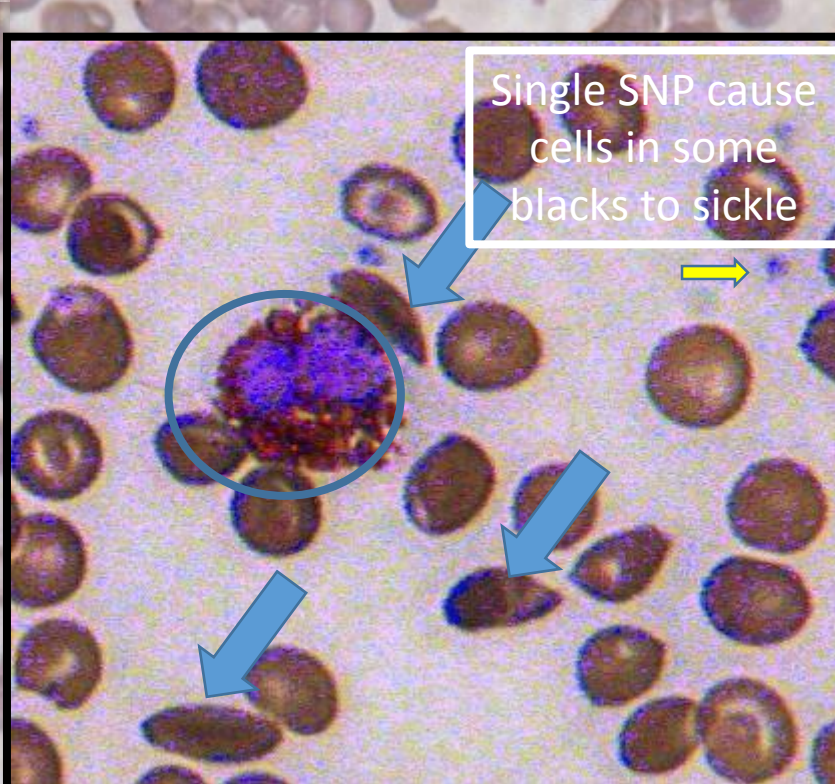
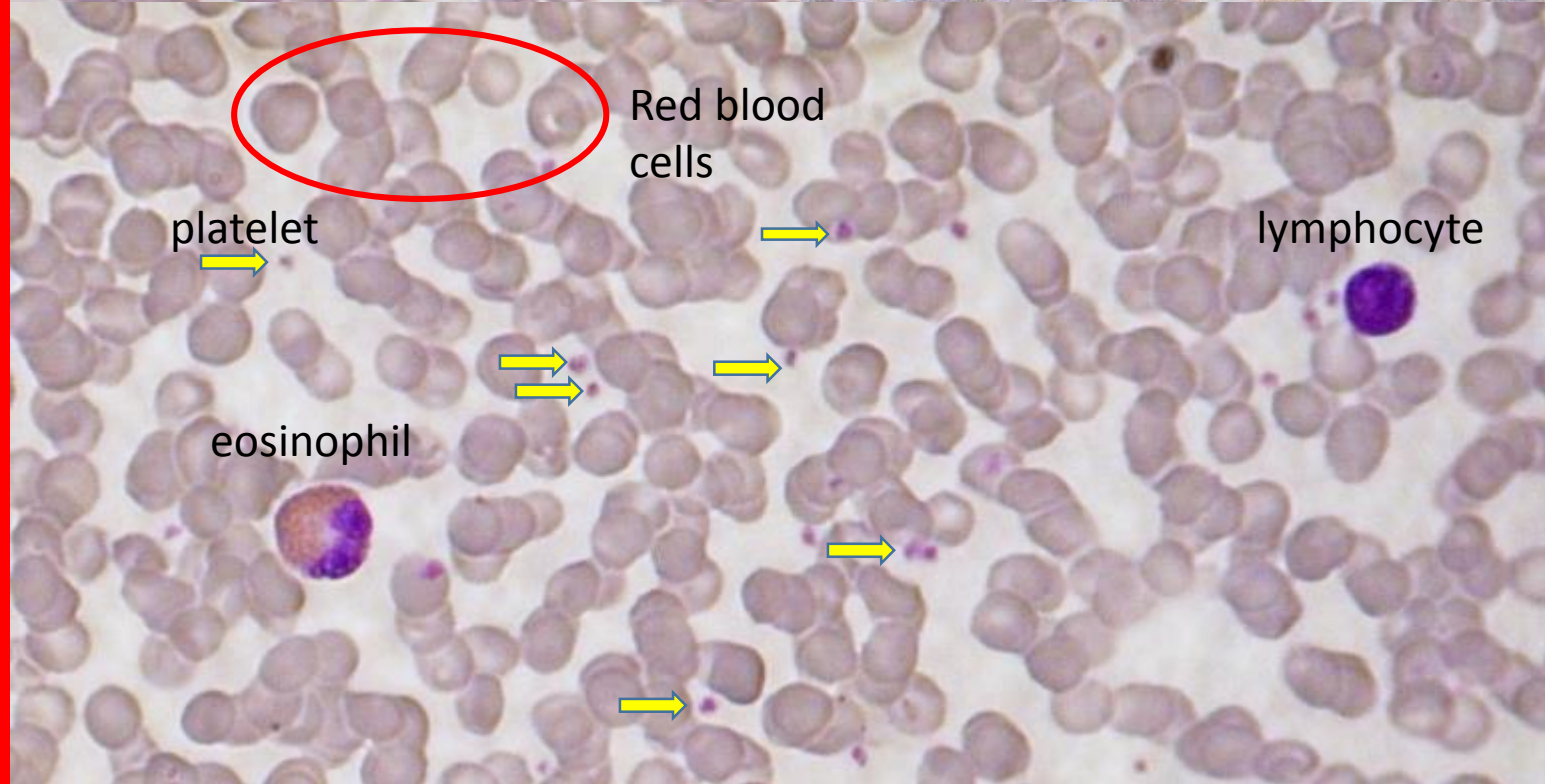
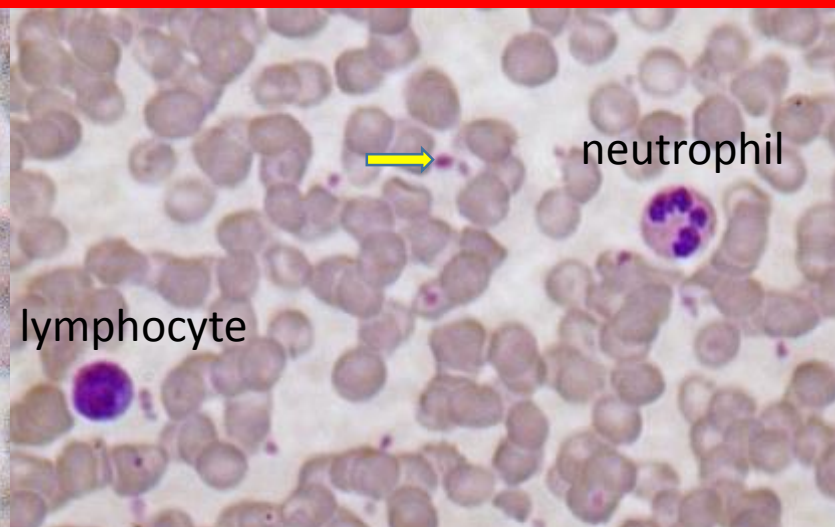
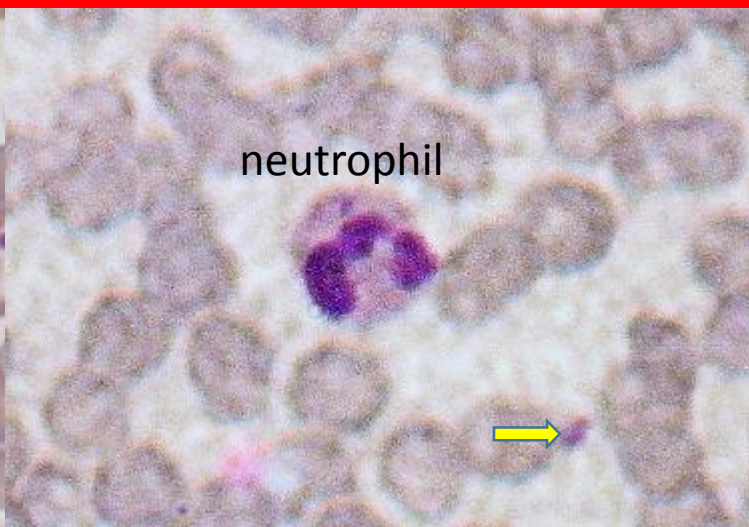
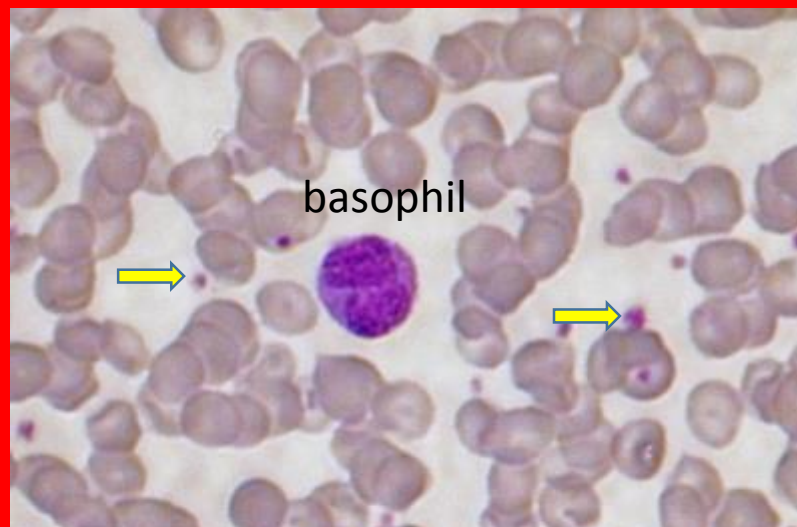


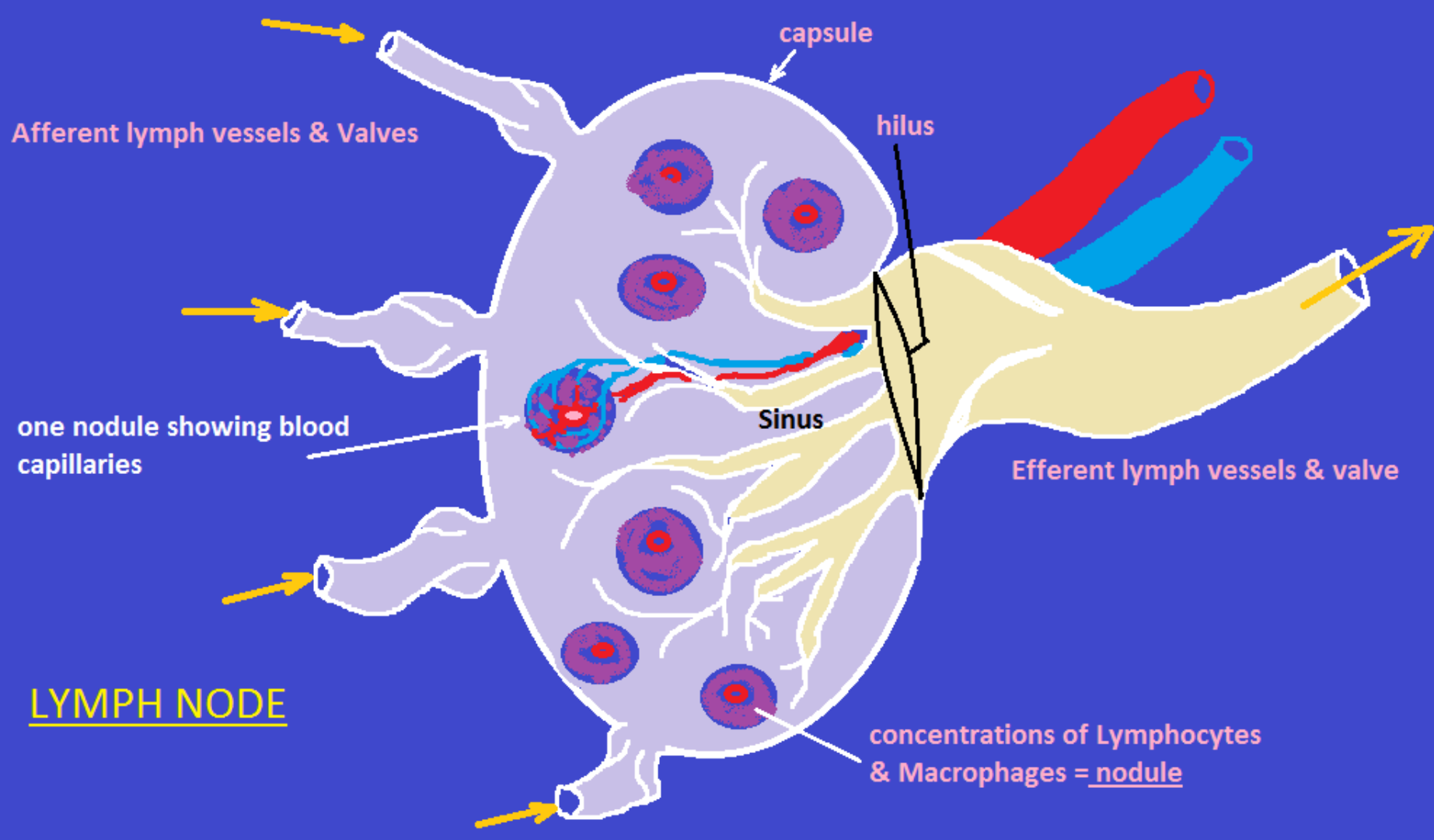
Blood, Lymphatic System & Immunity





Lymphatic System:

**Spleen, Thymus,
Lymph Nodes,
Lymph Nodules,
Lymph Vessels and
the Immune
System**



Afferent lymph vessels & Valves

capsule

hilus

one nodule showing blood capillaries

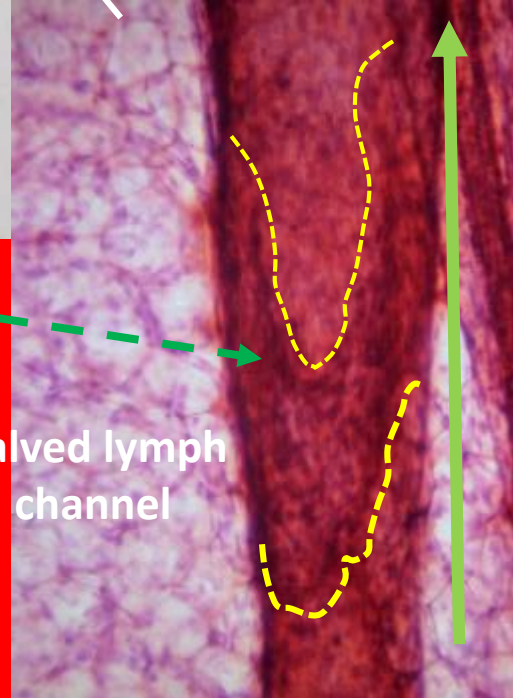
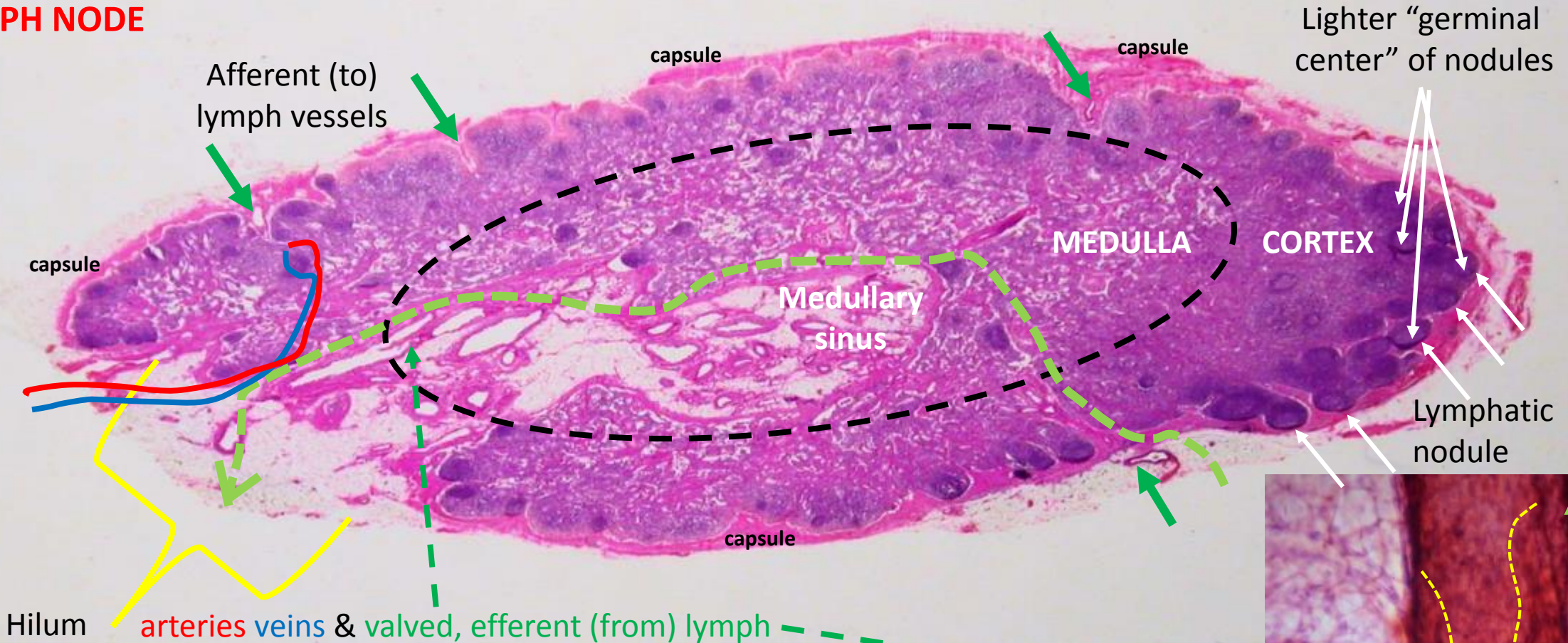
Sinus

Efferent lymph vessels & valve

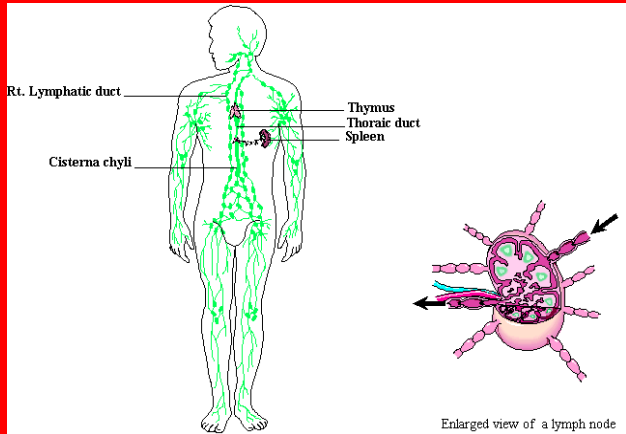
LYMPH NODE

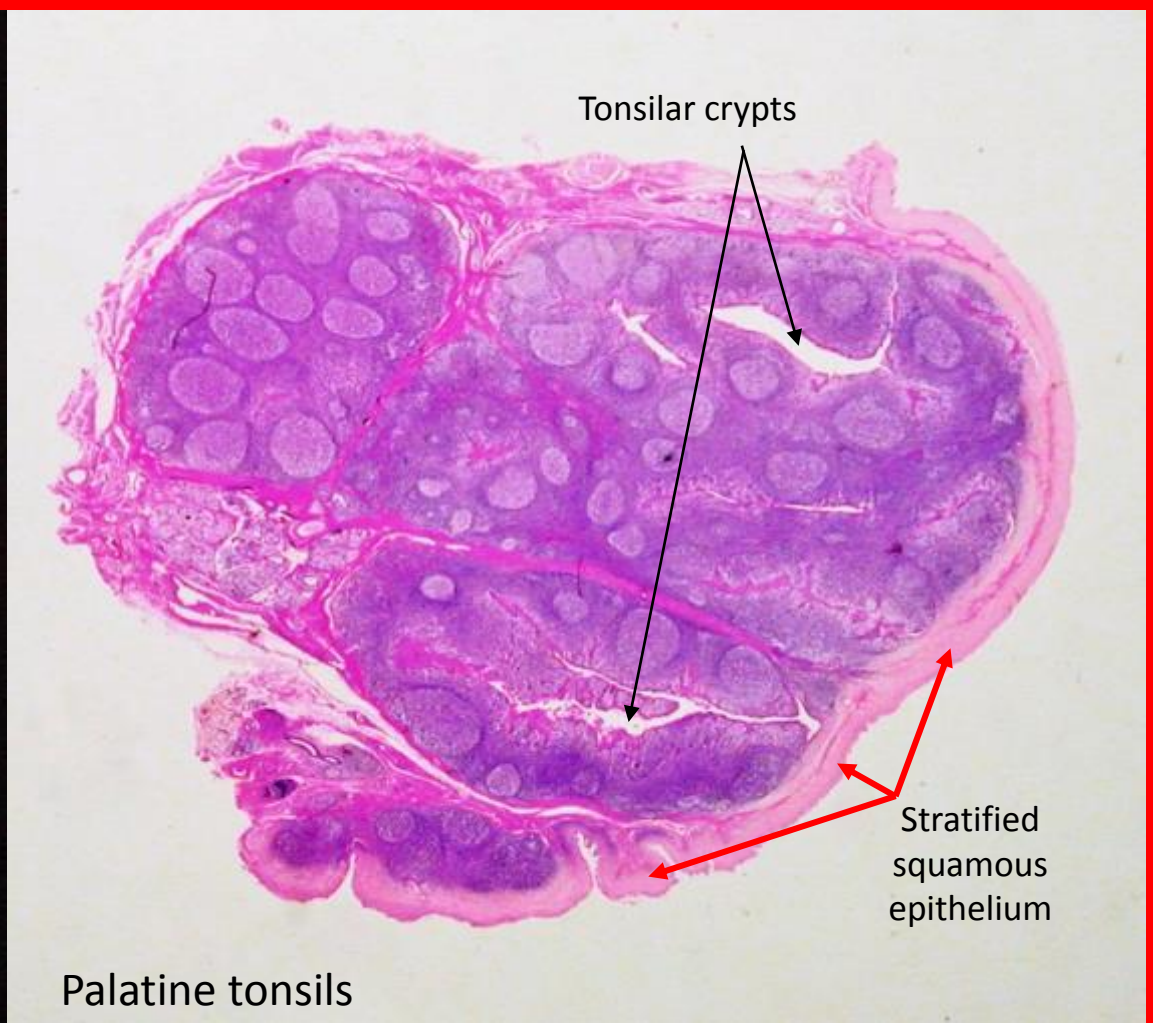
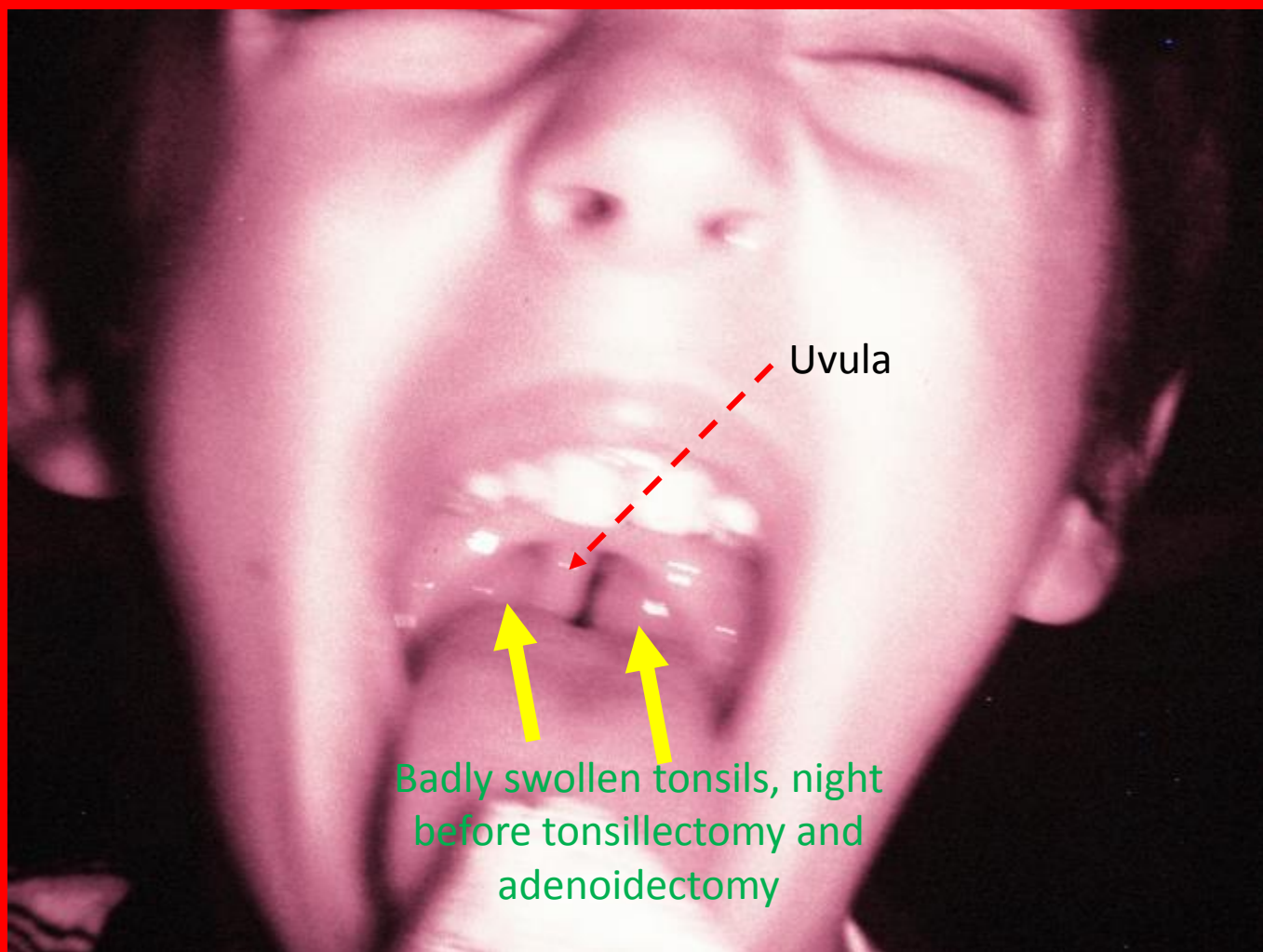
concentrations of Lymphocytes & Macrophages = nodule

LYMPH NODE

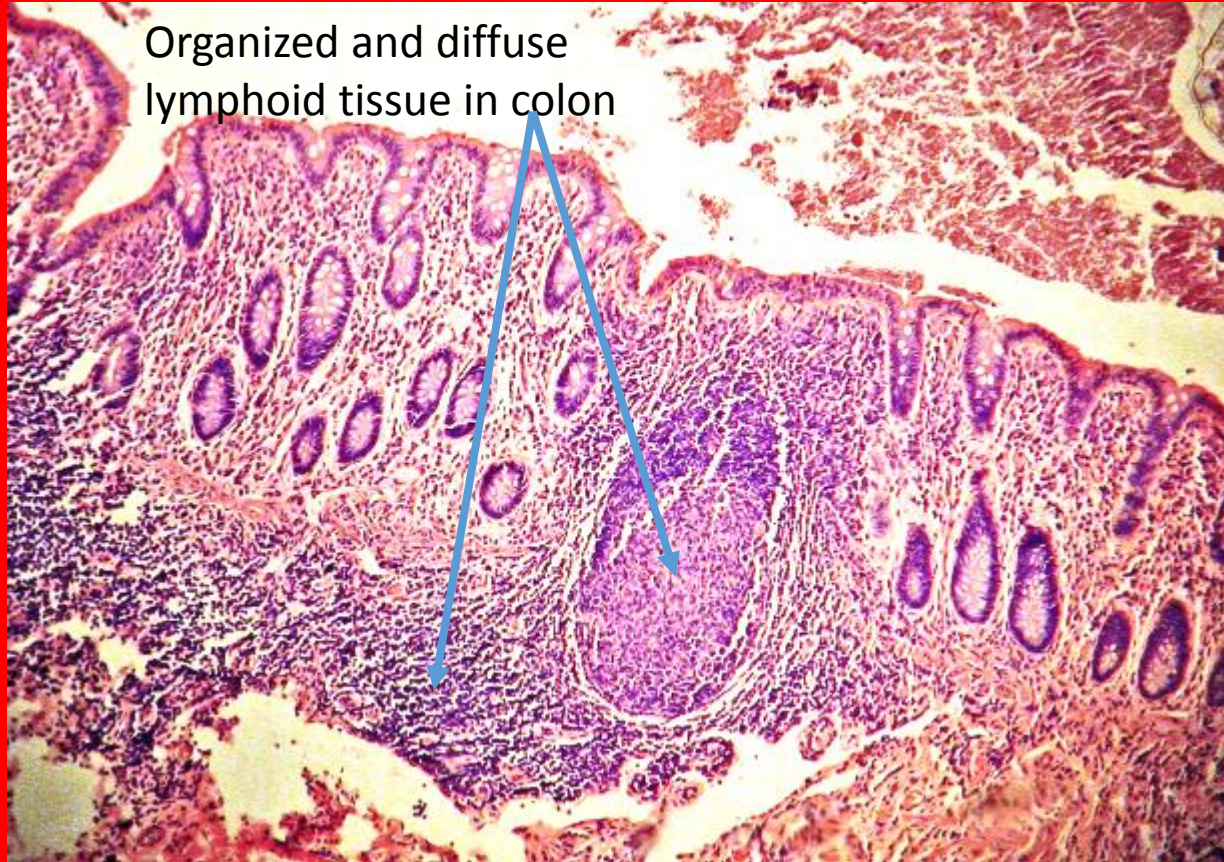


The most obvious lymph nodes I've seen were in Hilum of the lung of a smoker –pitch black!





Organized and diffuse lymphoid tissue in colon

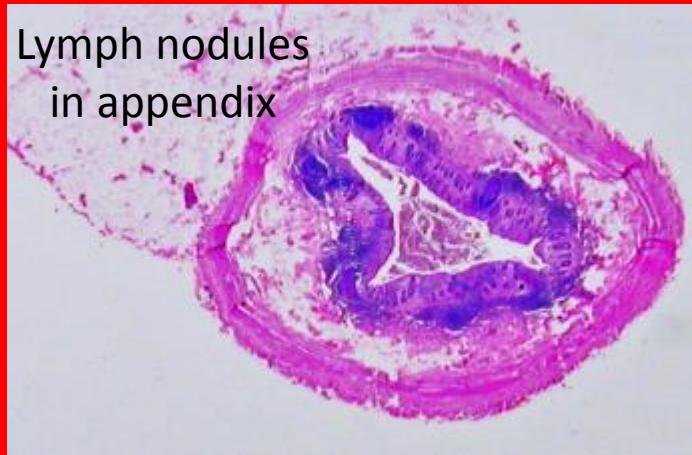


Palatine Tonsils

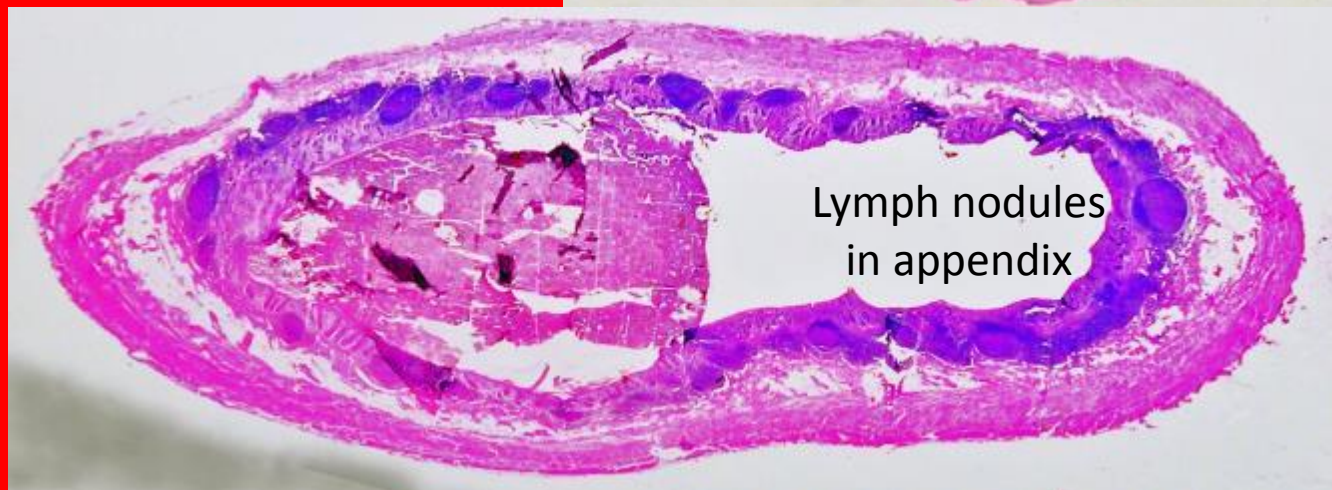


Stratified squamous epithelium

Lymph nodules in appendix



Lymph nodules in appendix



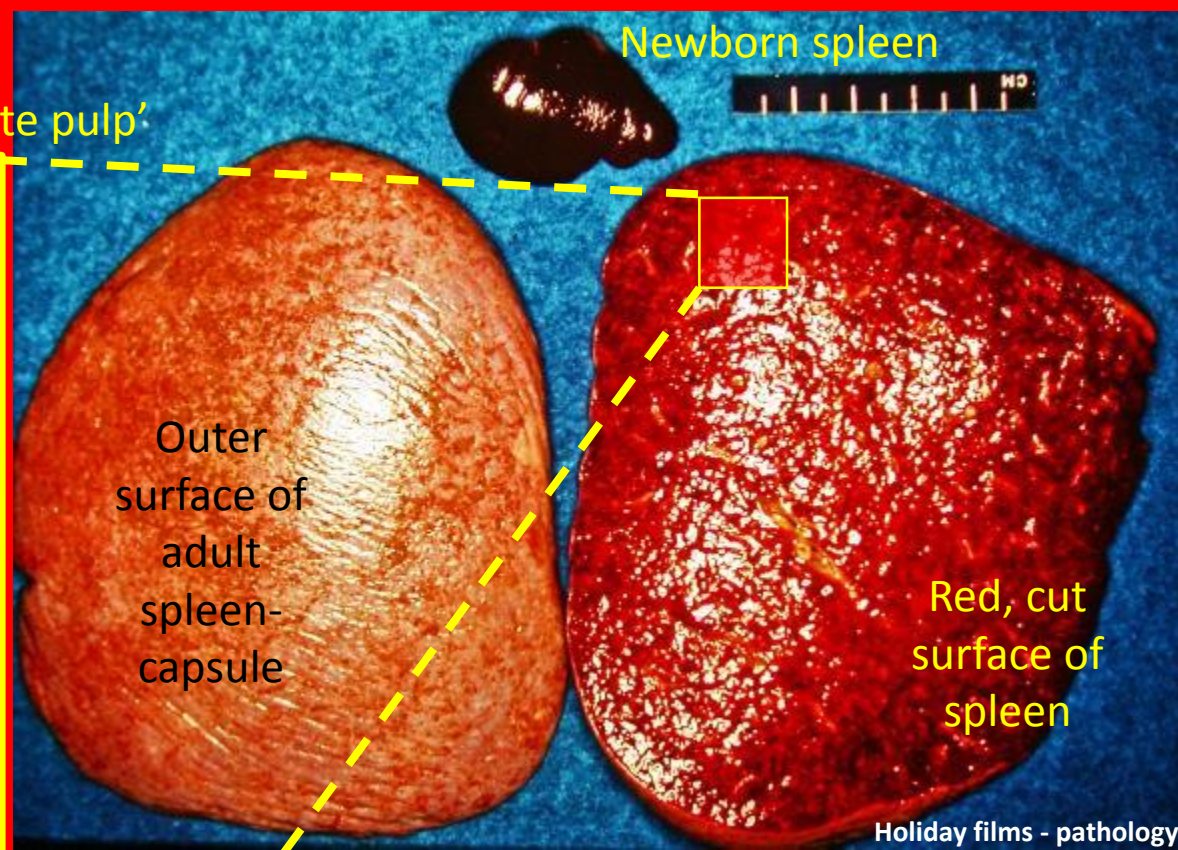
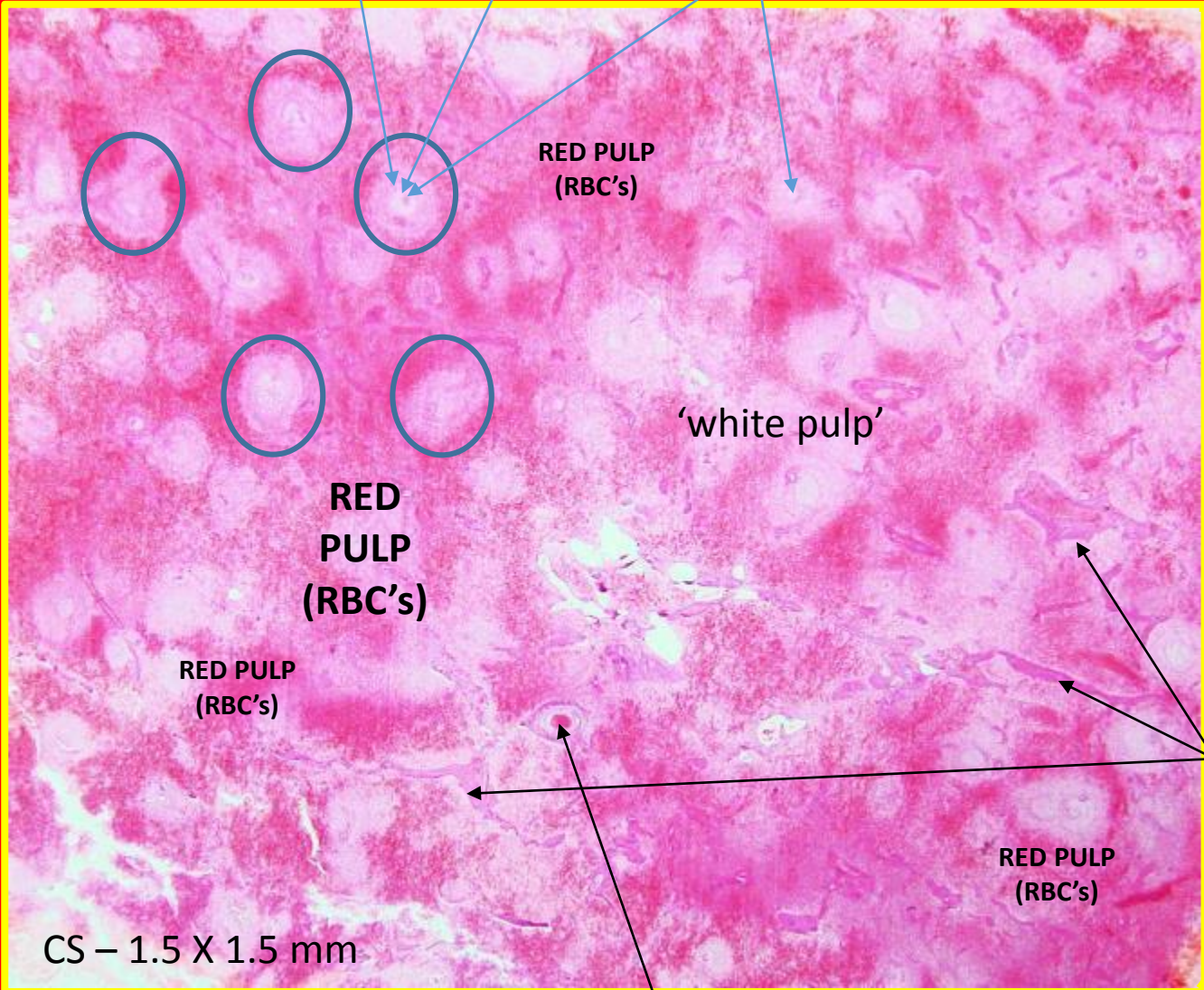


Thymus



THYMUS - Child

○ = margin, germinal center & central artery = splenic nodule or 'white pulp'



trabeculae

Fetus-infant it makes red blood cells; in adults it breaks down RBC's to recycle IRON (Fe)

Trabecular a&v

**RED
PULP
(RBC's)**

t
r
a
b
e
c
u
l
a
e

**RED
PULP
(RBC's)**



Silver
stain
reveals
reticular
fibers

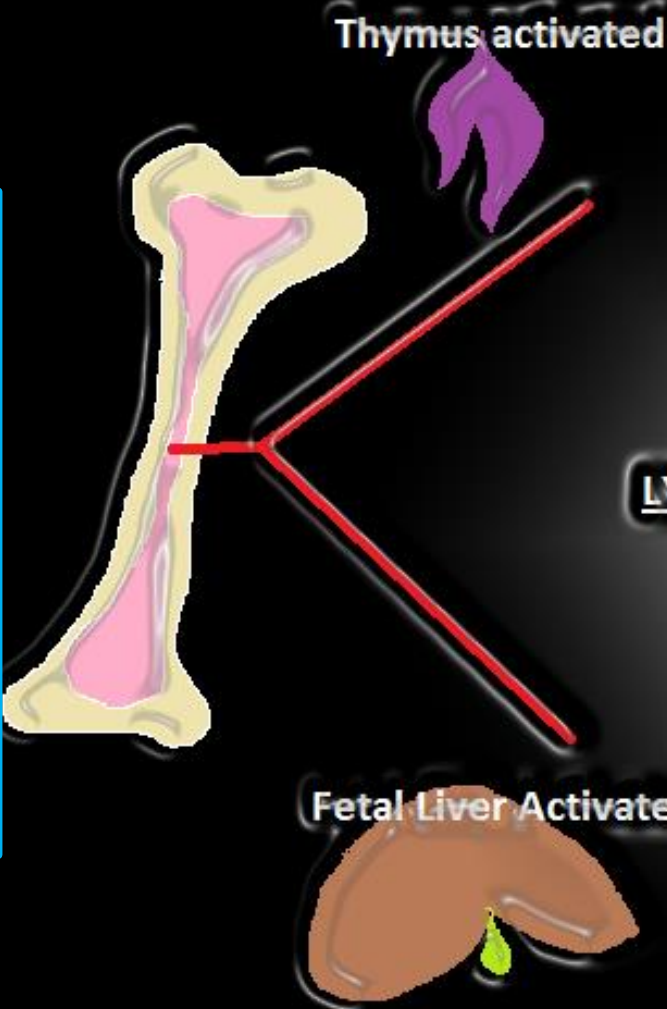
**RED
PULP
(RBC's)**

splenic nodule or
'white pulp'

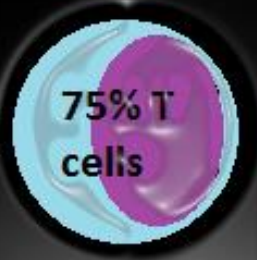
margin, germinal
center & central artery

splenic nodule or
'white pulp'

**RED
PULP
(RBC's)**



LYMPHOCYTES



CMI cell mediated Immunity

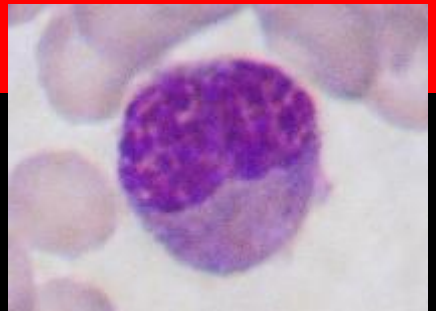
directly attack bacteria/viruses & release CYTOKINES



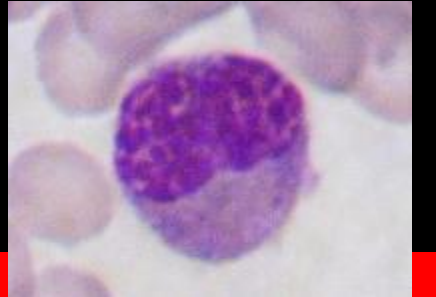
AMI antibody mediated immunity

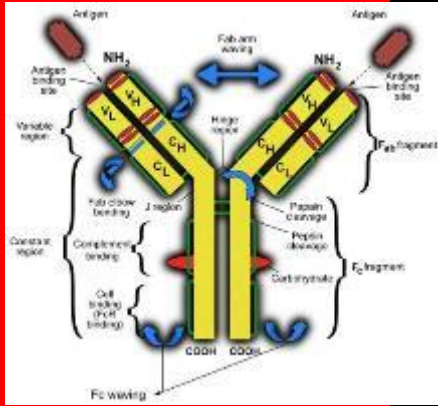
'humoral' response; antibody formation & cloning

Plasma & Memory cells

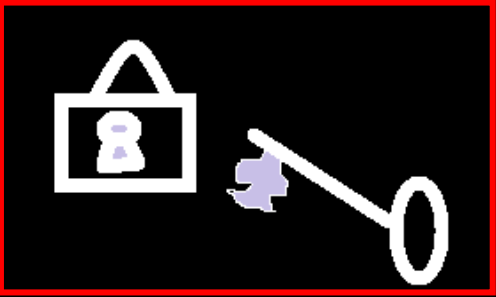


spleen and Lymph nodes for storage





Specific Antigen recognition sites

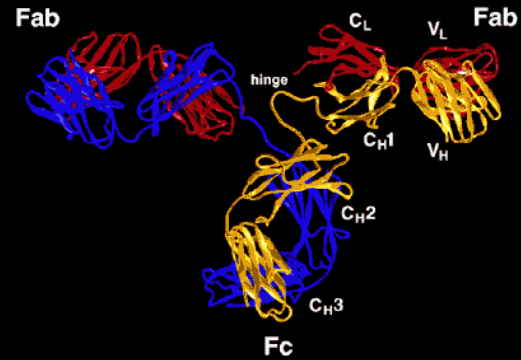
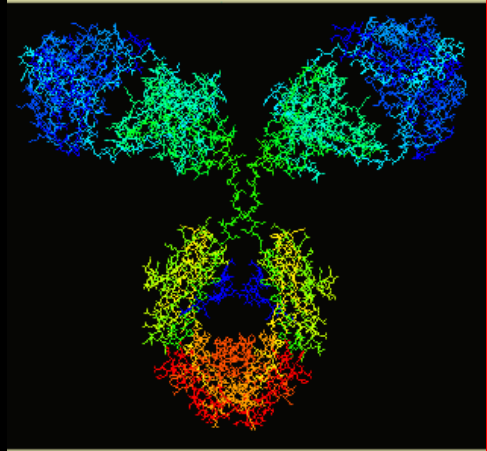


Sulfur bridges, disulfides

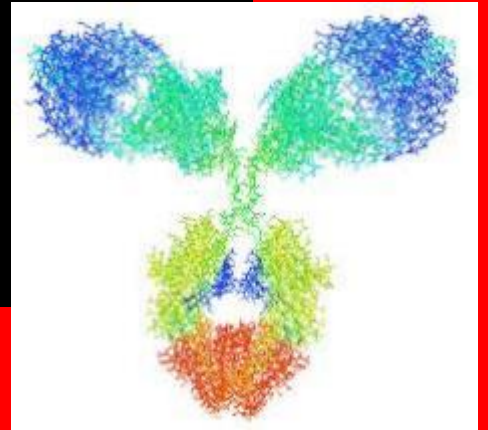
Short &

Long Chain

carbohydrate



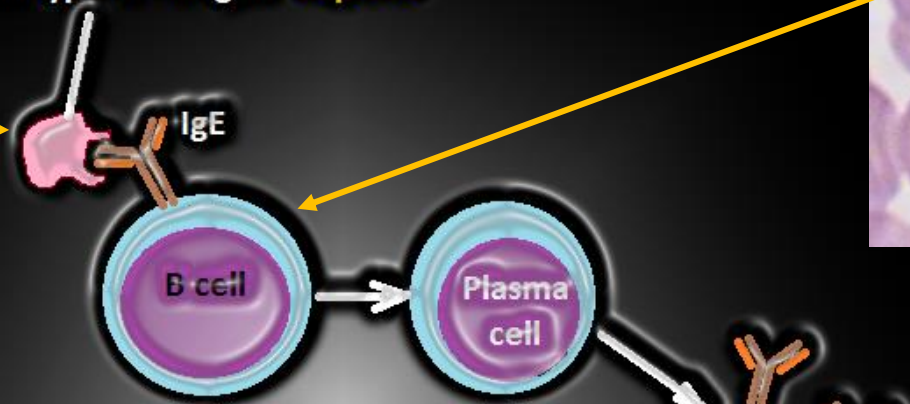
Antibody structure



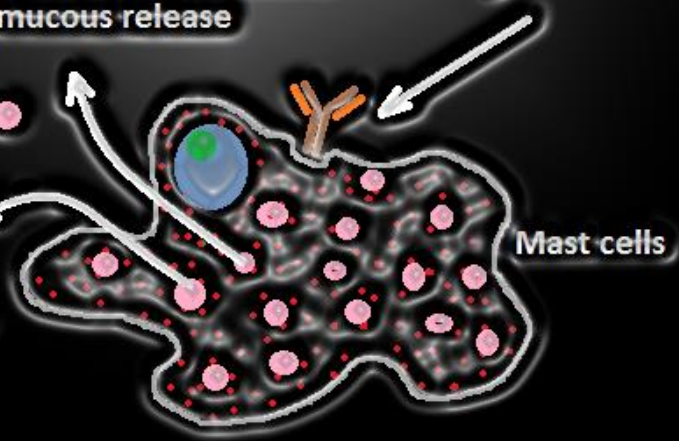


IgE quick response system for 'known' allergens

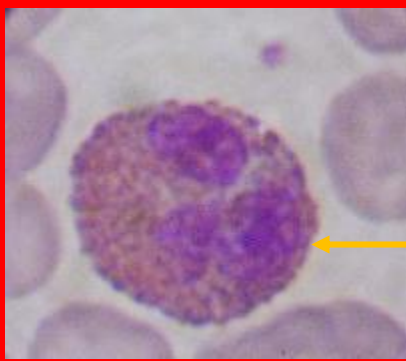
Allergen type of Antigen 'haptens'

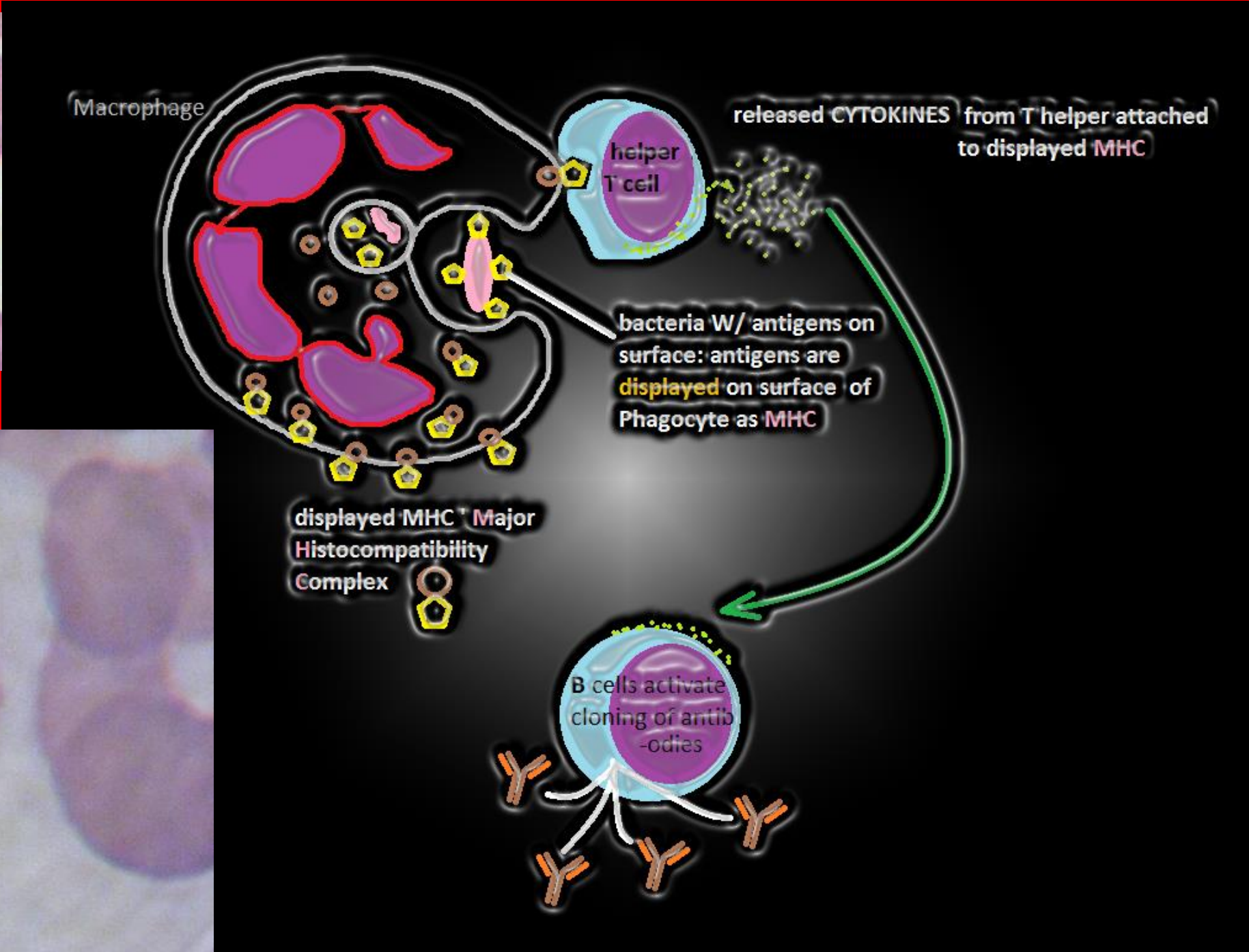
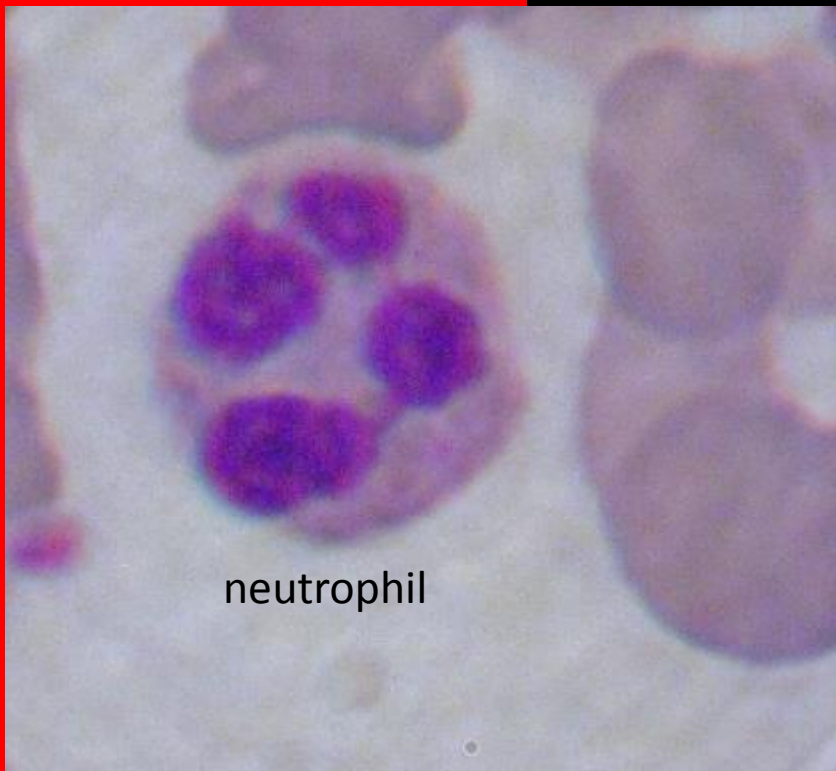
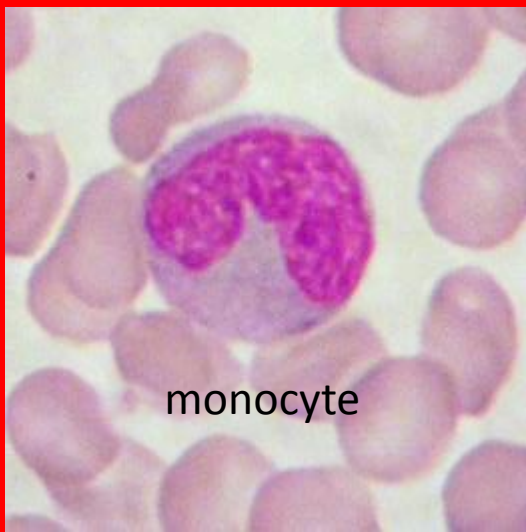


Histamine Release
bronchoconstriction &
mucous release



may lead to Anaphylactic Shock if not counteracted by Eosinophil's antihistamines





Antibodies

IgG – destroys virus & bacteria, activates MHC's in plasma & lymph' neutralizes toxins, can pass through Placenta, activates COMPLEMENTS

IgA – in exocrine secretions – gastric juice, mother's milk & body secretions

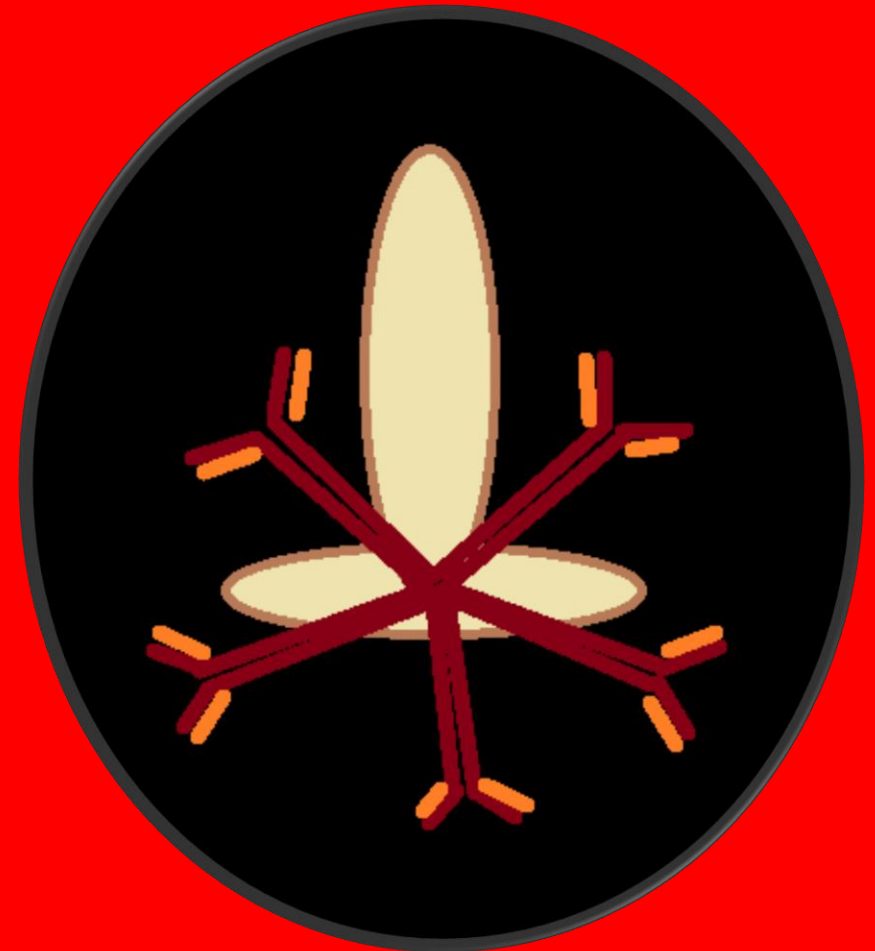
IgM – in blood plasma, agglutinates in AntiA & AntiB, also activates COMPLEMENTS, appears during infections

IgE – allergic reactions

IgD – small quantities, works with IgM

COMPLEMENTS enzymes triggered by Antibodies:

- 1- Inflammation –swelling, reddening
- 2- Chemotaxis-macrophages attracted
- 3- Lysis of invader's cell membrane
- 4- Opsonization = faster phagocytosis rates
- 5- Virus molecules altered



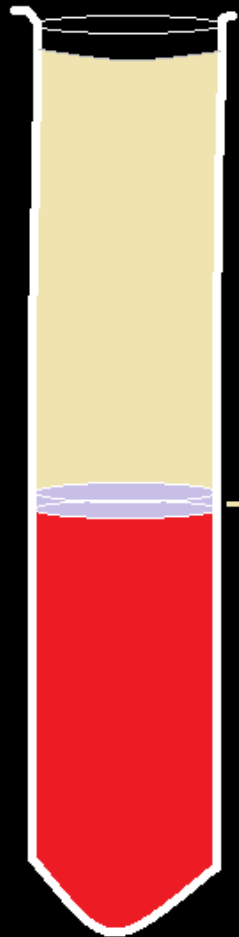
BLOOD

The CBC

CBC (INCLUDES DIFF/PLT)

WHITE BLOOD CELL COUNT	8.8	Thousand		3.8-10.8	Thousand/uL
RED BLOOD CELL COUNT	4.26	Million		4.20-5.80	Million/uL
HEMOGLOBIN	13.7			13.2-17.1	g/dL
HEMATOCRIT	40.3	% of Volume that is RBC's		38.5-50.0	%
MCV	94.5			80.0-100.0	fL
MCH	32.2			27.0-33.0	pg
MCHC	34.1			32.0-36.0	g/dL
RDW	14.2			11.0-15.0	%
PLATELET COUNT	203	Thousand		140-400	Thousand/uL
ABSOLUTE NEUTROPHILS	5826		$5826/8801=66.2$	1500-7800	cells/uL
ABSOLUTE LYMPHOCYTES	2112		$2112/8801=24.0$	850-3900	cells/uL
ABSOLUTE MONOCYTES	625		$625/8801 = 7.1$	200-950	cells/uL
ABSOLUTE EOSINOPHILS	185		$185/8801 = 2.1$	15-500	cells/uL
ABSOLUTE BASOPHILS	53		$53/8801 = 0.6$	0-200	cells/uL
NEUTROPHILS	66.2	50-75%			%
LYMPHOCYTES	24.0	20-45%			%
MONOCYTES	7.1	3-8%			%
EOSINOPHILS	2.1	2-4%			%
BASOPHILS	0.6	<1%			%

Digital scan of Leucocytes



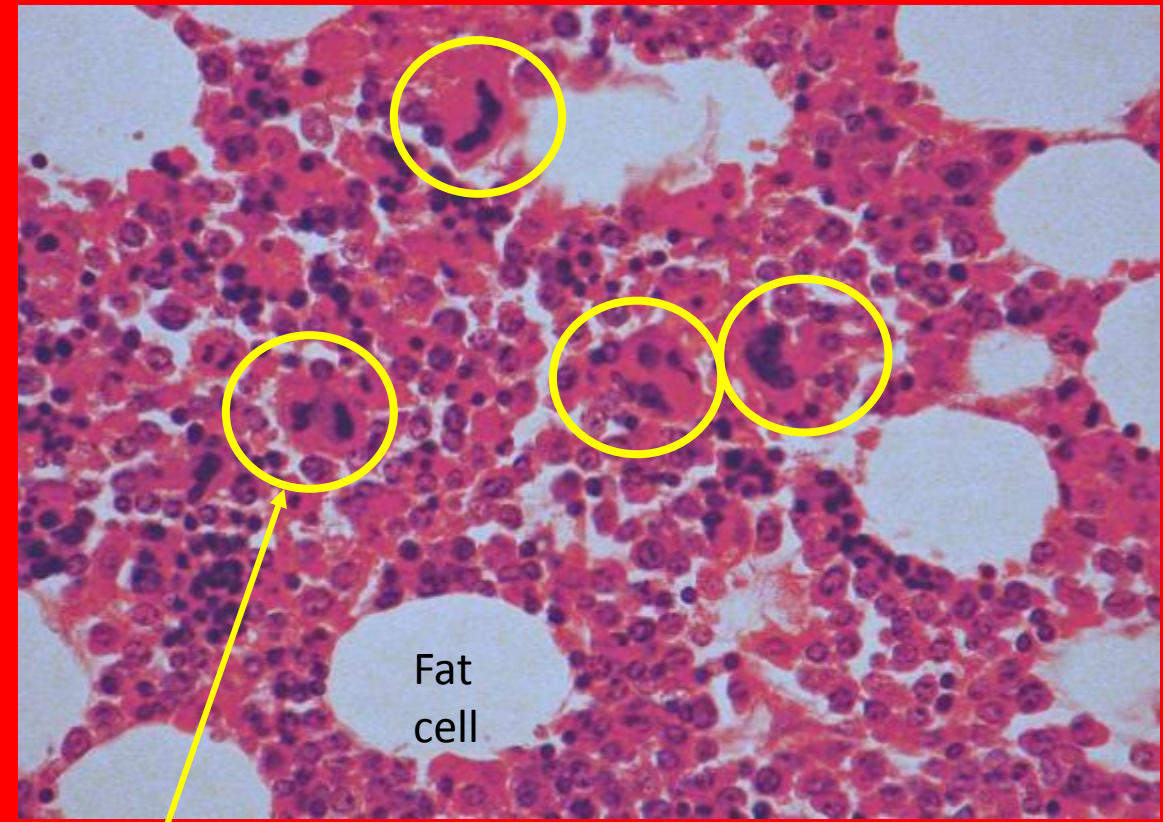
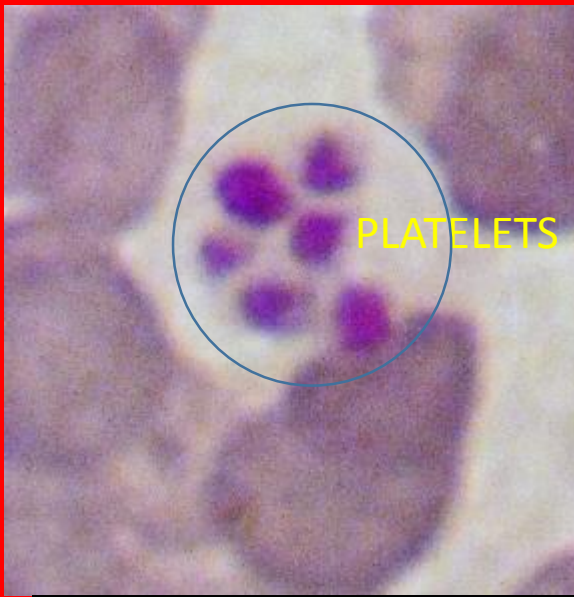
54% Plasma / 92% is water

'Buffy' coat 1% Leucocytes

Red Blood Cells 45% = Hematocrit

5-6 liters in adult, % body wt,

- 1- 92% H₂O
- 2- 7% plasma proteins
 - a) Albumin is 60 % of that
 - b) Immunoglobulins (IgE, IgM, IgH, etc.)
 - c) Fibrinogens 4%
- 3- 0.9% (<1%) Salts
- 4- Amino acids, lipids (LDL & HDL included), hormones, enzymes
- 5- Dissolved gases: CO₂, O₂, N₂
- 6- Urea, Uric Acid, Ammonim Salts
- 7- Electrolytes: Ca, Mg, Cl, HCO₃, PO₄, SO₄, Na
- 8- Maintains HCO₃⁻ / H⁺ Balance for neutral pH
- 9- Glucose



Megakaryocytes in marrow of bone break-up into PLATELETS

Tissue Damage

Blood Vessel Spasm : smooth muscle around vessels contract, serotonin from platelet plug causes further contraction

Platelet Plug forms : Sticks to rough surfaces of ruptured vessels or torn collagen on **Tunica Intima**

Blood Coagulation

Prothrombin Activator

Prothrombin alpha globulin from Liver

Ca⁺⁺

Thrombin

acts as an enzyme to

Fibrinogen

Ca⁺⁺

Fibrin

CLOT

Clot inhibitors: Aspirin, Warfarin, Citric Acid, Plavix (Clopidogril) & Heparin of Basophils.

Prothrombin Clotting Time PTT = time for threads of fibrin to form in blood sample

Urokinase of Lysosomes of kidney cells is also a plasminogen activator - reduces clots in kidney's nephrons. A variety called Streptokinase is the ER 'clot buster'

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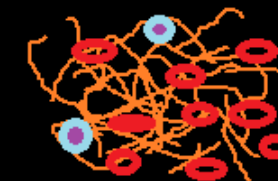
Ca⁺⁺

Fibrin

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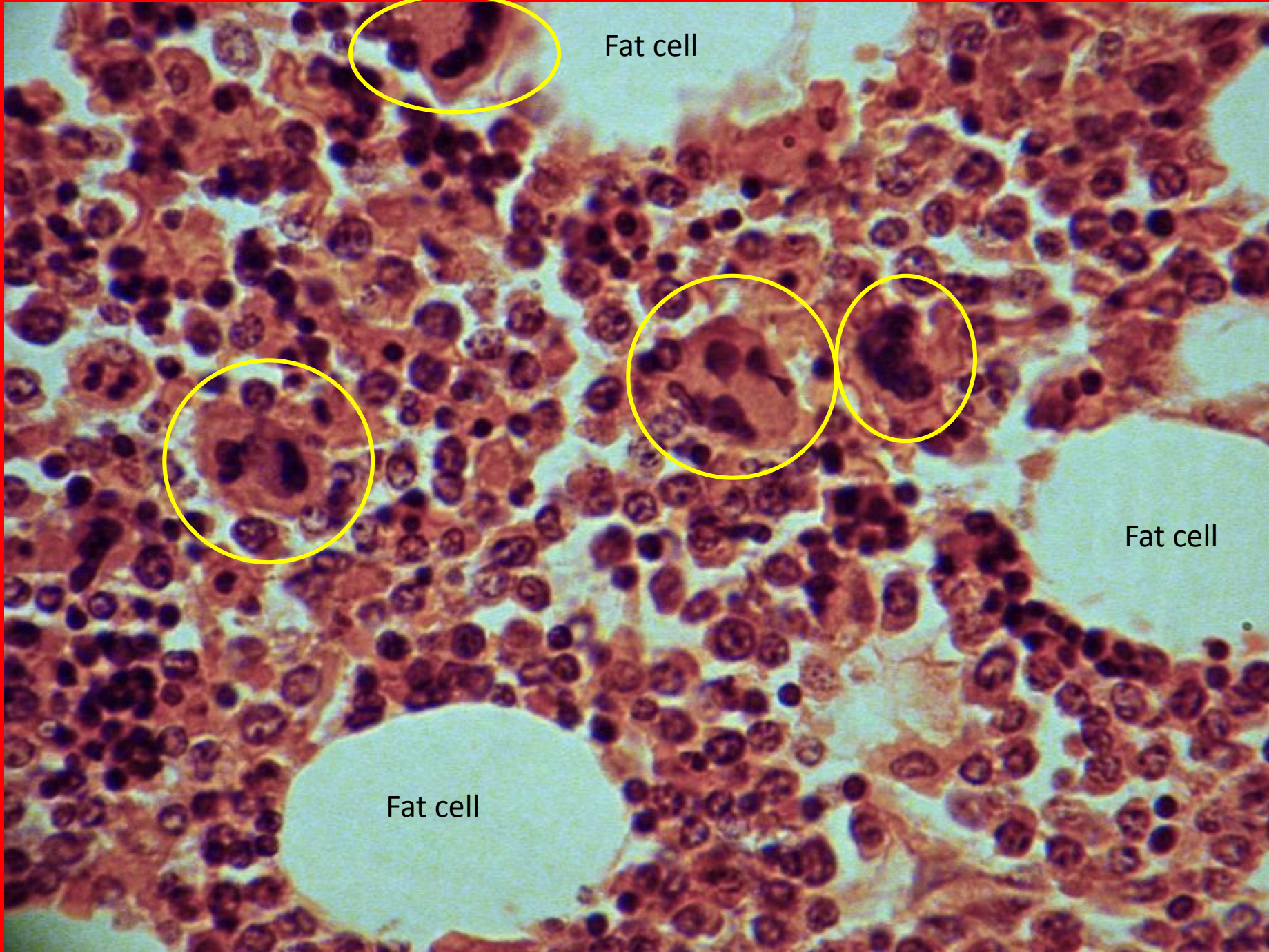
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CLOT = thrombus

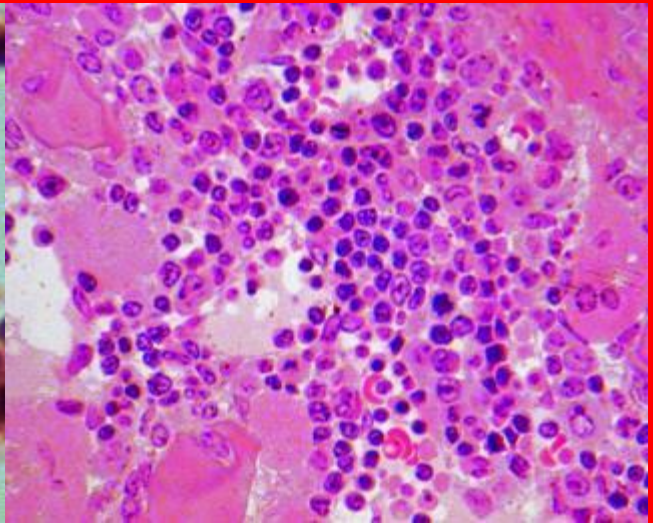
If thrombus breaks in vein free = **embolism**



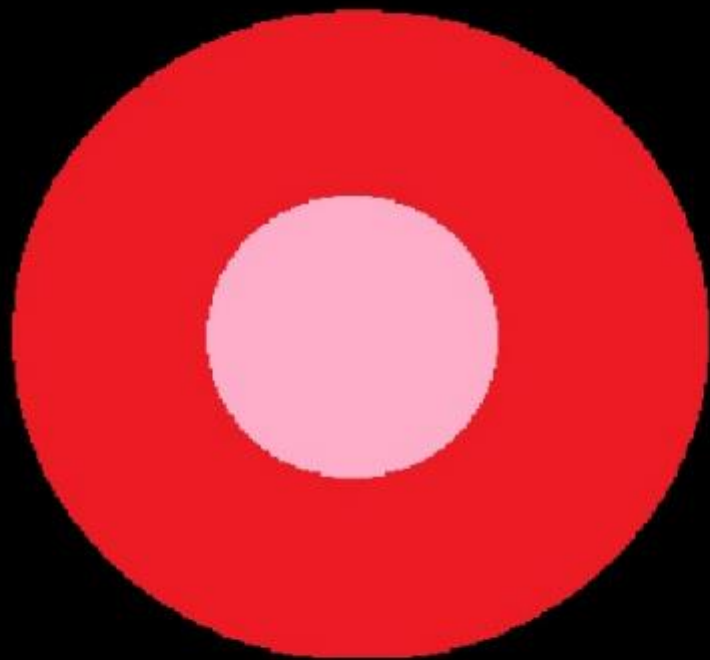
Fat cell

Fat cell

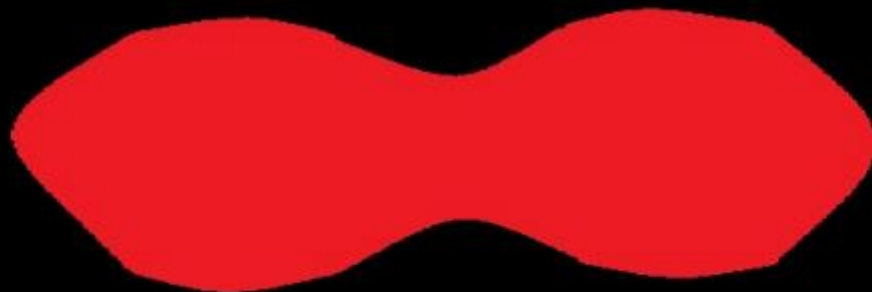
Fat cell



Bone marrow with 4 large **MEGAKARYOCYTES**, which break down into **PLATELETS**

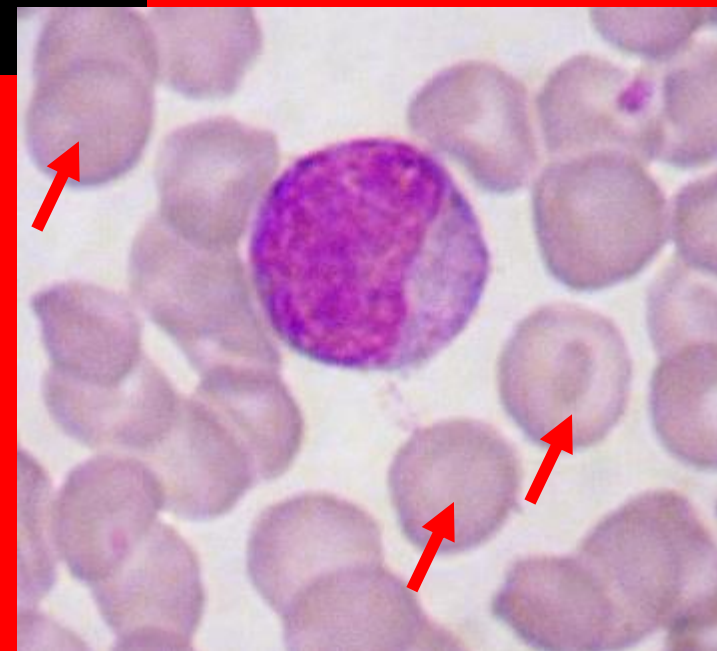
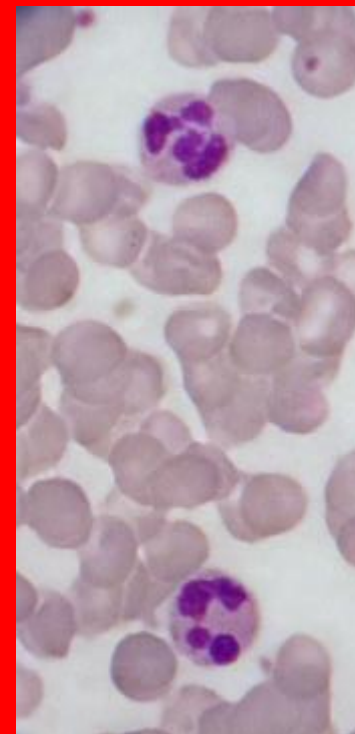


7.8 μm



2.6 μm

Erythrocytes or Red Blood Cells or red corpuscles



'agglutinogens' RBC antigens	Blood Type	agglutins Antibody in Plasma
	A	 antibody B
	B	 antibody A
	AB universal recipient	neither antibody
	O universal donor	 both antibodies

antigens

Genotypes: 1) Rh+ Rh- = Rh+ phenotype ~ 15%

2) Rh+ Rh+ =

3) Rh- Rh- = Rh- phenotype ~ 85%

Important in mother's rejection of fetus

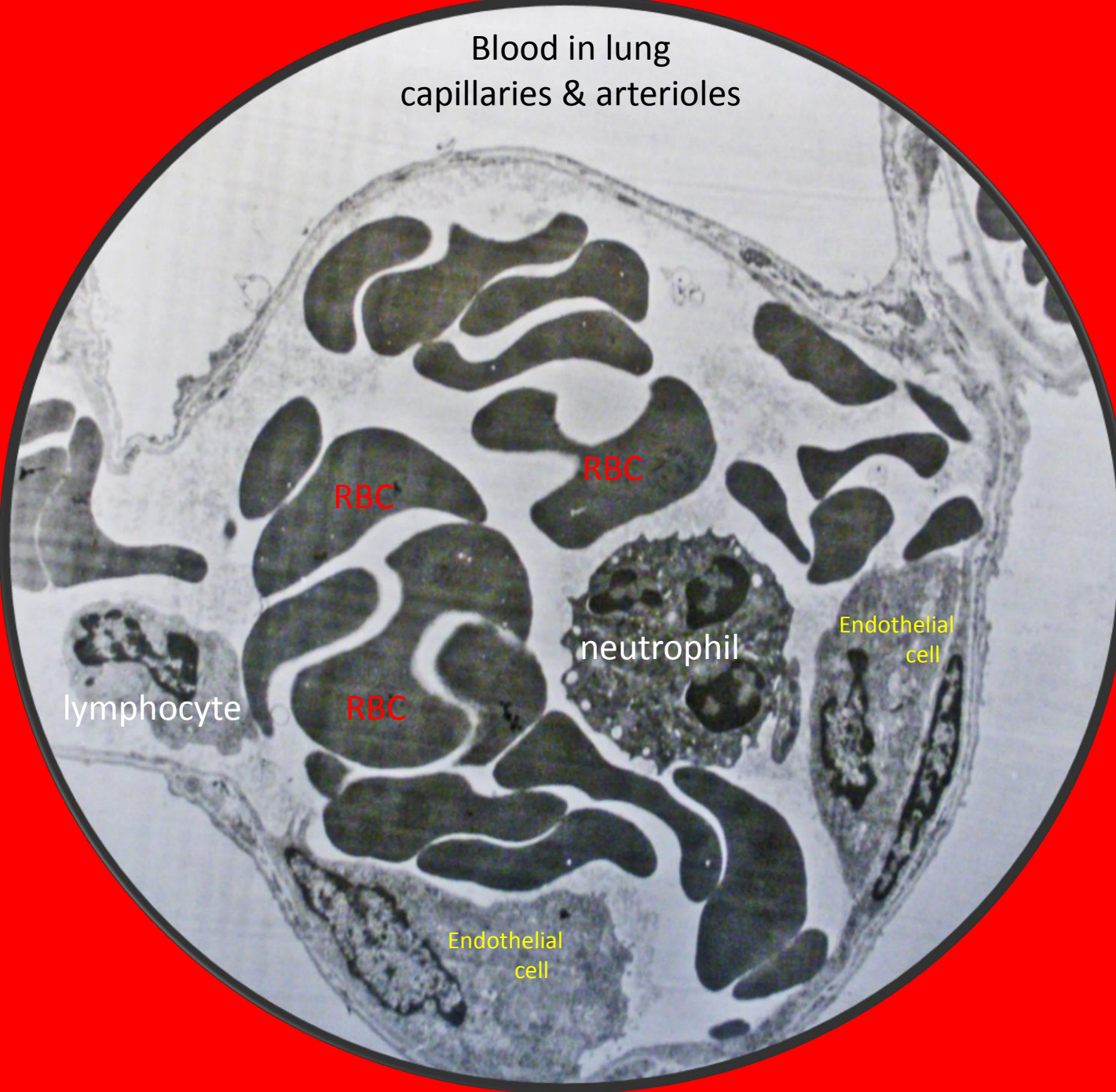
<u>GENOTYPE</u>			<u>PHENOTYPE</u>
i	i	→	O
I ^A I ^A	I ^A i	→	A
I ^B I ^B	I ^B i	→	B
I ^A I ^B		→	AB

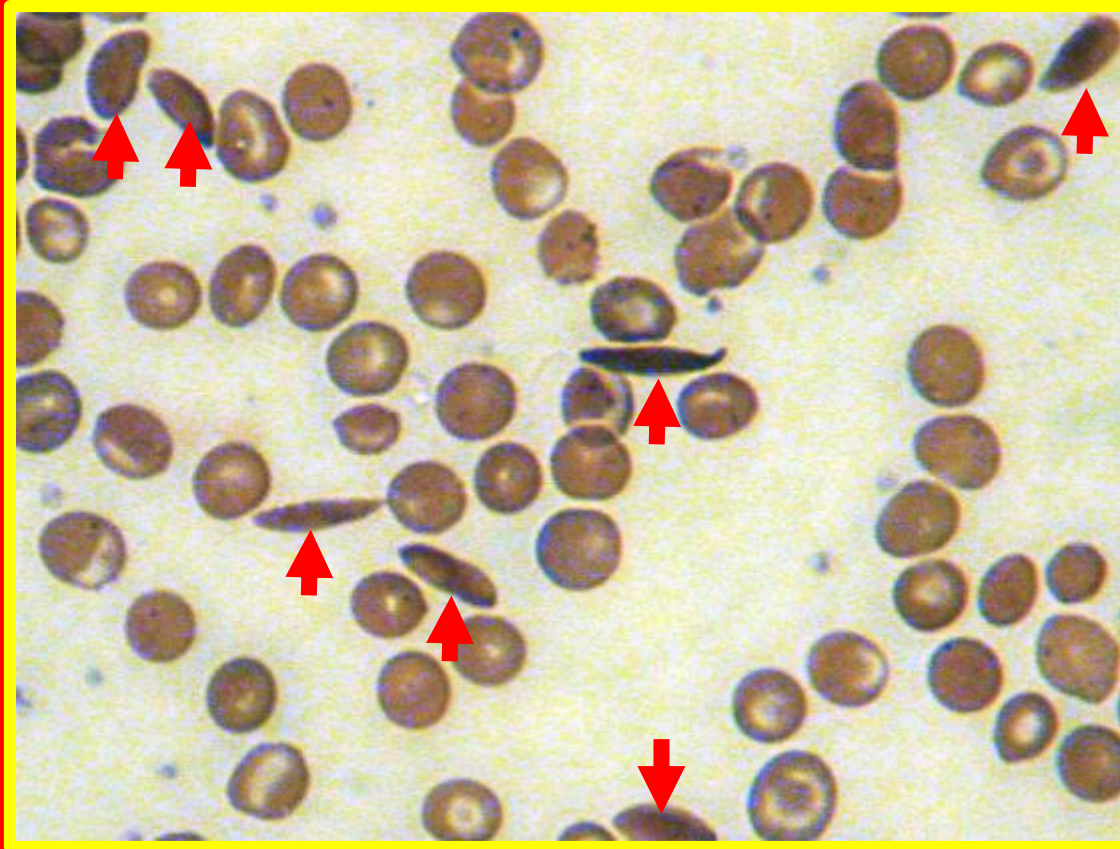
	I ^A	I ^B	i
I ^A	I ^A I ^A	I ^A I ^B	I ^A i
I ^B	I ^A I ^B	I ^B I ^B	I ^B i
i	I ^A i	I ^B i	i i

I^A, I^B = codominant
 a single gene with 3 alleles

I^A, I^B, i

Blood in lung
capillaries & arterioles





Sickle cell anemia: many African & African-American and Middle Eastern peoples carry this 'snp'allele ('S'codominant with normal Hemoglobin'A') one of the hemoglobin genes to *avoid malaria*. Causes clumping of cells in capillaries and consequent ischemia-if SS. Always tired and in pain. If AS (malarial resistant) or AA your OK, if SS you are a victim.

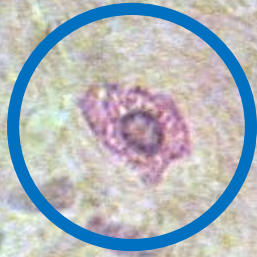
Granulocytes: if ↑ = Myeloid Leukemia

BASOPHIL

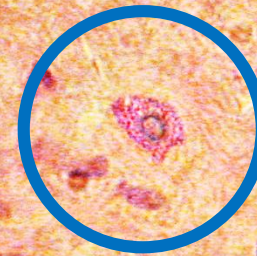
Bilobed nucleus,
2ndary granules
with **HISTAMINE**
a vaso-dilator &
HEPARIN a blood
anticoagulant. <
1 % of WBC's or
Leucocytes

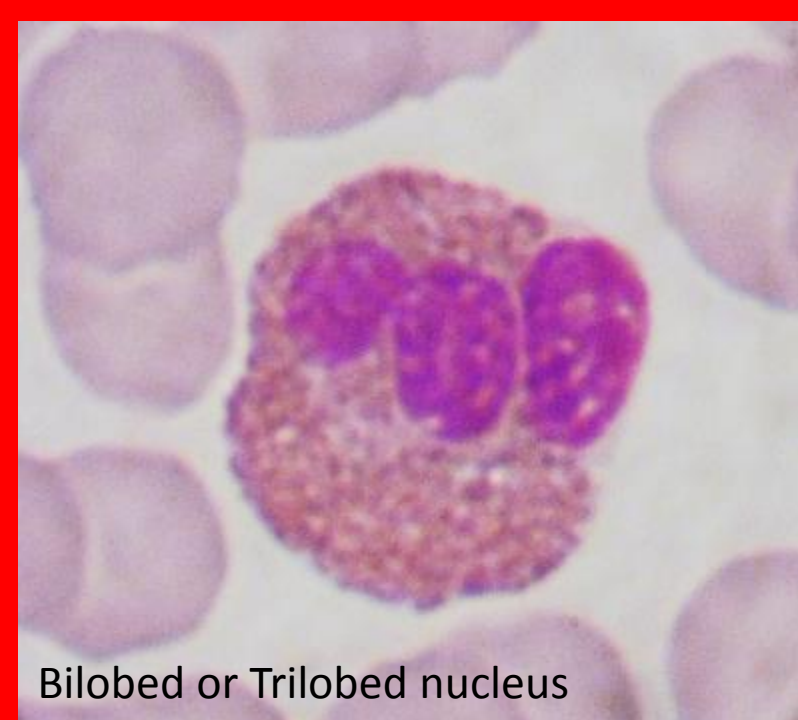


Mast cells full of histamines and heparin, that migrated from blood to connective tissue of organs (like uterus) related to Basophils

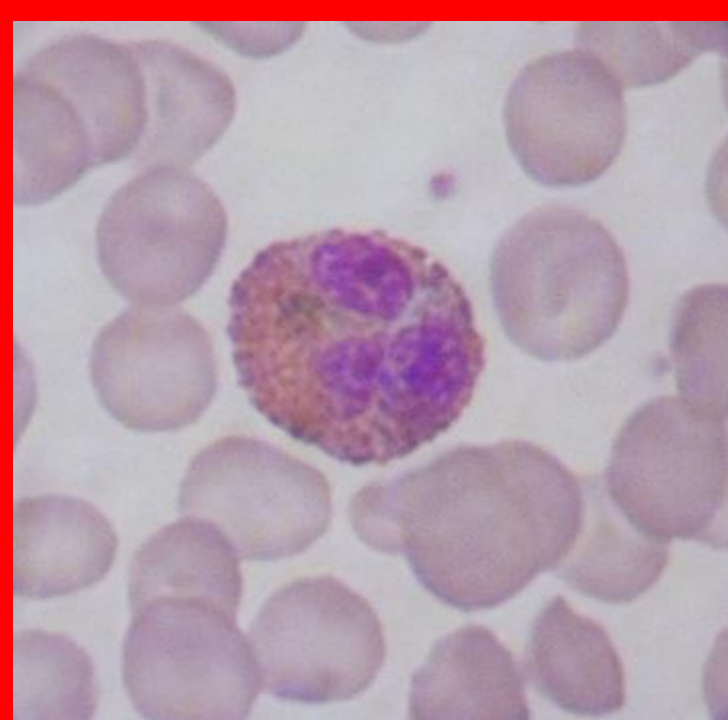


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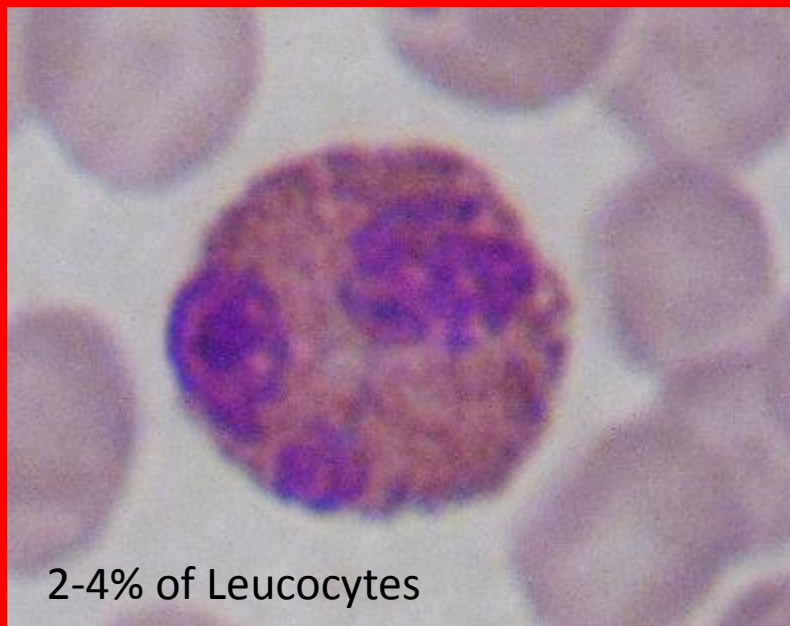




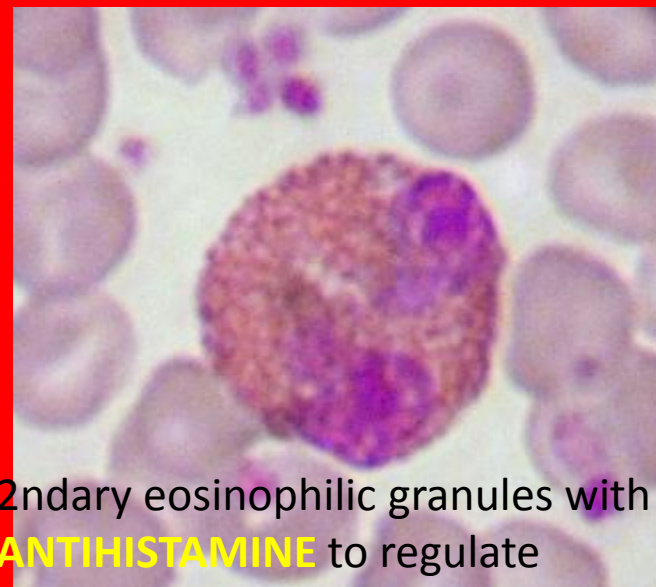
Bilobed or Trilobed nucleus



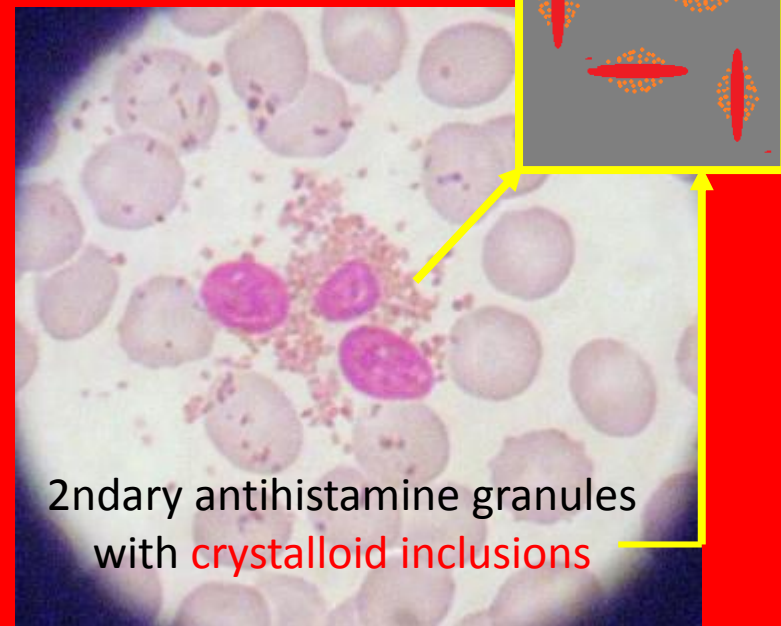
EOSINOPHILS



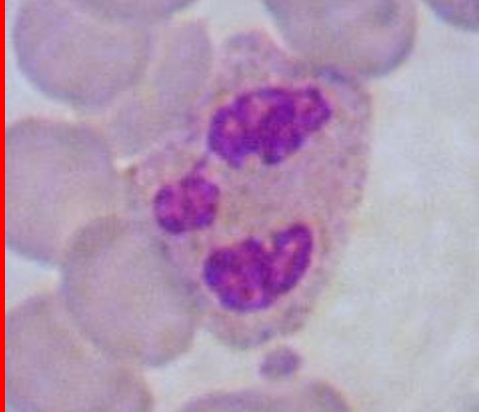
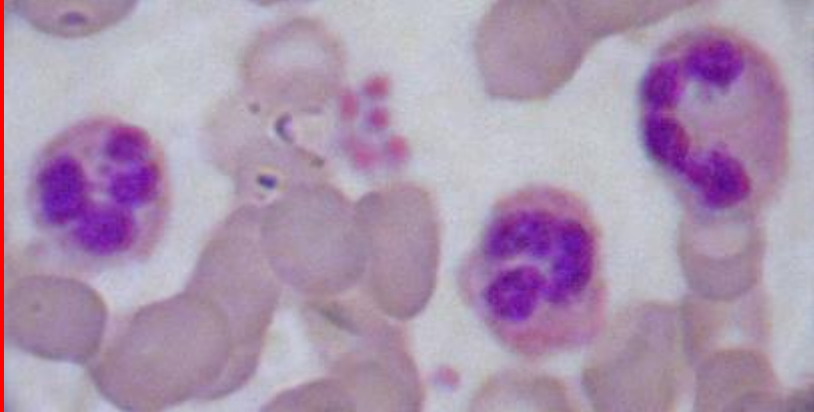
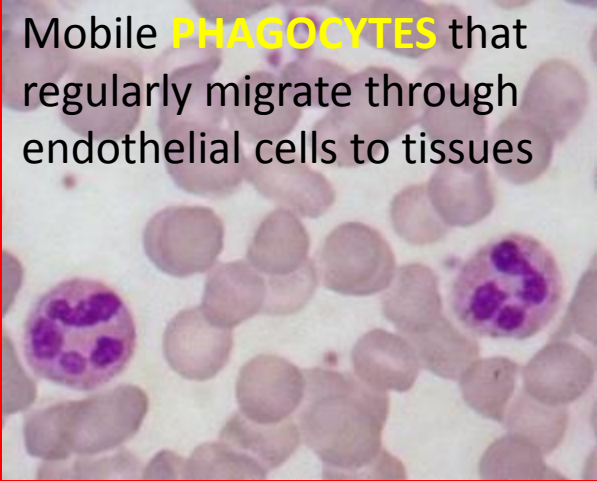
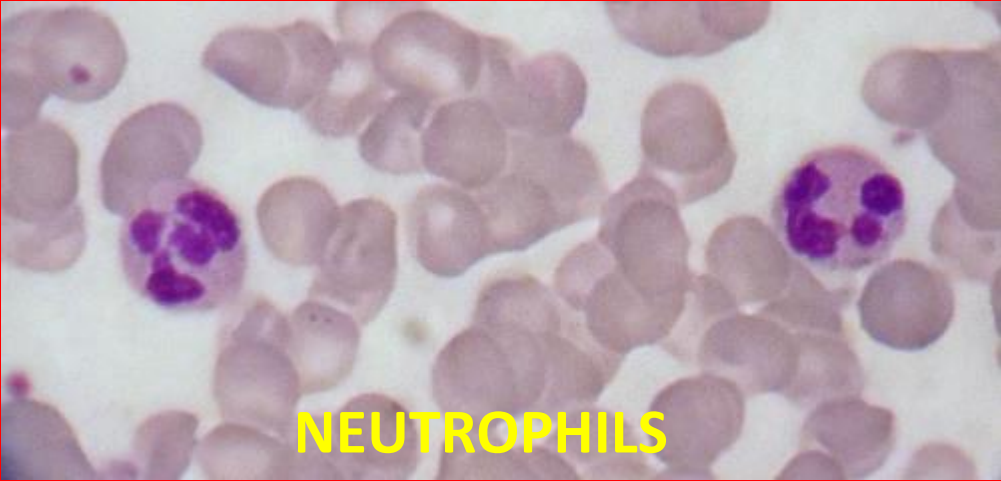
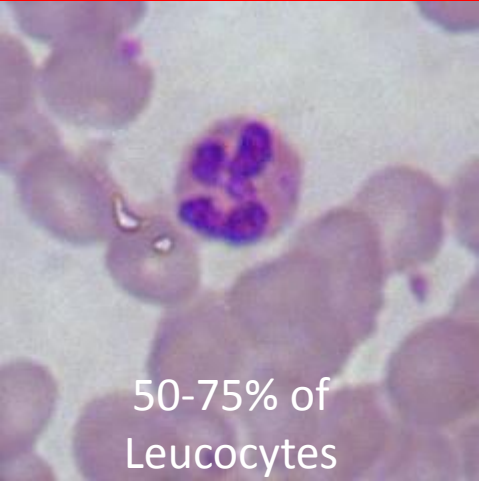
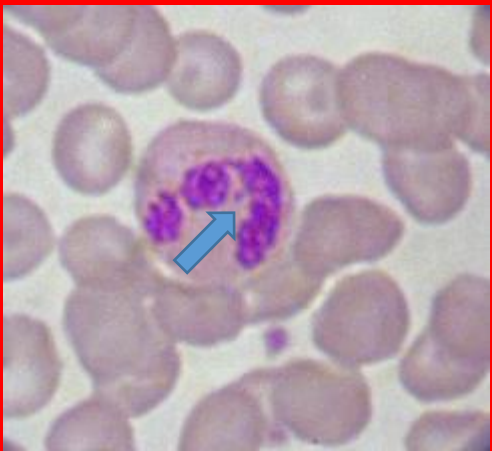
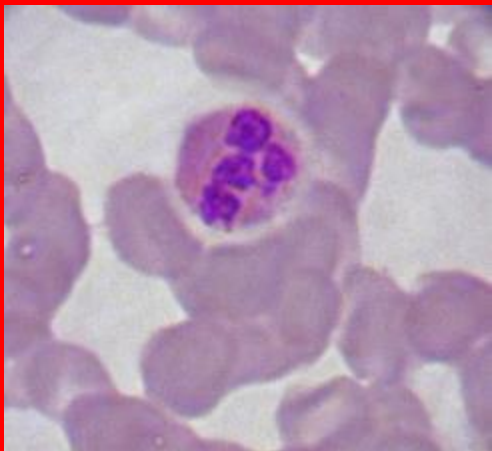
2-4% of Leucocytes



2ndary eosinophilic granules with **ANTIHISTAMINE** to regulate Histamine of Basophils & Mast cells



2ndary antihistamine granules with **crystalloid inclusions**



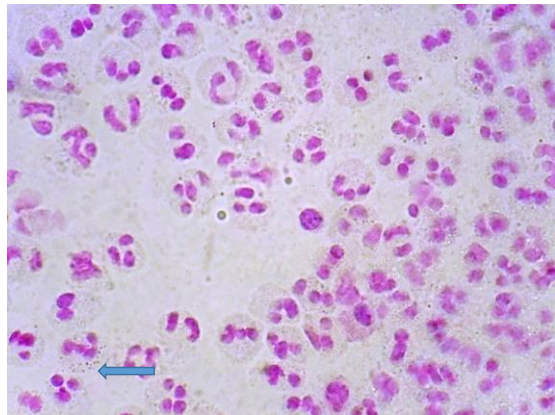
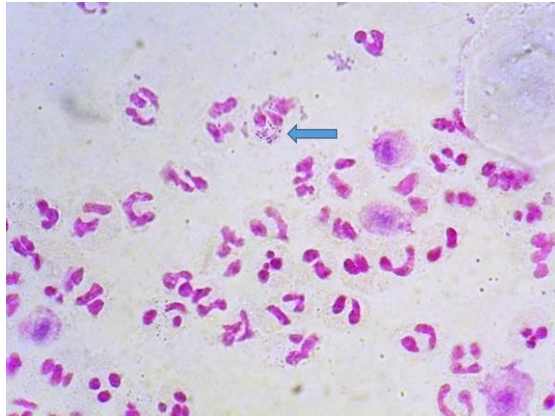
Neutrophils phagocytize cocci bacteria

After 5 days on 875 mg Amoxicillin, bid. Pus from Molar 14 (1st ul) shows

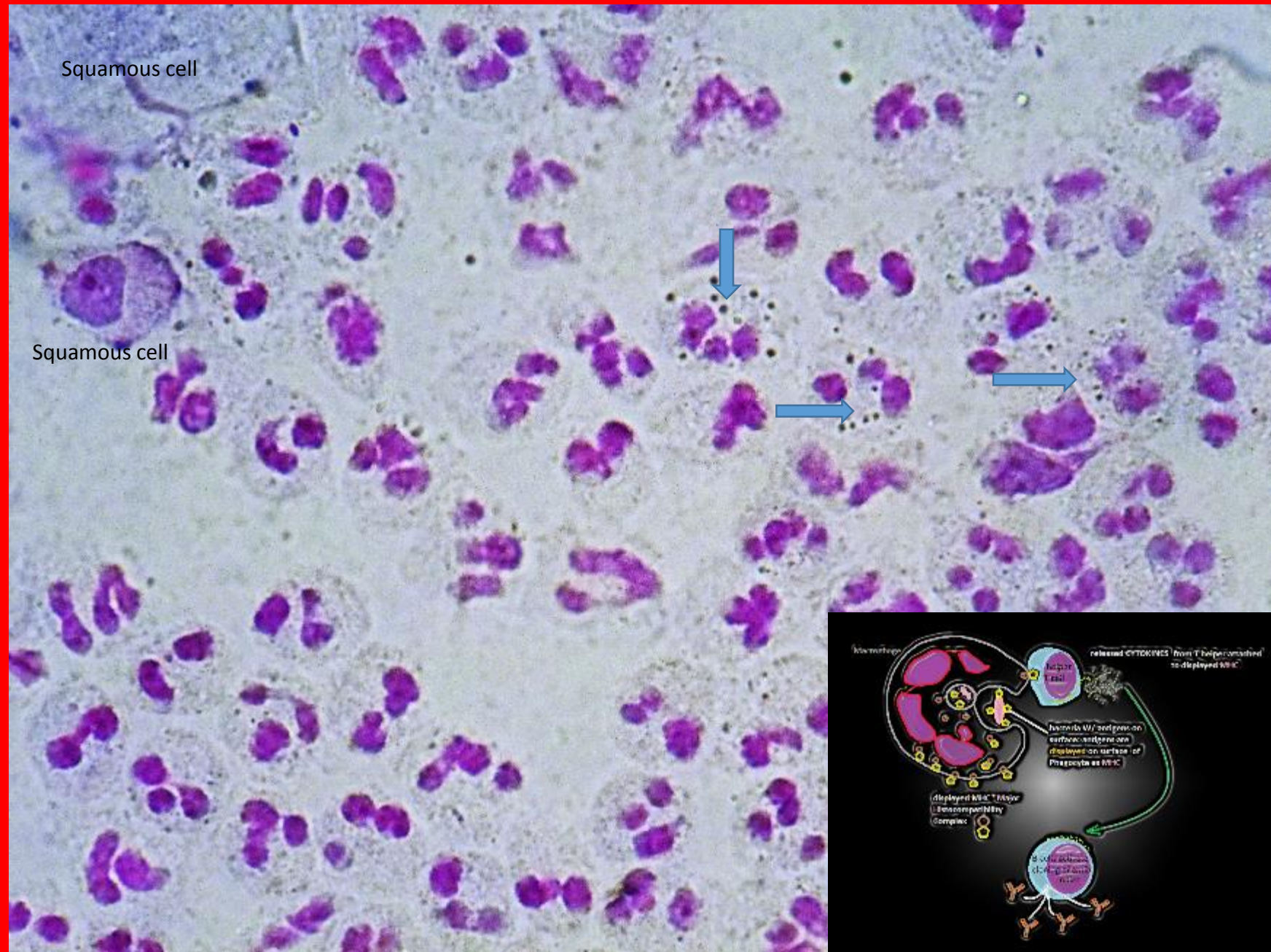
Neutrophils and a cocci (arrows);

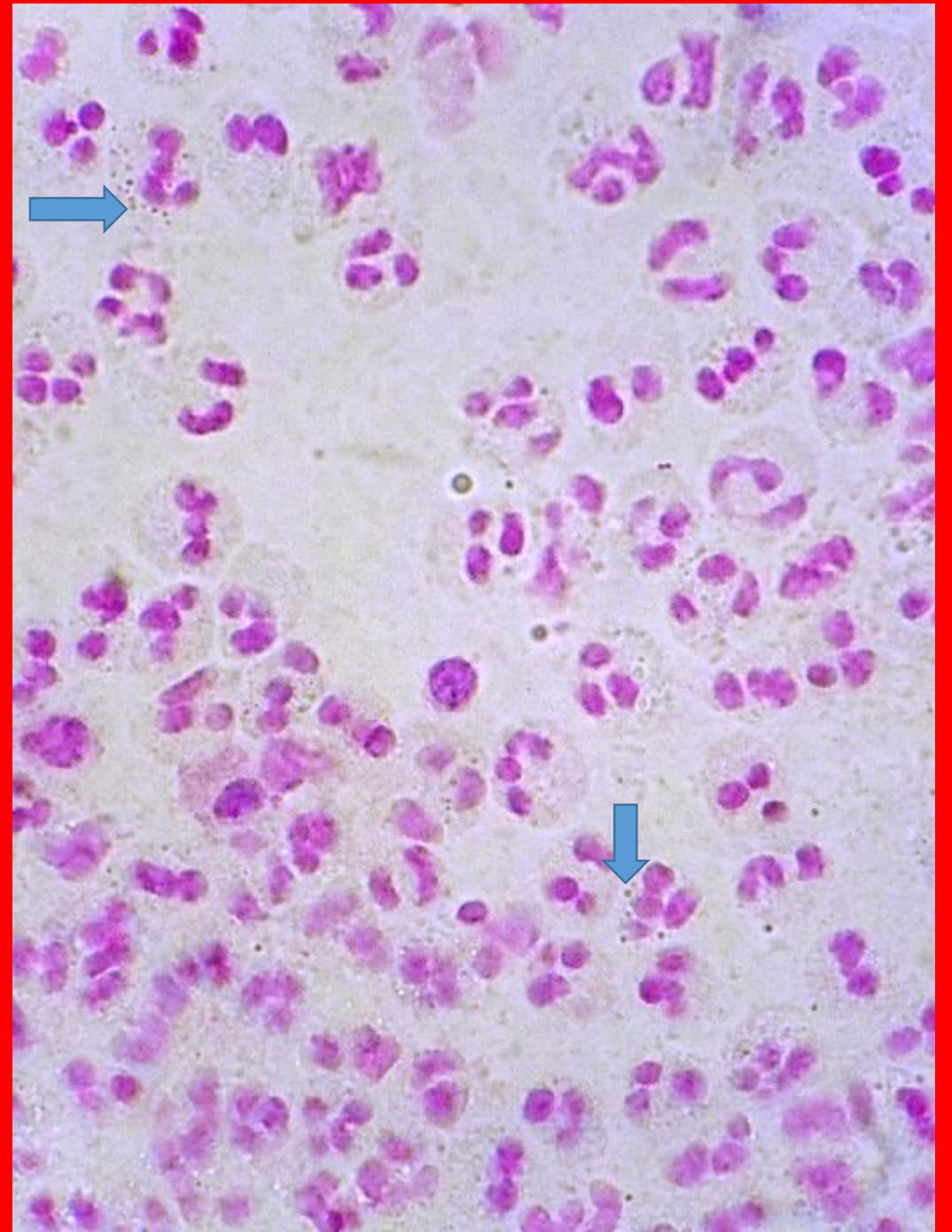
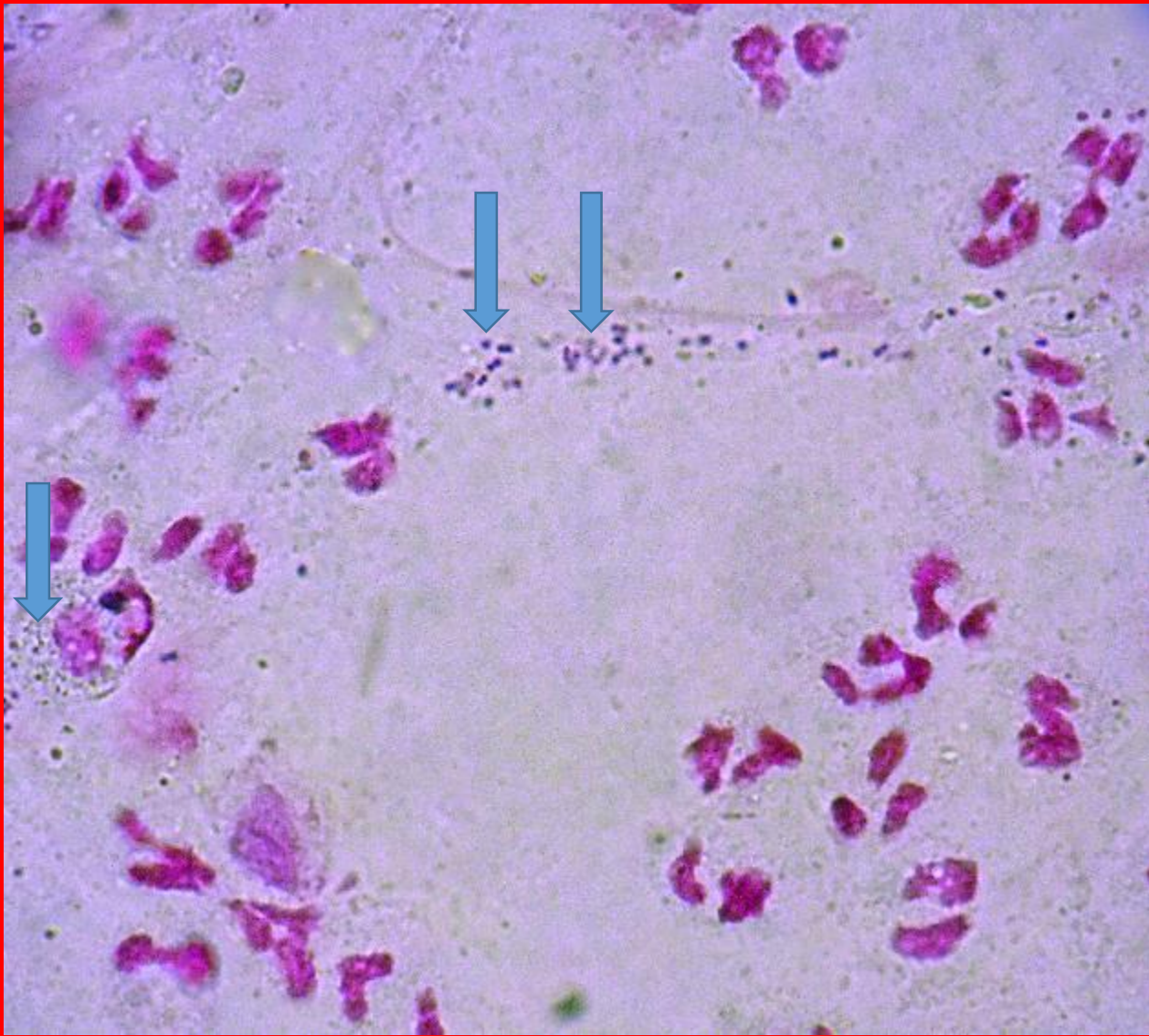
1000X mag (oil immersion), Toluidine Blue stain

John E.B. Baker, 2/27/2014



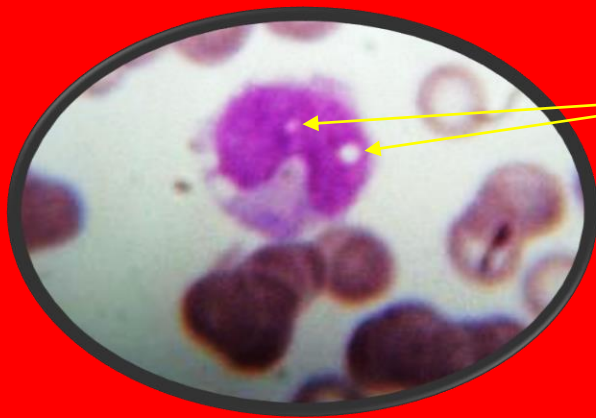
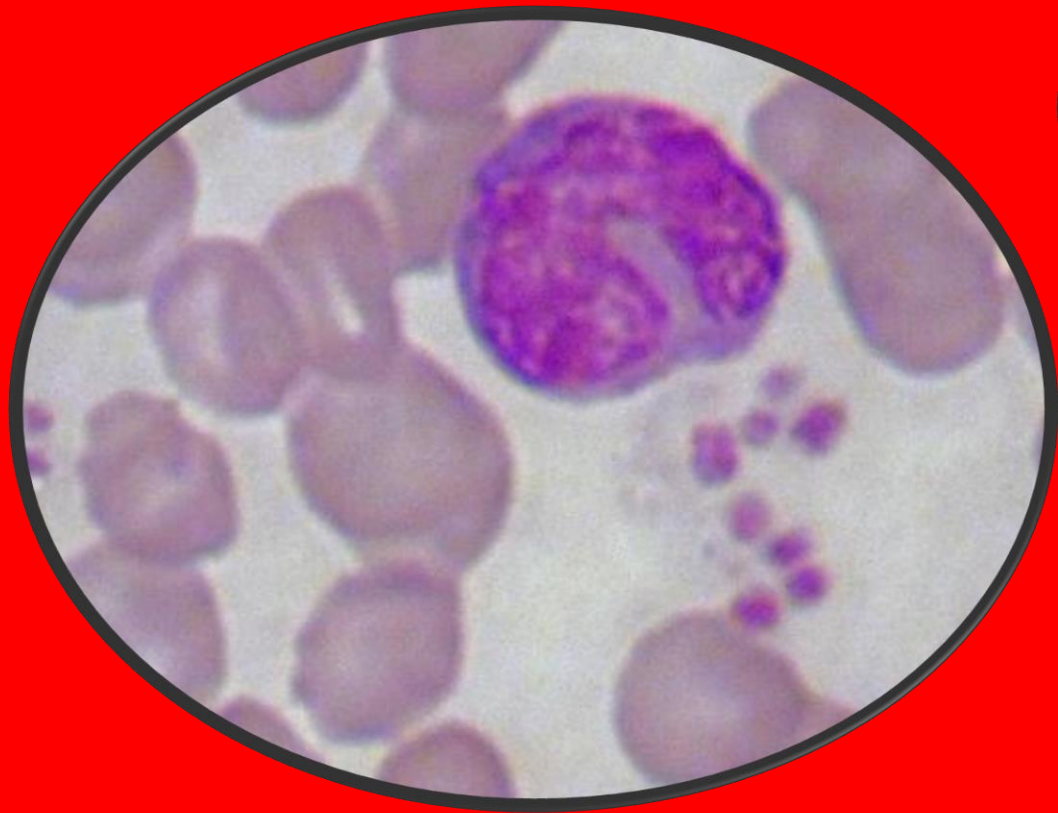
Pus





Neutrophils
phagocytize bacteria

Agranulocytes: if ↑ = Lymphocytic Leukemia

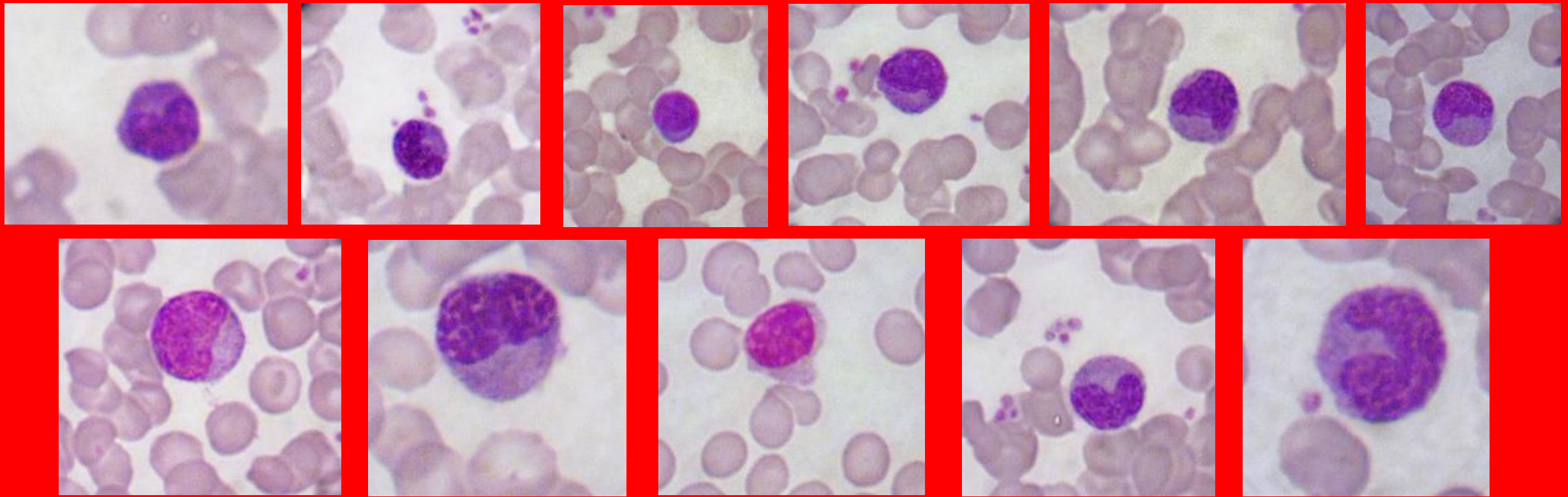


Lipid granules

MONOCYTES

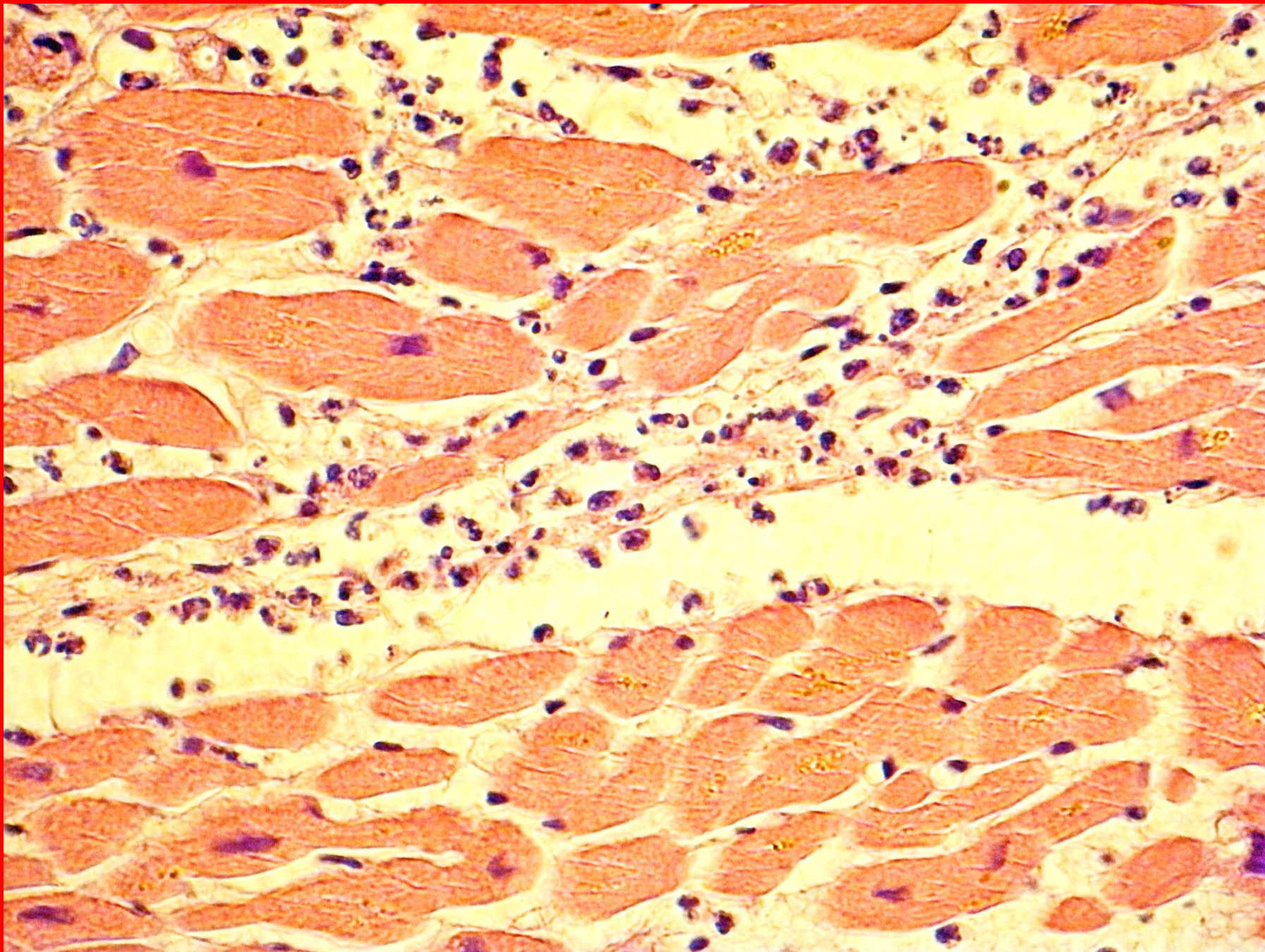


2nd to neutrophils in mobility & phagocytic action, Many Lysosomes (with Lysozymes)



LYMPHOCYTES

'T' or 'B' types, Lymphokine granules; 'B' cells become memory or Plasma Cells; 'T' cells make ANTIBODIES (kill Antigens) 20-45% of Leucocytes



Lymphocytes and
Neutrophils entering
cardiac muscle tissue
hours after myocardial
infarct & cell death