BLOOD PRACTICAL

(Complete Blood Count (CBC), ESR, TLC and DLC)

Dr. Taj

Complete Blood Count (CBC)

Coulter Technology Center
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Miami, FL 33116-9015

	Cass / Pos	Sample ID	Date	Time	Run Status	Instrument	Operator
)	A 005501	205933	9/17/2013	11:03:24	Completed	Instrument 1	LABADMIN

ıtient ID	Last Name	First Name
ınder	Seq #	Drawn Date
ɔcation	Age	User Field 1
ıysician ,		User Field 2
ıte of Birth		User Field 3
ɔmments:		

ɹport Name All Parameters Last Modified: By: DEFAULT

WBC	8.1	10^3/µL	RBC	4.91	10^6/µL	RET %		
			HGB	13.6 L	g/dL	RET #		
NE %	51.4	%	HCT	40.2	%	MRV		
LY %	39.0	%	MCV	81.9	fL	IRF		
MO %	7.8	%	MCH	27.6	pg			
EO %	1.2	%	MCHC	33.7	g/dL			
BA %	0.6	%	RDW	13.0	%			
			RDW-SD	38.1	fL			
NE #	4.2	10^3/µL						
LY #	3.2	10^3/µL						
MO #	0.6	10^3/µL	PLT	279	10^3/µL			
EO #	0.1	10^3/µL	MPV	9.2	fL			
BA #	0.0	10^3/µL						

(DLC & TLC)

Differential Leukocyte Count, Total Leukocyte Count

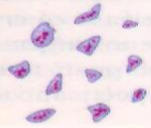
Cell type	Occurrence in blood (per mm^3)	Cell anatomy*	Function
Erythrocytes (red blood cells, or RBCs) 	4–6 million	Salmon-colored biconcave disks; anucleate; literally, sacs of hemoglobin; most organelles have been ejected	Transport oxygen bound to hemoglobin molecules; also transport small amount of carbon dioxide
Leukocytes (white blood cells, or WBCs)	4000–11,000		
Granulocytes			
• Neutrophils 	3000–7000 (40–70% of WBCs)	Cytoplasm stains pale pink and contains fine granules, which are difficult to see; deep purple nucleus consists of three to seven lobes connected by thin strands of nucleoplasm	Active phagocytes; number increases rapidly during short-term or acute infections
• Eosinophils 	100–400 (1–4% of WBCs)	Red coarse cytoplasmic granules; figure-8 or bilobed nucleus stains blue-red	Kill parasitic worms; increase during allergy attacks; might phagocytize antigen-antibody complexes and inactivate some inflammatory chemicals
• Basophils 	20–50 (0–1% of WBCs)	Cytoplasm has a few large blue-purple granules; U- or S-shaped nucleus with constrictions, stains dark blue	Granules contain histamine (vasodilator chemical), which is discharged at sites of inflammation
Agranulocytes			
• Lymphocytes 	1500–3000 (20–45% of WBCs)	Cytoplasm pale blue and appears as thin rim around nucleus; spherical (or slightly indented) dark purple-blue nucleus	Part of immune system; one group (B lymphocytes) produces antibodies; other group (T lymphocytes) involved in graft rejection, fighting tumors and viruses, and activating B lymphocytes
• Monocytes 	100–700 (4–8% of WBCs)	Abundant gray-blue cytoplasm; dark blue-purple nucleus often kidney-shaped	Active phagocytes that become macrophages in the tissues; long-term "clean-up team"; increase in number during chronic infections such as tuberculosis
Platelets 	250,000–500,000	Essentially irregularly shaped cell fragments; stain deep purple	Needed for normal blood clotting; initiate clotting cascade by clinging to broken area; help to control blood loss from broken blood vessels

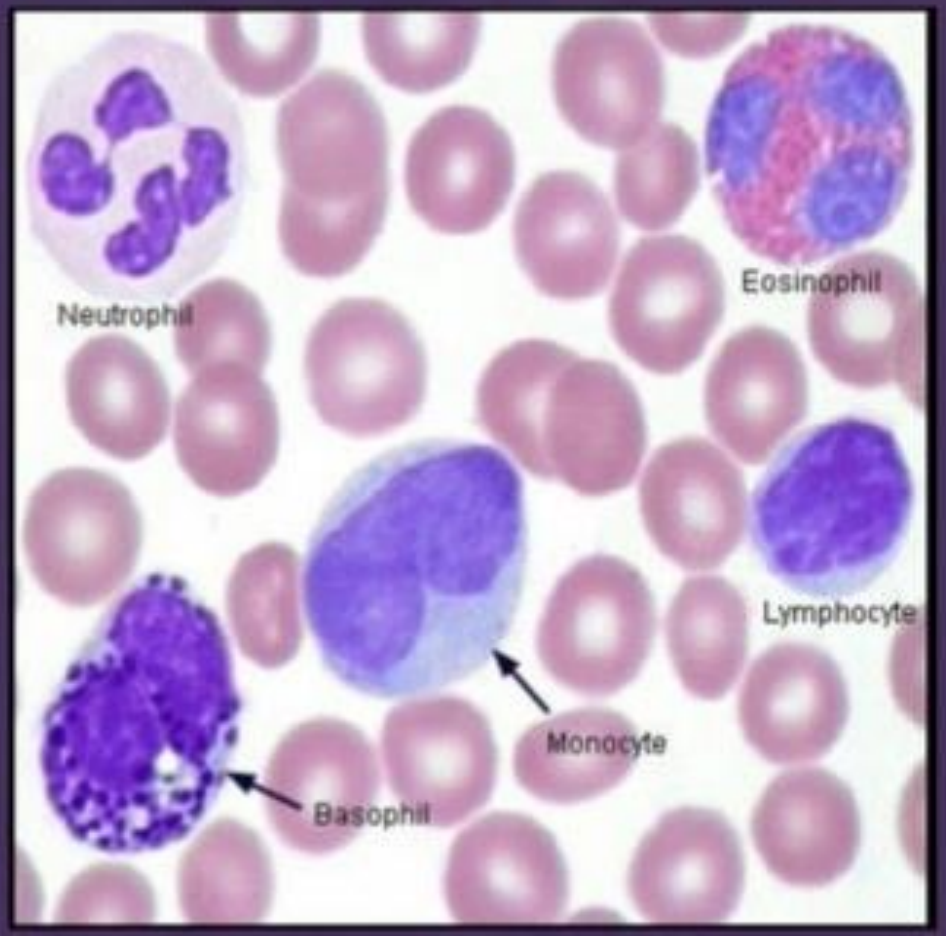
TABLE 1.2

Appearance of white blood corpuscles in a stained blood film

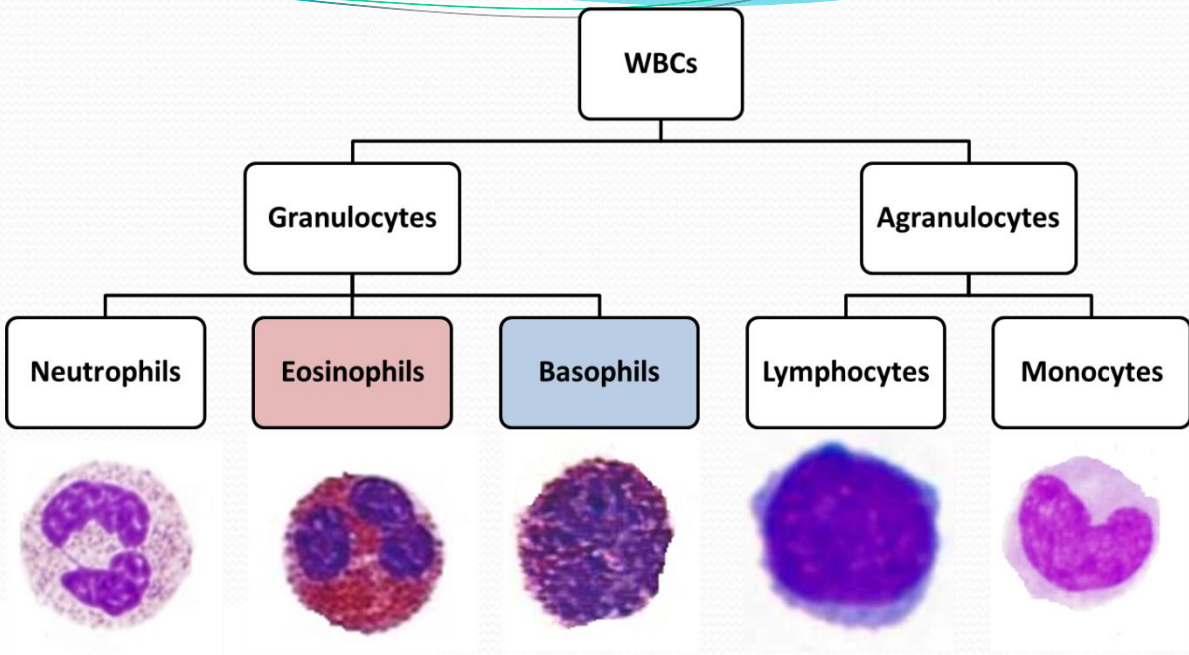
Cell type	Diameter (μm)	Nucleus	Cytoplasm	Cytoplasmic granules
Granulocytes				
Neutrophils (40-70%)	10-14 (1.5-2X a RBC)	• Blue-violet. • 2-6 lobes, connected by chromatin threads. Seen clearly through cytoplasm.	• Slate-blue in color.	• Fine, closely-packed violet-pink. • Not seen separately. • Give ground-glass appearance. • Do not cover nucleus.
Eosinophils (1-6%)	10-15	• Blue-violet • 2-3 lobes, often bi-lobed, lobes connected by thick or thin chromatin band. • Seen clearly through cytoplasm.	• Eosinophilic. • Light pink-red. • Granular.	• Large, coarse. • Uniform-sized. • Brick-red to orange. • Seen separately. • Do not cover nucleus.
Basophils (0-1%)	10-15	• Blue-violet. • Irregular shape, may be S-shaped, rarely bilobed. • Not clearly seen, because overlaid with granules.	• Basophilic. • Bluish. • Granular.	• Large, very coarse. • Variable-sized. • Deep purple. • Seen separately. • Completely fill the cell, and cover the nucleus.

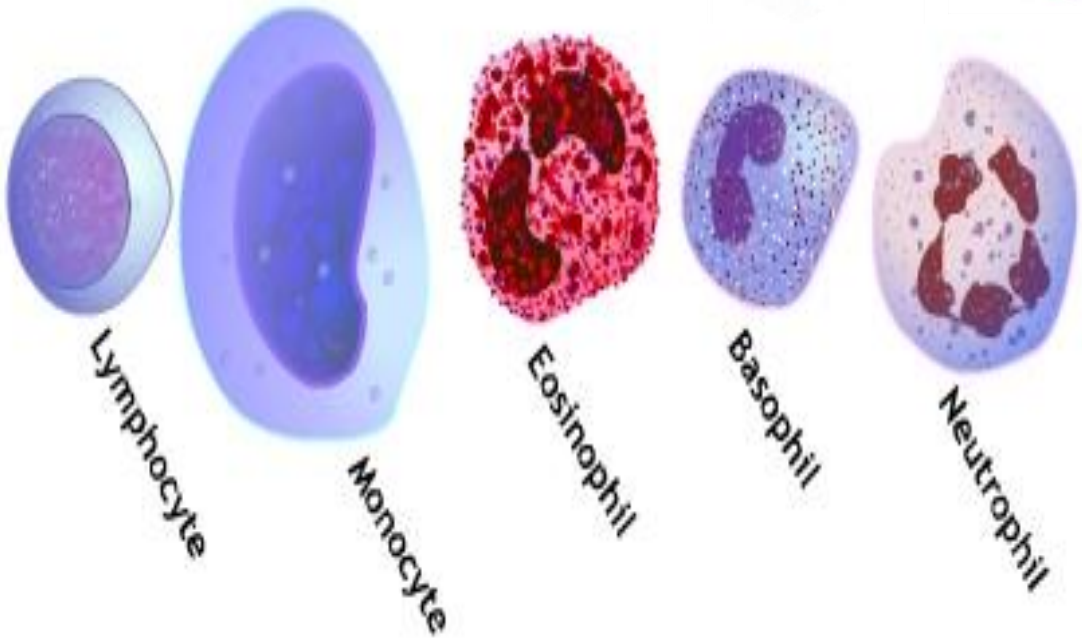
Agranulocytes				
Monocytes (5-10%)	12-20 (1.5-3 X a RBC)	• Pale blue-violet. • Large single. • May be indented horse-shoe, or kidney shaped (can appear oval or round, if seen from the side).	• Abundant. • 'Frosty'. • Slate-blue. • Amount may be larger than that of nucleus.	• No visible granules.
Small Lymphocyte (20-40%)	7-9	• Deep blue-violet. • Single, large, round, almost fills cell. • Condensed, lumpy chromatin, gives 'ink-spot' appearance.	• Hardly visible. • Thin crescent of clear, light blue cytoplasm.	• No visible granules.
Large lymphocyte (5-10½)	10-15	• Deep blue-violet. • Single, large, round or oval, almost fills cell. • May be central or eccentric.	• Large, crescent of clear, light blue cytoplasm. • Amount larger than in small lymphocyte.	• No visible granules.

NORMAL PERIPHERAL BLOOD SMEAR



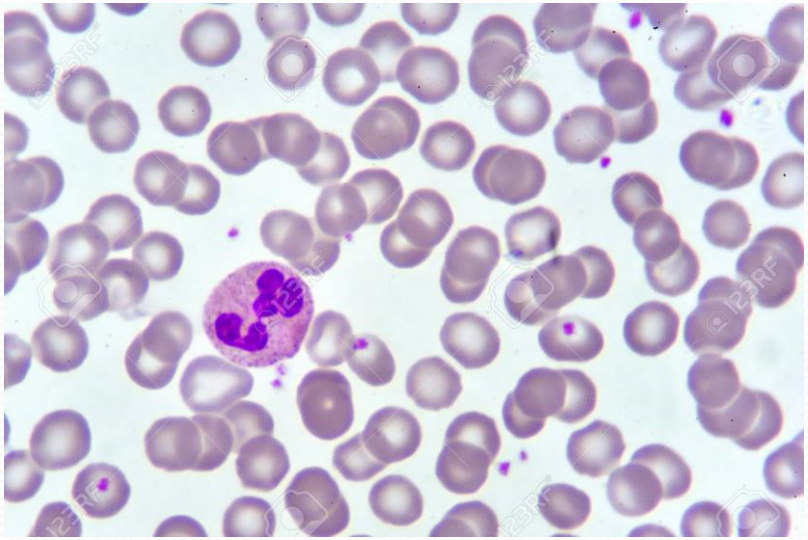
Granulocyte vs. Agranulocyte





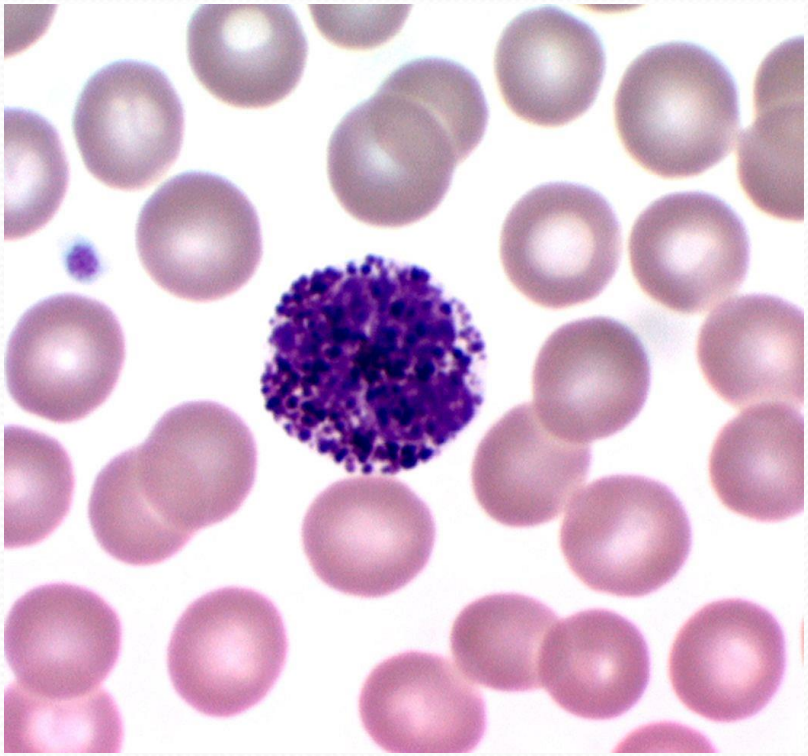
NEUTROPHILS (Segmented and Band)

- Small violet pink granules
- Multilobed
- Usually thin filaments present connecting the nuclei.



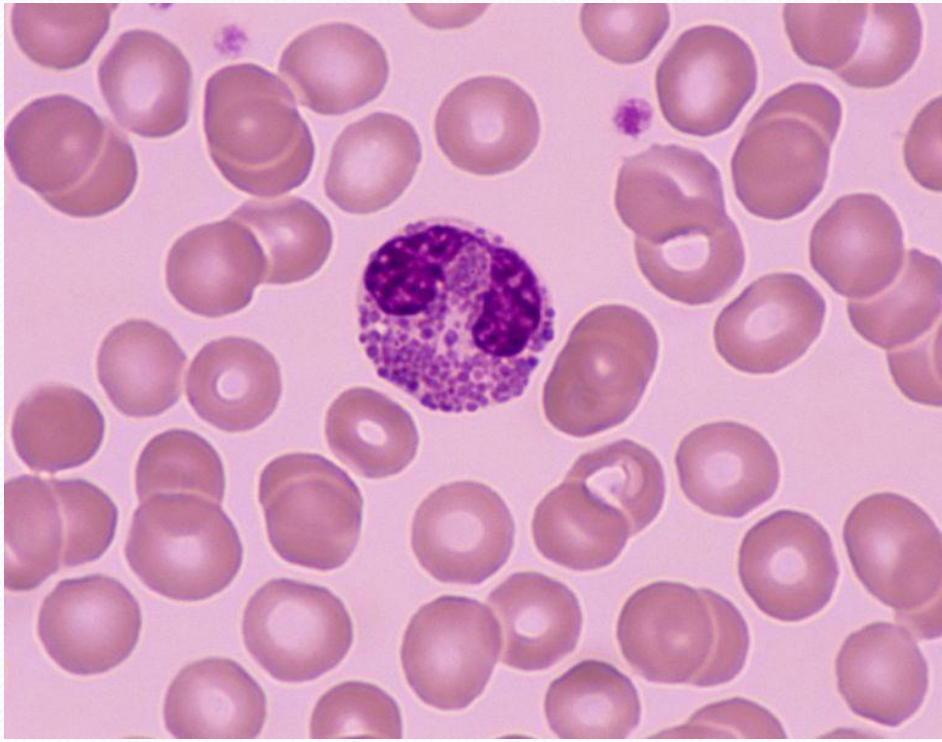
BASOPHILS

- Small rare cell
- Granular with densely packed dark violet/blue granules.
- Small non-segmented nucleus but often hardly visible amongst the dark granules.



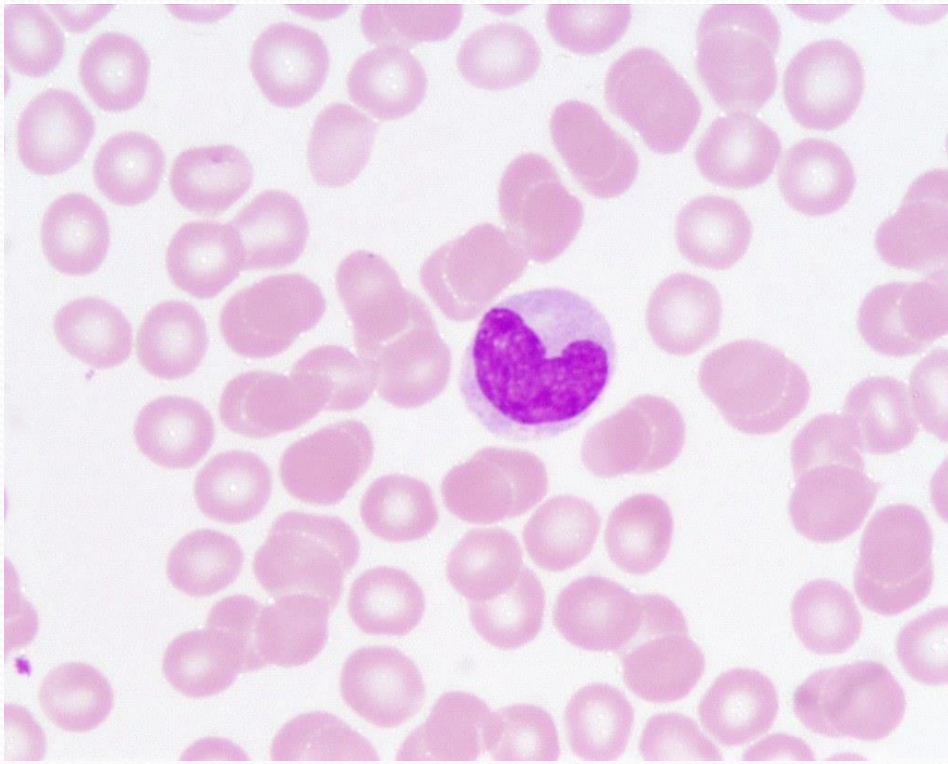
EOSINOPHILS

- Granular with Red Orange granules.
- Usually bi-lobed nuclei.



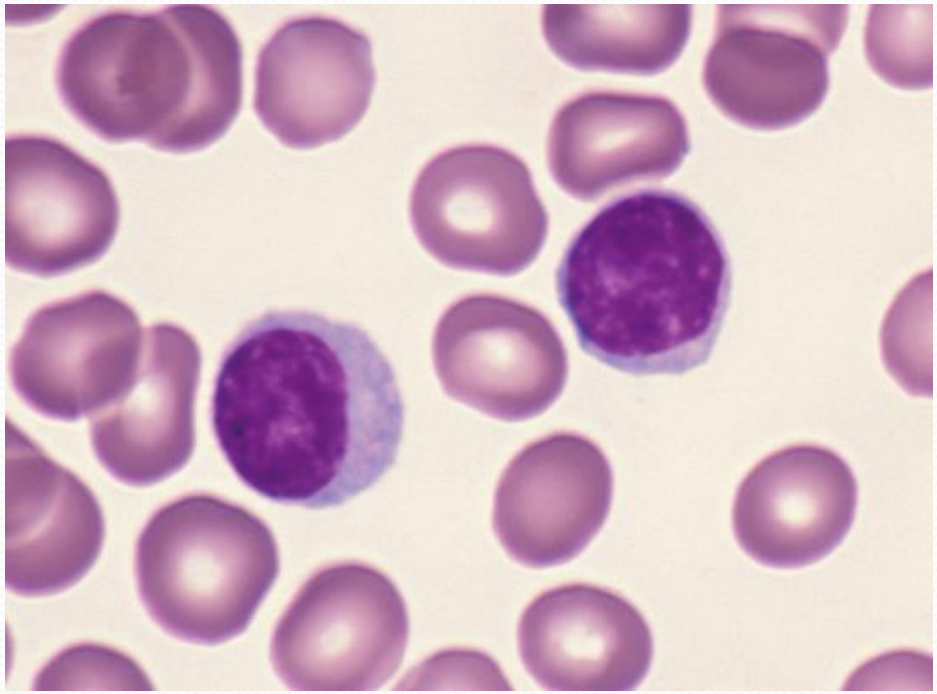
MONOCYTES

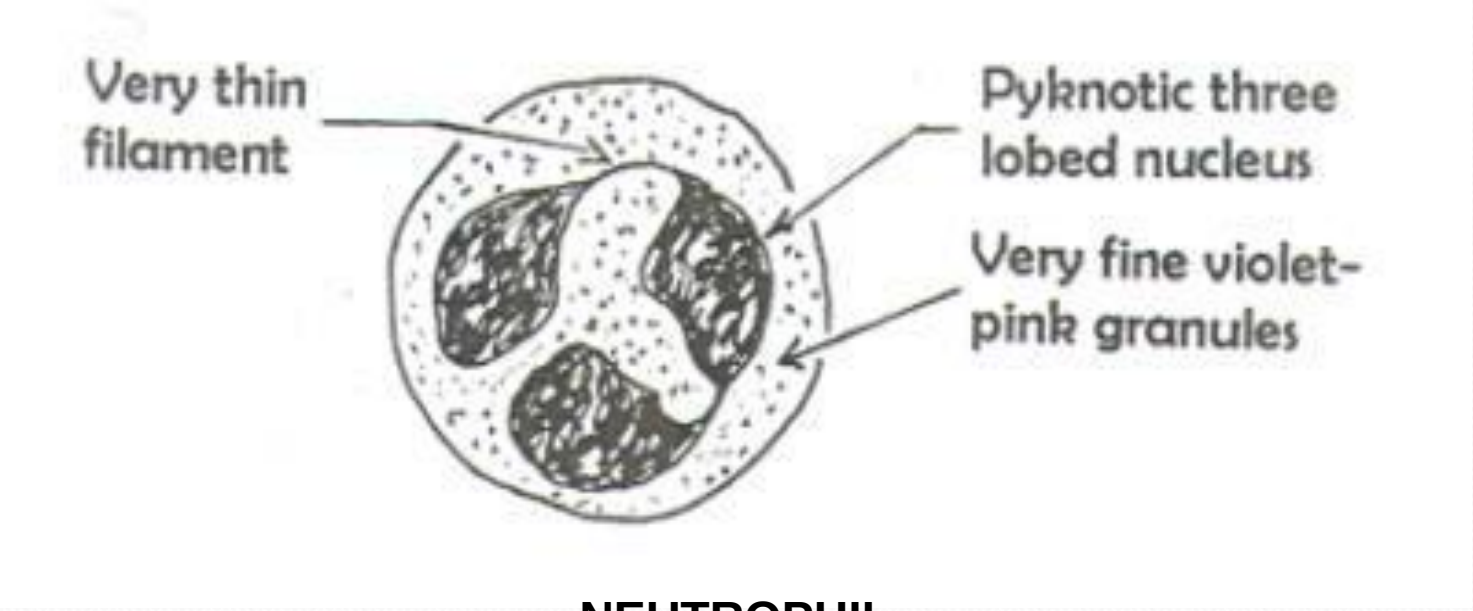
- Agranular cytoplasm but some small red dust like particles may be seen.
- Kidney shaped or Horse shoe shaped nucleus.



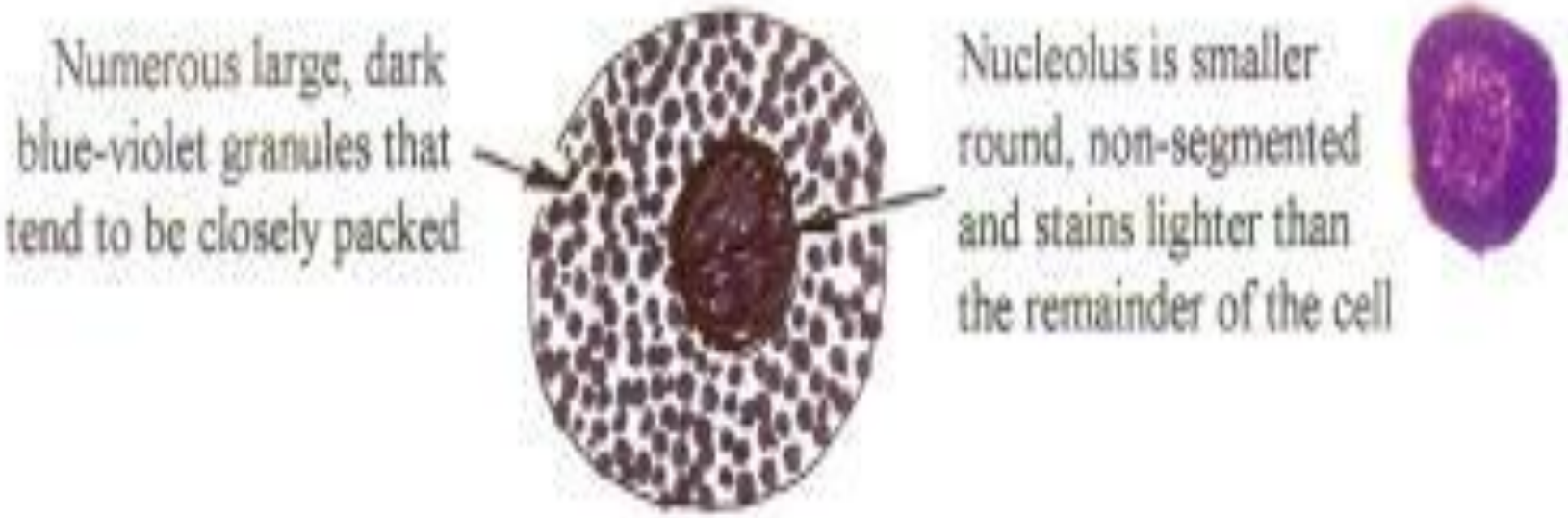
LYMPHOCYTES

- Agranular cytoplasm
- Large round blue / violet stained nucleus. Which covers a large part of the cytoplasm. (Ring)

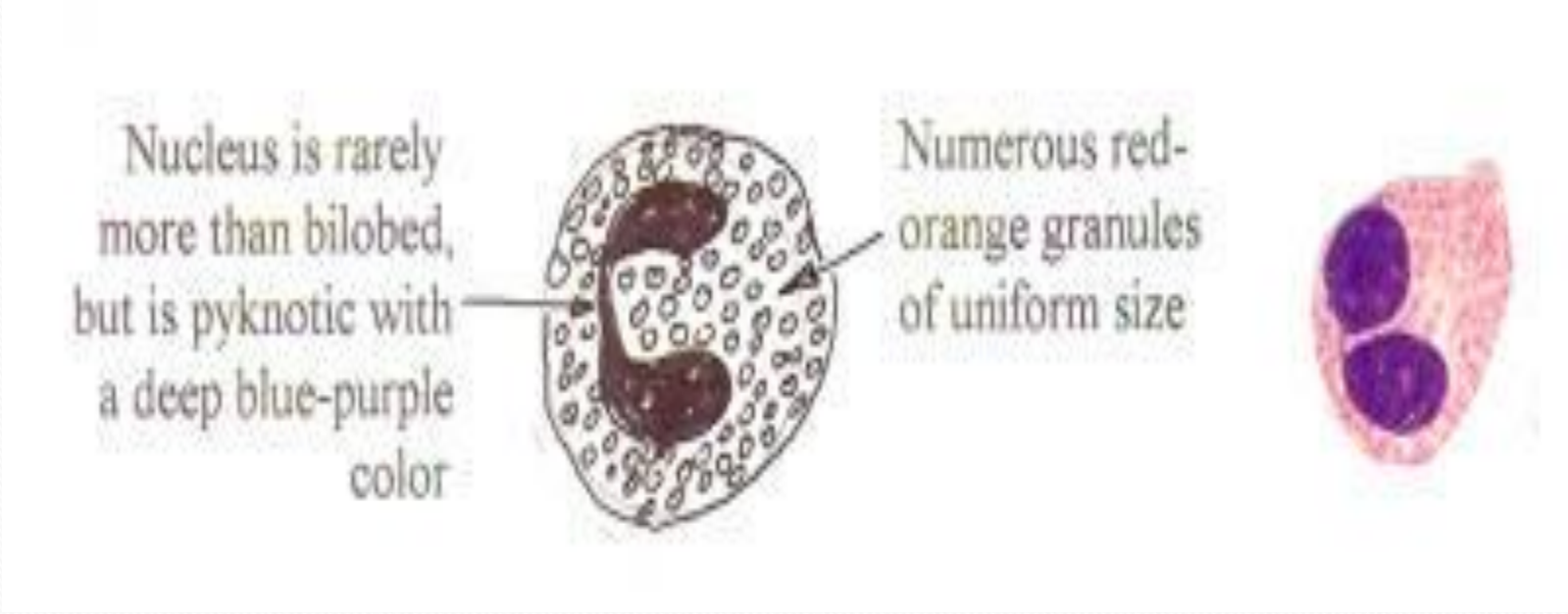



Very thin filament
Pyknotic three lobed nucleus
Very fine violet-pink granules

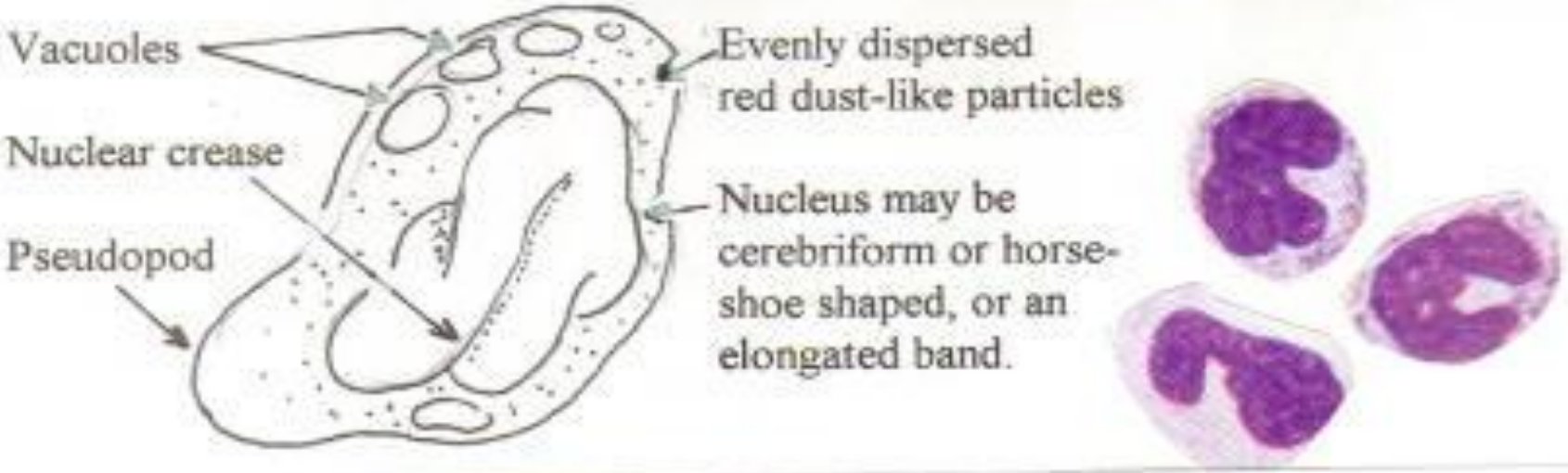
NEUTROPHIL


Numerous large, dark blue-violet granules that tend to be closely packed
Nucleolus is smaller round, non-segmented and stains lighter than the remainder of the cell

BASOPHIL

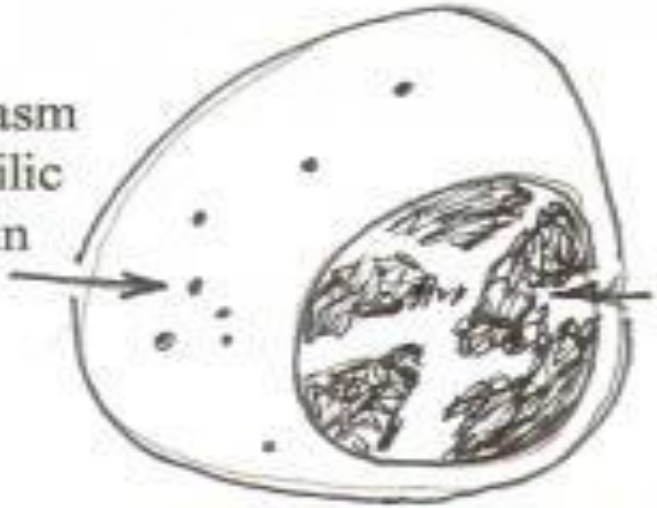

Nucleus is rarely more than bilobed, but is pyknotic with a deep blue-purple color
Numerous red-orange granules of uniform size

EOSINOPHIL


Vacuoles
Nuclear crease
Pseudopod
Evenly dispersed red dust-like particles
Nucleus may be cerebriform or horse-shoe shaped, or an elongated band.

MONOCYTE

Abundant cytoplasm contains azurophilic granules, lighter in coloration than moderate size lymphocyte



Eccentric nucleus

LARGE LYMPHOCYTE

Scanty cytoplasm (staining from sky-blue to darker hues)

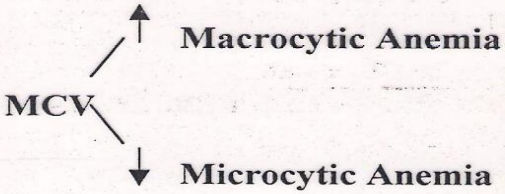
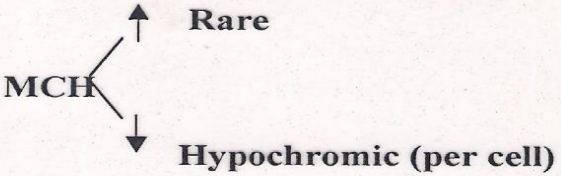
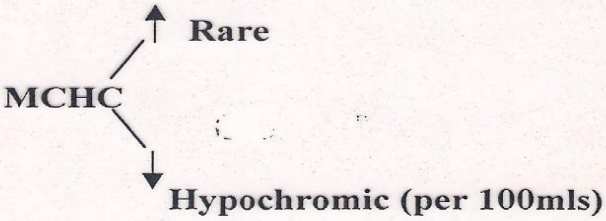
Eccentric nucleus is round to oval

Chromatin is homogenous with coarse appearance

SMALL LYMPHOCYTE

CLASSIFICATION OF ANEMIA

Anemias are usually classified on the basis of RBC's morphology or aetiology of Anemias.

AETIOLOGICAL CLASSIFICATION	MORPHOLOGICAL CLASSIFICATION
1. **BLOOD LOSS ANEMIA.** Seen after rapid blood loss (Hemorrhage). The plasma is replaced within 1-3 day while the RBCs take 3-6 weeks to be replaced.	
2. **APLASTIC ANEMIA** Lack or absence of functioning bone marrow due to Radiation, Certain chemical and some drugs.	
3. **MAGALOBLASTIC ANEMIA** Large sized RBCs due to lack or absence of Vit. B_{12}, Folic Acid and Intrinsic factor. This leads to slow reproduction and maturational failure, Hence the Large sized RBCs. Gastric atrophy and Gastractomy can lead to this.	
4. **HEMOLYTIC ANEMIA** Abnormalities (mostly genetic) making the cells fragile and prone to easy rupture. eg. (S.C.D) the cells have abnormal "S" Hb that crystallizes at low O_2 tension. These crystals cause elongation (sickle shape) of the RBCs. Extensive crystallization leads to Haemolysis.	

INDICES

INDICES:

1. **Mean Cell Volume:**
This is the volume of an average RBC measured in cubic microns.

$$MCV = \frac{\text{Packed Cell Volume} \times 10}{\text{RBC count}}$$ **(78-98 µm^3)**

2. **Mean Cell Hemoglobin:**
This is the weight of hemoglobin in an average RBC measured in picograms (pg) = micro-microgram (µµg).

$$MCH = \frac{\text{Hemoglobin Concentration} \times 10}{\text{RBC count}}$$ **(27-32 µµg)**

3. **Mean Cell Hemoglobin Concentration:**
This is the concentration of hemoglobin per 100 mls of RBCs measured in g/dl.

$$MCHC = \frac{\text{Hemoglobin Concentration} \times 100}{\text{Packed Cell volume}}$$ **(30-35 g/dl)**

Erythrocyte Sedimentation Rate (ESR) or (Sed. Rate)

Adults (Westergren method)

- Men under 50 years old: < 15 mm/hr
- Men over 50 years old: < 20 mm/hr
- Women under 50 years old: < 20 mm/hr
- Women over 50 years old: < 30 mm/hr

Children (Westergren method)

- Newborn: 0-2 mm/hr
- Newborn to puberty: 3-13 mm/hr

Erythrocyte Sedimentation Rate (ESR)

What is meant by rouleaux formation?

- When red blood cells are stacked together in long columns or chains because of their biconcave disc like surfaces sticking to each other, it is called Rouleaux formation.

Erythrocyte Sedimentation Rate (ESR) cont….

What is the clinical significance of E.S.R.?

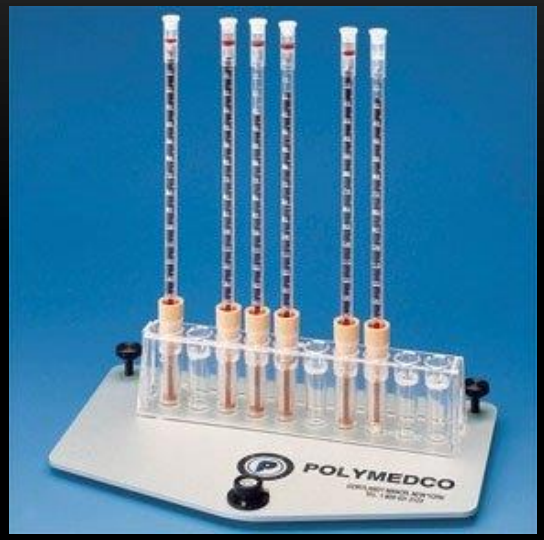
- This is a non-specific indicator of presence of a disease (Diagnostic).
- This is a useful (Prognostic) tool.

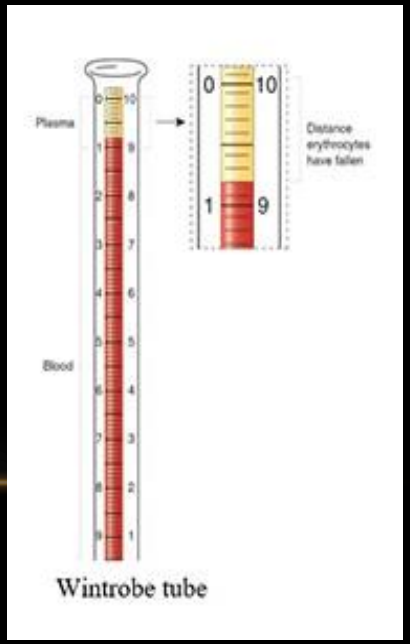
Erythrocyte Sedimentation Rate (ESR) cont…

What conditions are associated with an increased E.S.R.?

- Infections
- Connective tissue disorders
- Inflammatory disorders
- Malignancies
- Anemia
- Pregnancy

WESTERGREN TUBES





Wintrobe tube

THANK YOU