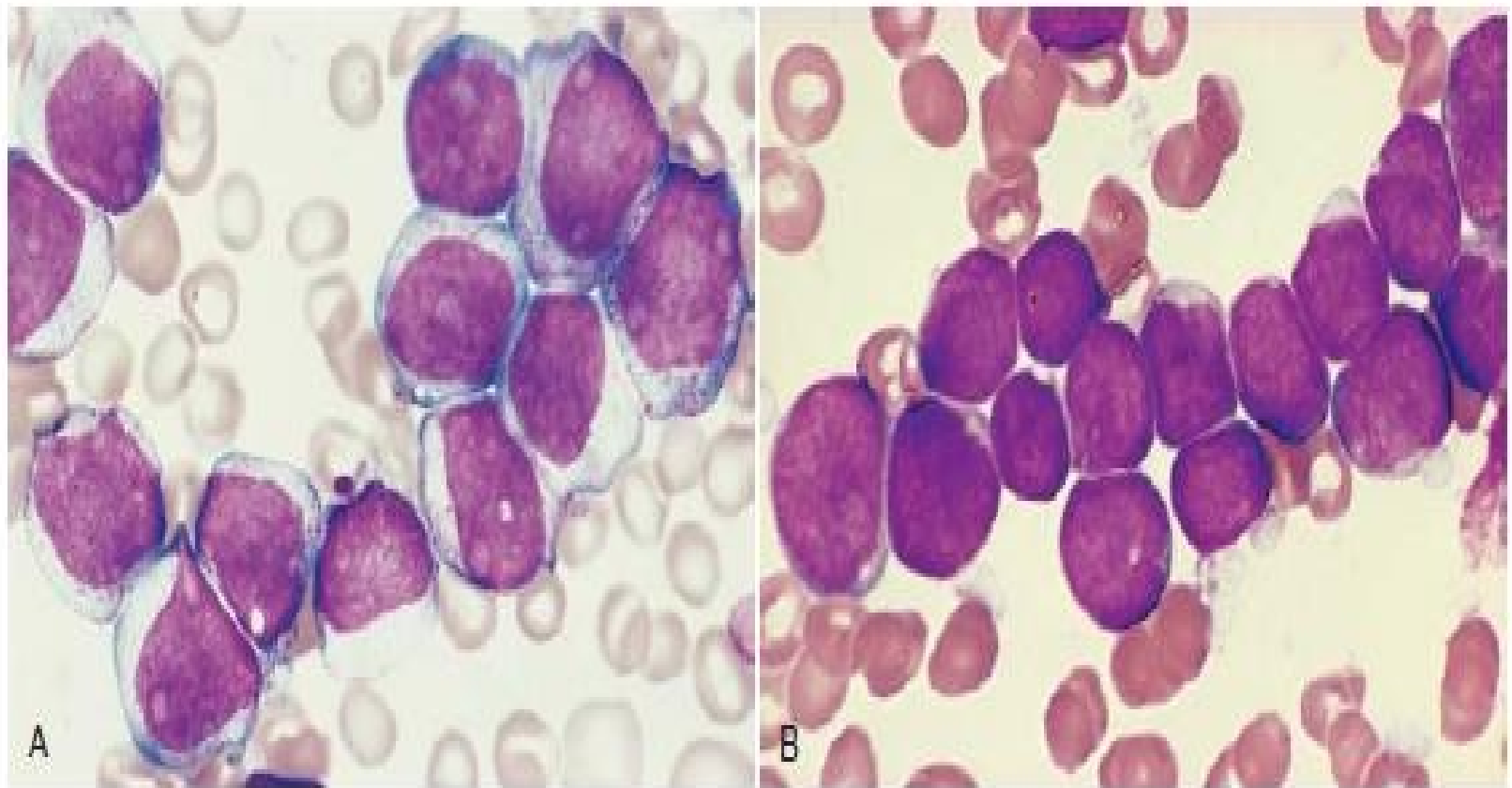
**FIGURE 13-12** Lower limbs of a male with **hemophilia** showing the effect of recurrent hemorrhage into the knees. (Courtesy Dr. G. Dolan, University Hospital, Nottingham, UK.)



**FIGURE 13-13** A, **Petechiae** result from bleeding from capillaries or small arterioles. B, **Ecchymoses** are larger and more extensive than petechiae.

# DISEASES OF WHITE BLOOD CELLS

- **Leukemia** - Increase in cancerous white blood cells (leukocytes).
- **Four types** of leukemia are:
  - 1. Acute myelogenous (myelocytic) leukemia (AML).
  - 2. Acute lymphocytic leukemia (ALL).
  - 3. Chronic myelogenous (myelocytic) leukemia (CML).
  - 4. Chronic lymphocytic leukemia (CLL).
- **Remission** - disappearance of signs and symptoms of disease.
- **Relapse** - occurs when disease symptoms and signs reappear, necessitating further treatment
- **RX** - Transplantation of normal bone marrow
- **Granulocytosis** - Abnormal increase in granulocytes in the blood
- **Mononucleosis** - Infectious disease marked by increased numbers of mononuclear leukocytes and enlarged cervical lymph nodes. transmitted by the Epstein-Barr virus (EBV).



**FIGURE 13-14** Acute leukemia. **A**, Acute myeloblastic leukemia (AML). Myeloblasts (immature granulocytes) predominate. There are large cells with small granules in their cytoplasm. AML affects primarily adults. A majority of patients achieve remission with intensive chemotherapy, but relapse is common. Hematopoietic stem cell transplantation may be a curative therapy. **B**, Acute lymphoblastic leukemia (ALL). Lymphoblasts (immature lymphocytes) predominate. ALL is a disease of children and young adults. Most children are cured with chemotherapy. (Courtesy Dr. Robert W. McKenna, Department of Pathology, University of Texas Southwestern Medical School, Dallas.)

## Most Common Types of Leukemia



knowmedge

### **Acute Myelogenous Leukemia (AML)**

**Occurs in both children and adults**

### **Acute Lymphocytic Leukemia (ALL)**

**Most common type of Leukemia in children. Also affects adults.**

### **Chronic Myelogenous Leukemia (CML)**

**Mainly affects adults**

### **Chronic Lymphocytic Leukemia (CLL)**

**Most often in people over age 55**

# DISEASE OF BONE MARROW CELLS

- **Multiple myeloma** - Malignant neoplasm of bone marrow. The malignant cells (lymphocytes that produce antibodies) destroy bone tissue and cause overproduction of immunoglobulins, including Bence Jones protein, an immunoglobulin fragment found in urine.
- Drugs such as thalidomide and Velcade (bortezomib) are palliative (relieving symptoms) and stop disease progression, which improves the outlook for this disease.
- **Autologous bone marrow transplantation (ABMT)**, in which the patient serves as his or her own donor for stem cells, may lead to prolonged remission.

- Hemorrhage ([bleeding](#)): Blood leaking out of blood vessels may be obvious, as from a wound penetrating the skin. Internal bleeding (such as into the intestines, or after a car accident) may not be immediately apparent.
- [Hematoma](#): A collection of blood inside the body tissues. Internal bleeding often causes a hematoma.
- [Disseminated intravascular coagulation](#) (DIC): An uncontrolled process of simultaneous bleeding and clotting in very small blood vessels. DIC usually results from severe infections or cancer.

- Septicemia is a serious bloodstream infection. **Septicemia** is a bacterial infection that spreads into the bloodstream.
- **Sepsis** is the body's response to that infection, during which the immune system will trigger extreme, and potentially dangerous, whole-body inflammation.
- Sepsis can also cause blood clots to form in your organs and in your arms, legs, fingers and toes — leading to varying degrees of organ failure and tissue death (gangrene).
- If sepsis progresses to **septic shock**, blood pressure drops dramatically. This may lead to death.

# LABORATORY TESTS

- **antiglobulin test (Coombs test)** - Test for the presence of antibodies that coat and damage erythrocytes.
- **bleeding time** - Time required for blood to stop flowing from a tiny puncture wound.
- **coagulation time** - Time required for venous blood to clot in a test tube.
- **complete blood count (CBC)** - Determination of numbers of blood cells, hemoglobin concentration, hematocrit, and red cell values—MCH, MCV, MCHC
- **erythrocyte sedimentation rate (ESR)** - Speed at which erythrocytes settle out of plasma.
- **hematocrit (Hct)**- Percentage of erythrocytes in a volume of blood.
- **hemoglobin test (H, Hg, Hgb, HGB)** - Total amount of hemoglobin in a sample of peripheral blood.

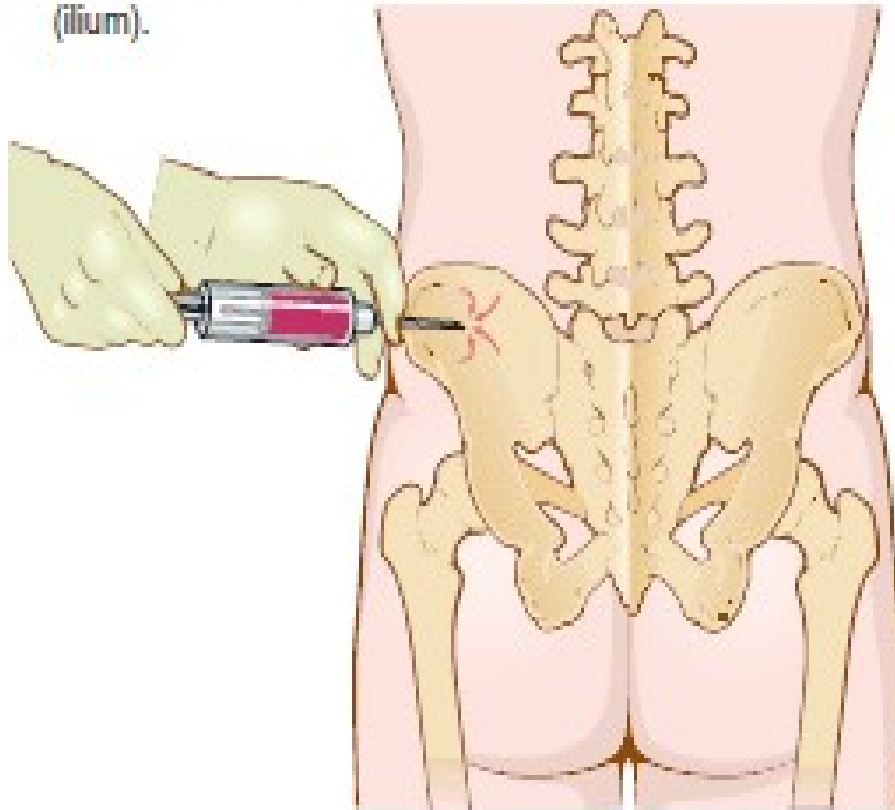
- **platelet count** - Number of platelets per cubic millimeter (mm<sup>3</sup>) or microliter (μL) of blood.
- **prothrombin time (PT)** - Test of the ability of blood to clot.
- **partial thromboplastin time (PTT)**
- **red blood cell count (RBC)** - Number of erythrocytes per cubic millimeter (mm<sup>3</sup>) or microliter (μL) of blood.
- **red blood cell morphology** - Microscopic examination of a stained blood smear to determine the shape of individual red cells.
- **WBC Count**- Number of leukocytes per cubic millimeter (mm<sup>3</sup>) or microliter (μL) of blood.
- **white blood cell differential [count]** - Percentages of different types of leukocytes in the blood.

# CLINICAL PROCEDURES

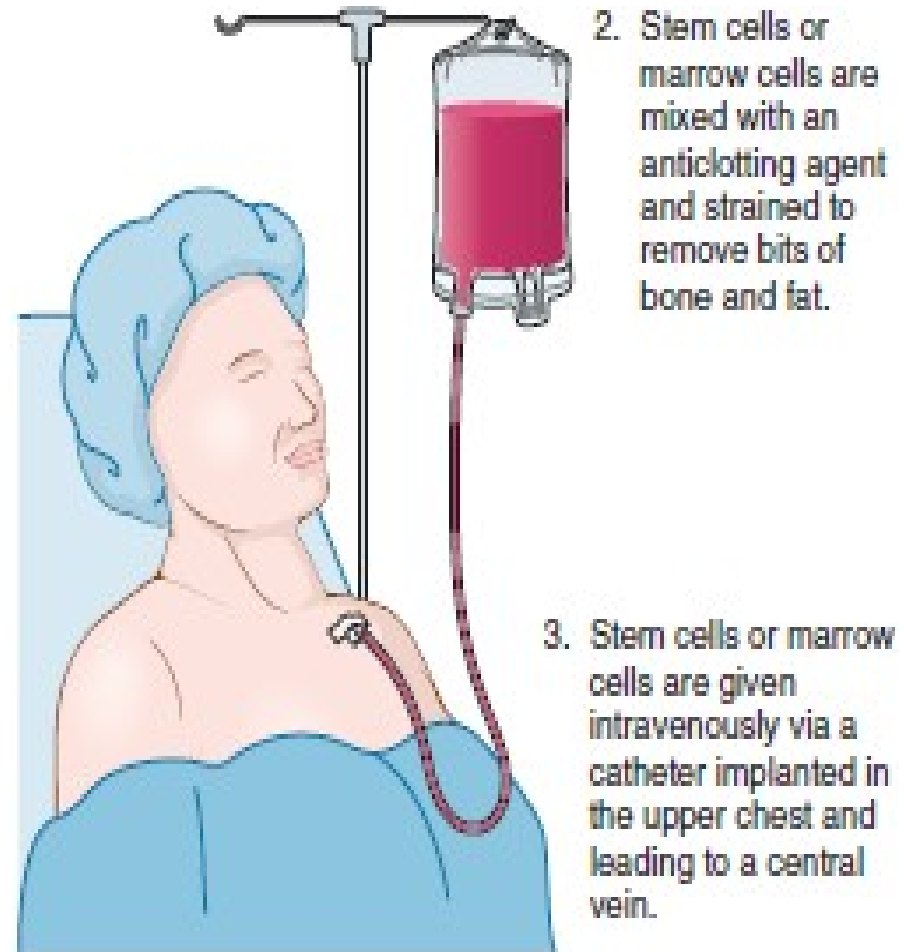
- **Apheresis** - Separation of blood into component parts and removal of a select portion from the blood.
- **Blood transfusion** - Whole blood or cells are taken from a donor and infused into a patient.
- **Bone marrow biopsy** - Microscopic examination of a core of bone marrow removed with a needle.
- **Hematopoietic stem cell transplantation** - Peripheral stem cells from a compatible donor are administered to a Recipient- Patients with malignancies, such as AML, ALL, CLL, CML, lymphoma and multiple myeloma, are candidates for this treatment
- **In autologous stem cell transplantation**, the patient's own stem cells are collected, stored, and reinfused after potent chemotherapy
- **Bone marrow transplantation**

# HEMATOPOIETIC AND BONE MARROW TRANSPLANTATION

1. Stem cells from the donor's circulating blood are collected in a transfer bag, or marrow cells are aspirated from the donor's hip bone (ilium).



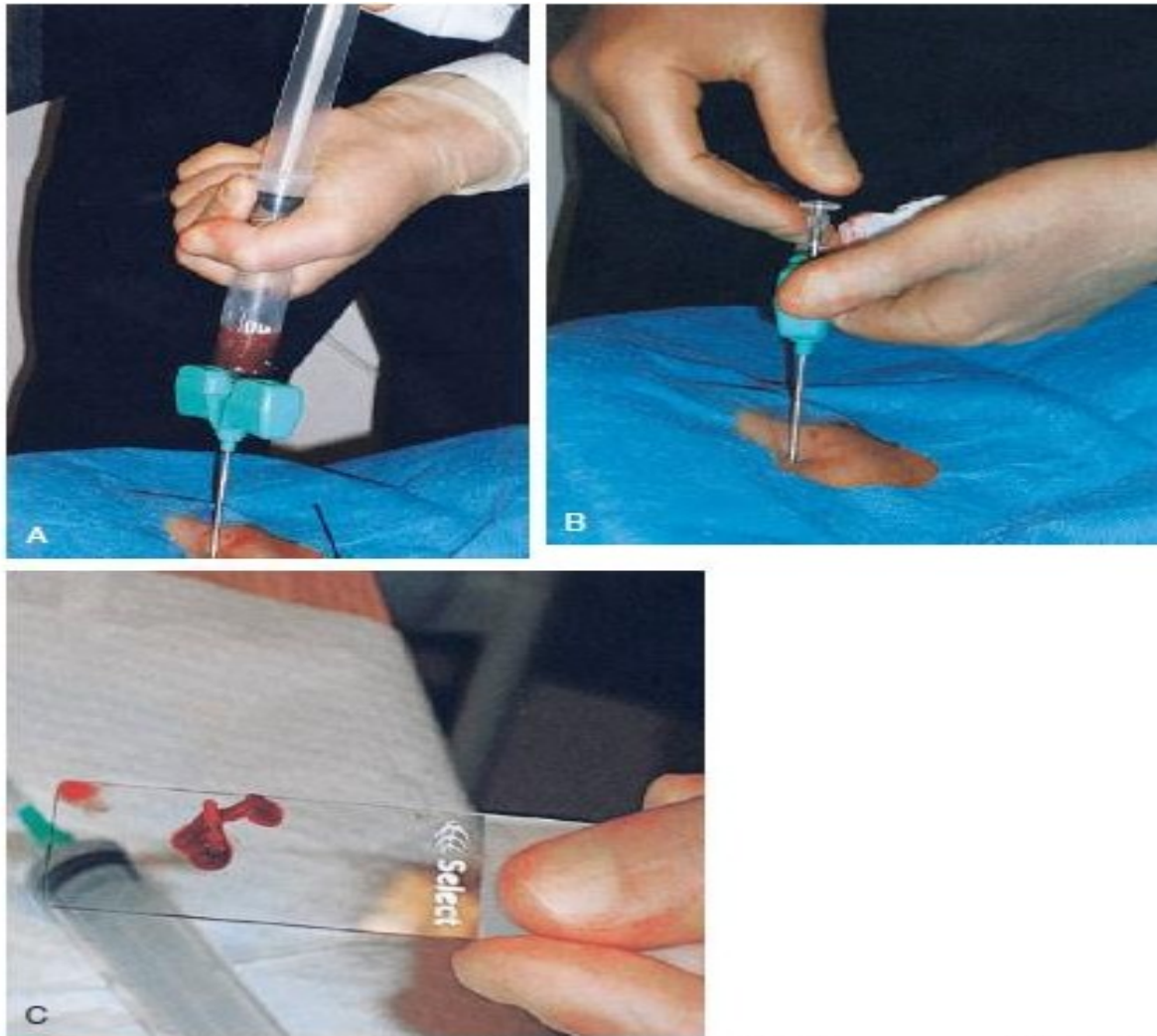
DONOR



2. Stem cells or marrow cells are mixed with an anticoagulating agent and strained to remove bits of bone and fat.

3. Stem cells or marrow cells are given intravenously via a catheter implanted in the upper chest and leading to a central vein.

PATIENT



**FIGURE 13-16 Bone marrow aspiration and biopsy.** **A,** Placement of a bone marrow needle into the iliac crest (upper portion of hipbone) and aspiration of liquid bone marrow. **B,** Trephine needle is then inserted and anchored in the bone. **C,** A solid piece of bone marrow (biopsy sample) is then extracted through the needle.

# TERMINOLOGY


## COMBINING FORMS

COMBINING FORM	MEANING	TERMINOLOGY	MEANING
bas/o	base ( <i>alkaline</i> , the opposite of acid)	<u>basophil</u> _____ <i>The suffix -phil means attraction to.</i>	
chrom/o	color	<u>hypochromic</u> _____ <i>Hypochromic anemia is marked by a decreased concentration of hemoglobin in red blood cells.</i>	
coagul/o	clotting	<u>anticoagulant</u> _____ <u>coagulopathy</u> _____	
cyt/o	cell	<u>cytology</u> _____	
eosin/o	red, dawn, rosy	<u>eosinophil</u> _____	
erythr/o	red	<u>erythroblast</u> _____ <i>-blast means immature.</i>	

granul/o	granules	<u>granulocyte</u> _____
hem/o	blood	<u>hemolysis</u> _____ <i>Destruction or breakdown of red blood cells. See hemolytic anemia, page 516.</i>
hemat/o	blood	<u>hematocrit</u> _____ <i>The suffix -crit means to separate. The hematocrit gives the percentage of red blood cells in a volume of blood. See page 521.</i>
hemoglobin/o	hemoglobin	<u>hemoglobinopathy</u> _____
is/o	same, equal	<u>anisocytosis</u> _____ <i>An abnormality of red blood cells; they are of unequal (anis/o) size; -cytosis means an increase in the number of cells.</i>
kary/o	nucleus	<u>megakaryocyte</u> _____
leuk/o	white	<u>leukopenia</u> _____
mon/o	one, single	<u>monocyte</u> _____ <i>The cell has a single, rather than a multilobed, nucleus.</i>
morph/o	shape, form	<u>morphology</u> _____

COMBINING FORM	MEANING	TERMINOLOGY	MEANING
<b>myel/o</b>	bone marrow	<u>myeloblast</u> _____ <i>The suffix -blast indicates an immature cell.</i>	
		<u>myelodysplasia</u> _____ <i>This is a preleukemic condition.</i>	
<b>neutr/o</b>	neutral (neither base nor acid)	<u>neutropenia</u> _____ <i>This term refers to neutrophils.</i>	
<b>nucle/o</b>	nucleus	polymorphon <u>uclear</u> _____	
<b>phag/o</b>	eat, swallow	<u>phagocyte</u> _____	
<b>poikil/o</b>	varied, irregular	<u>poikilocytosis</u> _____ <i>Irregularity in the shape of red blood cells. Poikilocytosis occurs in certain types of anemia.</i>	
<b>sider/o</b>	iron	<u>sideropenia</u> _____	
<b>spher/o</b>	globe, round	<u>spherocytosis</u> _____ <i>In this condition, the erythrocyte has a round shape, making the cell fragile and easily able to be destroyed.</i>	
<b>thromb/o</b>	clot	<u>thrombocytopenia</u> _____	

## SUFFIXES

SUFFIX	MEANING	TERMINOLOGY	MEANING
-apheresis 	removal, a carrying away	<p>plasm<u>a</u>pheresis _____  <i>A centrifuge spins blood to remove plasma from the other parts of blood.</i></p> <p>leuk<u>a</u>pheresis _____</p> <p>platelet<u>a</u>pheresis _____  <i>Note that the a of apheresis is dropped in this term. Platelets are removed from the donor's blood (and used in a patient), and the remainder of the blood is reinfused into the donor.</i></p>	
-blast	immature cell, embryonic	monob <u>l</u> ast _____	

SUFFIX	MEANING	TERMINOLOGY	MEANING
-cytosis	abnormal condition of cells (increase in cells)	macrocytosis _____ <i>Macrocytes are erythrocytes that are larger (macro-) than normal.</i>  microcytosis _____ <i>These are erythrocytes that are smaller (micro-) than normal.</i> <i>Table 13-3 reviews terms related to abnormalities of red blood cell morphology.</i>	
-emia	blood condition	leukemia _____ <i>See page 518.</i>	
-gen	giving rise to; producing	fibrinogen _____ <i>Fibrin is a protein that forms the basis of a blood clot.</i>	
-globin	protein	hemoglobin _____	
-globulin		immunoglobulin _____	
-lytic	pertaining to destruction	thrombolytic therapy _____ <i>Used to dissolve clots.</i>	

-oid	derived or originating from	myeloid _____
-osis	abnormal condition	thrombosis _____
-penia	deficiency	granulocytopenia _____ pancytopenia _____
-phage	eat, swallow	macrophage _____ <i>A large phagocyte that destroys worn-out red blood cells and foreign material.</i>

**-philia**

attraction for (an  
increase in cell  
numbers)

eosinphilia \_\_\_\_\_

neutrophilia \_\_\_\_\_

**-phoresis**

carrying,  
transmission

electrophoresis \_\_\_\_\_

**-poiesis**

formation

hematopoiesis \_\_\_\_\_

erythropoiesis \_\_\_\_\_

*Erythropoietin is produced by the kidneys to stimulate  
erythrocyte formation.*

myelopoiesis \_\_\_\_\_

**-stasis**

stop, control

hemostasis \_\_\_\_\_

**TABLE 13-3****ABNORMALITIES OF RED BLOOD CELL MORPHOLOGY**

<b>Abnormality</b>	<b>Description</b>
<b>Anisocytosis</b>	Cells are <b>unequal</b> in size
<b>Hypo<b>chromia</b></b>	Cells have reduced <b>color</b> (less hemoglobin)
<b>Macrocytosis</b>	Cells are <b>large</b>
<b>Microcytosis</b>	Cells are <b>small</b>
<b>Poikilocytosis</b>	Cells are <b>irregularly shaped</b>
<b>Spherocytosis</b>	Cells are <b>rounded</b>

# ABBREVIATIONS



## ABBREVIATIONS

<b>Ab</b>	antibody	<b>DIC</b>	disseminated intravascular coagulation—bleeding disorder marked by reduction in blood clotting factors due to their use and depletion for intravascular clotting
<b>ABMT</b>	autologous bone marrow transplantation—patient serves as his or her own donor for stem cells	<b>diff</b>	differential count (white blood cells)
<b>ABO</b>	four main blood types—A, B, AB, and O	<b>EBV</b>	Epstein-Barr virus; cause of mononucleosis
<b>ALL</b>	acute lymphocytic leukemia	<b>eos</b>	eosinophils
<b>AML</b>	acute myelogenous leukemia	<b>EPO</b>	erythropoietin
<b>ANC</b>	absolute neutrophil count—total WBC times a measure of the number of bands and segs present in the blood; an ANC less than 1500 cells/uL is neutropenia	<b>ESR</b>	erythrocyte sedimentation rate
<b>ASCT</b>	autologous stem cell transplantation	<b>Fe</b>	iron

<b>bands</b>	immature white blood cells (granulocytes)	<b>G-CSF</b>	granulocyte colony-stimulating factor— promotes neutrophil production
<b>baso</b>	basophils	<b>GM-CSF</b>	granulocyte-macrophage colony- stimulating factor—promotes myeloid progenitor cells with differentiation to granulocytes
<b>BMT</b>	bone marrow transplantation		
<b>CBC</b>	complete blood count		
<b>CLL</b>	chronic lymphocytic leukemia	<b>g/dL</b>	gram per deciliter (1 deciliter = one tenth of a liter; 1 liter = 1.057 quarts)
<b>CML</b>	chronic myelogenous leukemia		

<b>GVHD</b>	graft-versus-host disease—immune reaction of donor's cells to recipient's tissue	<b>MDS</b>	myelodysplastic syndrome—preleukemic condition (anemia, cytopenias, and possible transformation to AML)
<b>HCL</b>	hairy cell leukemia—abnormal lymphocytes accumulate in bone marrow, leading to anemia, thrombocytopenia, neutropenia, and infection	<b>mm<sup>3</sup></b>	cubic millimeter—one millionth of a liter; 1 liter = 1.057 quarts
<b>Hct</b>	hematocrit	<b>mono</b>	monocyte
<b>Hgb, HGB</b>	hemoglobin	<b>polys, PMNs, PMNLs</b>	polymorphonuclear leukocytes; neutrophils, eosinophils, basophils
<b>H and H</b>	hemoglobin and hematocrit	<b>PT, pro time</b>	prothrombin time
<b>HLA</b>	human leukocyte antigen		

<b>IgA, IgD, IgE, IgG, IgM</b>	immunoglobulins	<b>PTT</b>	partial thromboplastin time
		<b>RBC</b>	red blood cell; red blood cell count
<b>lymphs</b>	lymphocytes	<b>sed rate</b>	erythrocyte sedimentation rate
<b>MCH</b>	mean corpuscular hemoglobin—average amount of hemoglobin per cell	<b>segs</b>	segmented, mature white blood cells (neutrophils)
<b>MCHC</b>	mean corpuscular hemoglobin concentration—average concentration of hemoglobin in a single red cell; when MCHC is low, the cell is hypochromic	<b>SMAC</b>	Sequential Multiple Analyzer Computer—an automated chemistry system that determines substances in serum
<b>MCV</b>	mean corpuscular volume—average volume or size of a single red blood cell; when MCV is high, the cells are macrocytic, and when low, the cells are microcytic	<b>μL</b>	microliter—one millionth of a liter; 1 liter = 1.057 quarts
		<b>WBC</b>	white blood cell; white blood cell count
		<b>WNL</b>	within normal limits

**THANK YOU**