BLOOD

8% body weight, 5-6 l, transporting medium

functions: 1. Respiratory

2. Homeostatic a) water, ions, pH

b) temperature

3. Excretoric

4. Chemical control

5. Immunity

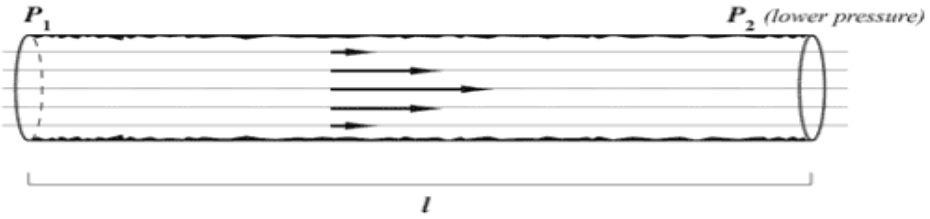
6. Nutritional

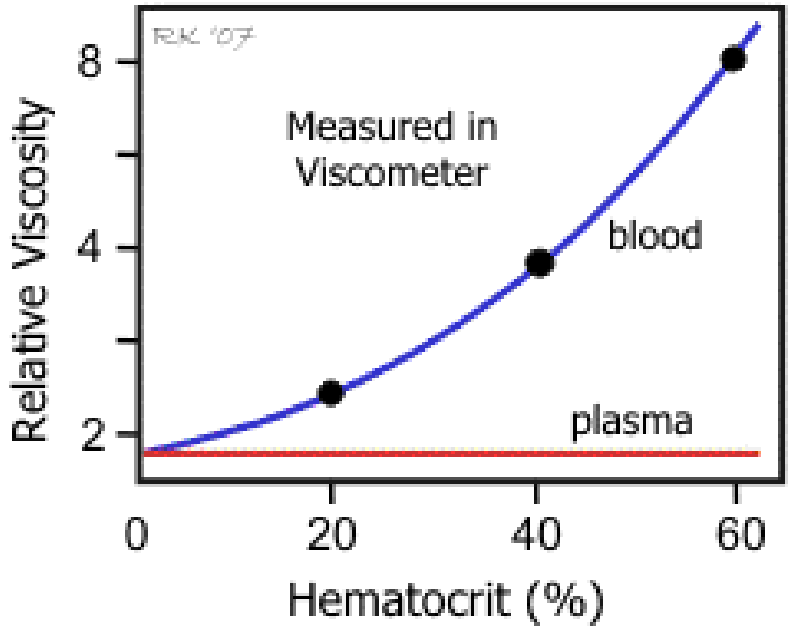
Formed elements + plasma

Poiseuille's Law

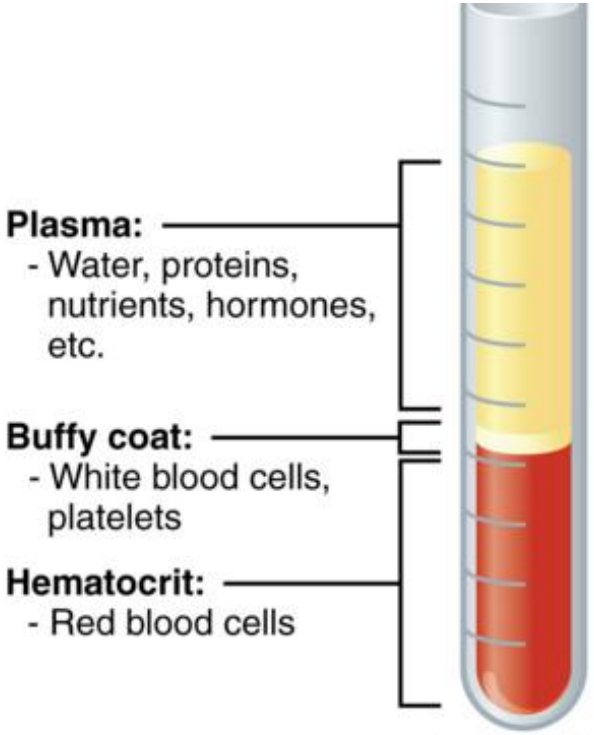
$$Q = \frac{\Delta P \, \pi \, r^4}{8 \, \eta \, l}$$

Q = volume flux
ΔP = change in pressure
r = pipe or vessel radius
η = viscosity
l = pipe or vessel length





Composition of blood



Normal Blood:

♀ 37%–47% hematocrit

♂ 42%–52% hematocrit

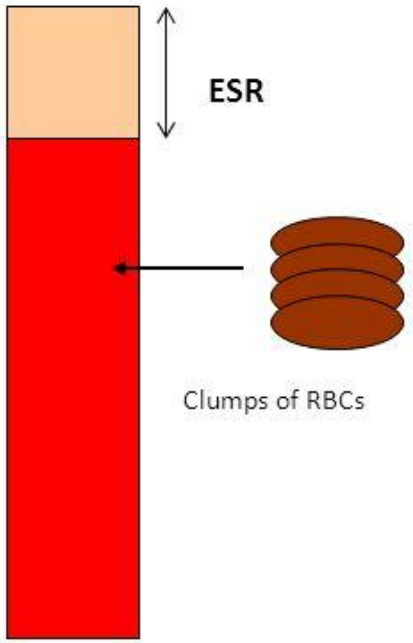
ERYTHROCYTE SEDIMENTATION RATE (ESR)

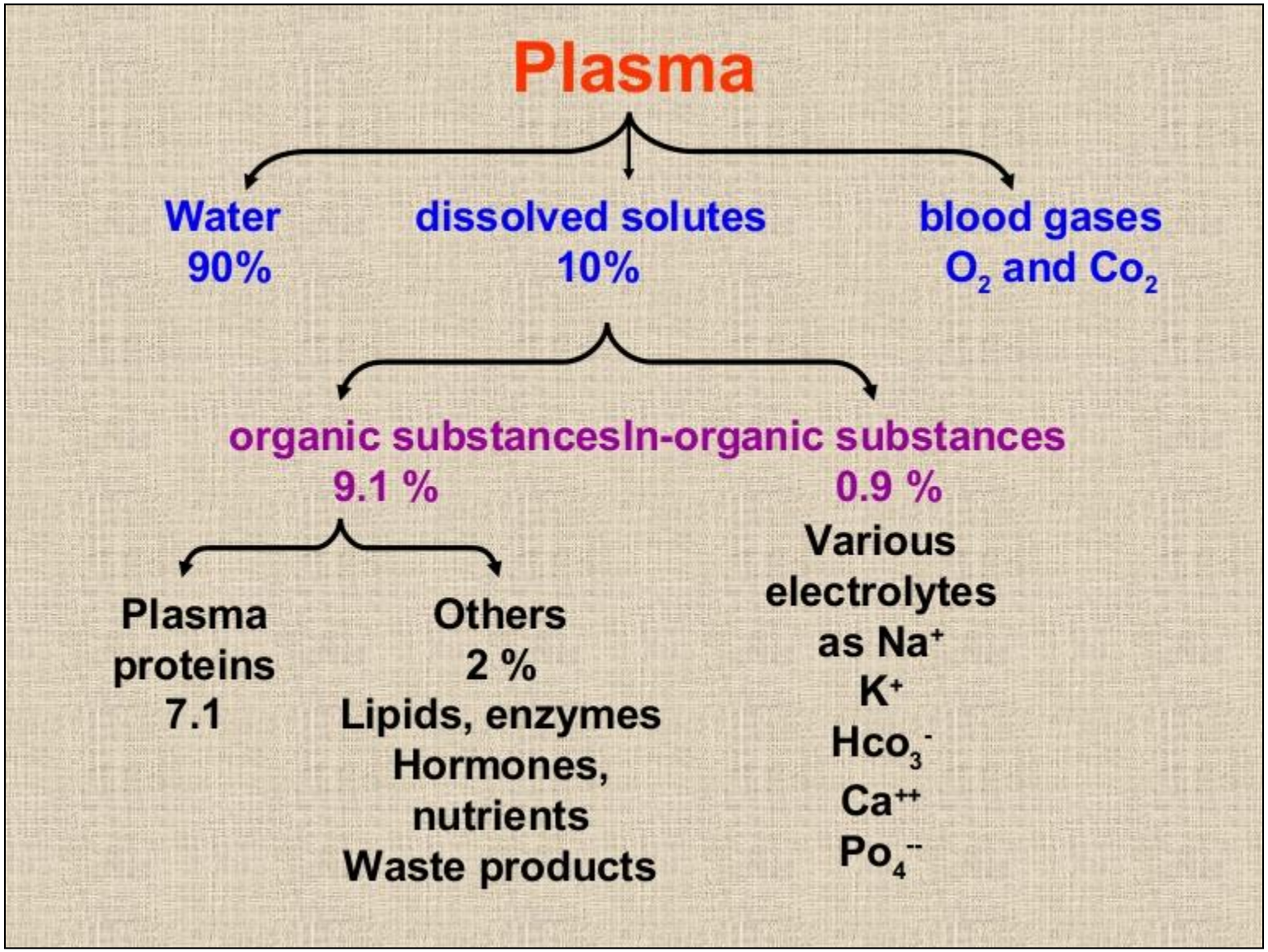
- Specific weight of the RBC is higher than that of the plasma → in a stabilized blood, RBC slowly sink towards the bottom of the test tube -**sedimentation**

Males – 3-6 mm/h
Females – 8-10 mm/h

- **Factors increasing ESR**
  - ↓ Htc, ↓ blood viscosity
  - ↑ concentration of fibrinogen (i.e., pregnancy, vascular diseases, heart diseases), haptoglobulin, lipoproteins, immunoglobulins
  - Macrocytic RBC
  - Extreme elevation of WBC count (leukemia)

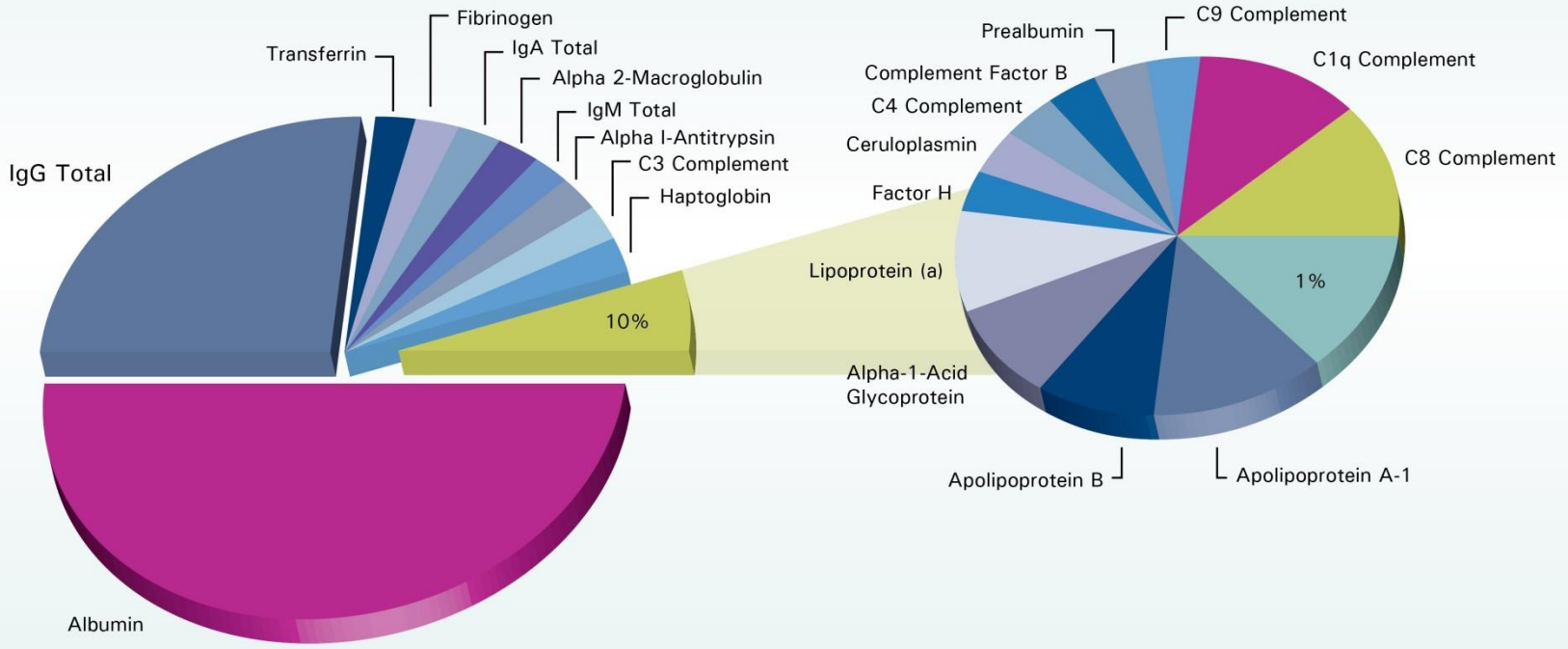
- **Factors decreasing ESR**
  - ↑ Htc
  - Change in the RBC shape (i.e., sickle-cell anemia, poikilocytosis – nonuniformity of shape)
  - ↑ albumin concentration




Plasma
Water
90%
dissolved solutes
10%
blood gases
O_2 and Co_2
organic substances
9.1 %
In-organic substances
0.9 %
Plasma
proteins
7.1
Others
2 %
Lipids, enzymes
Hormones,
nutrients
Waste products
Various
electrolytes
as Na^+
K^+
Hco_3^-
Ca^{++}
Po_4^{--}

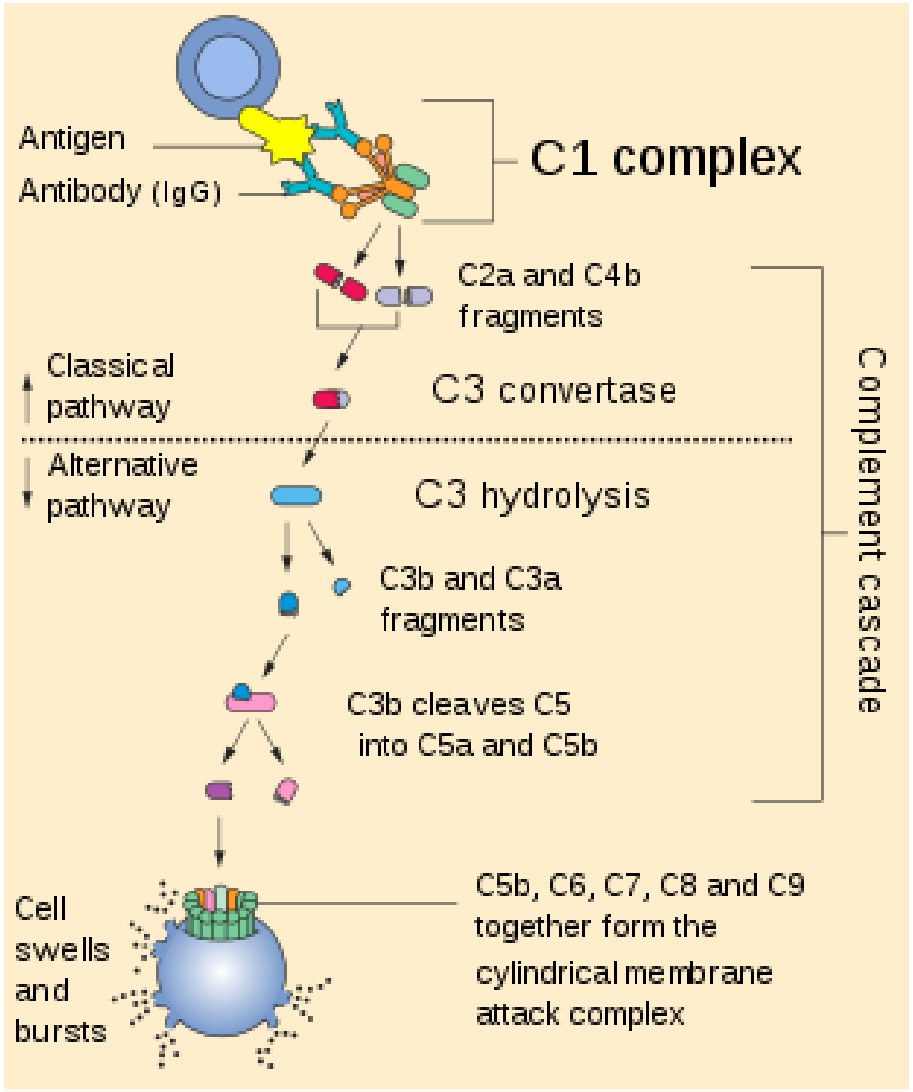
Major Plasma Proteins

99% of Plasma Protein Mass

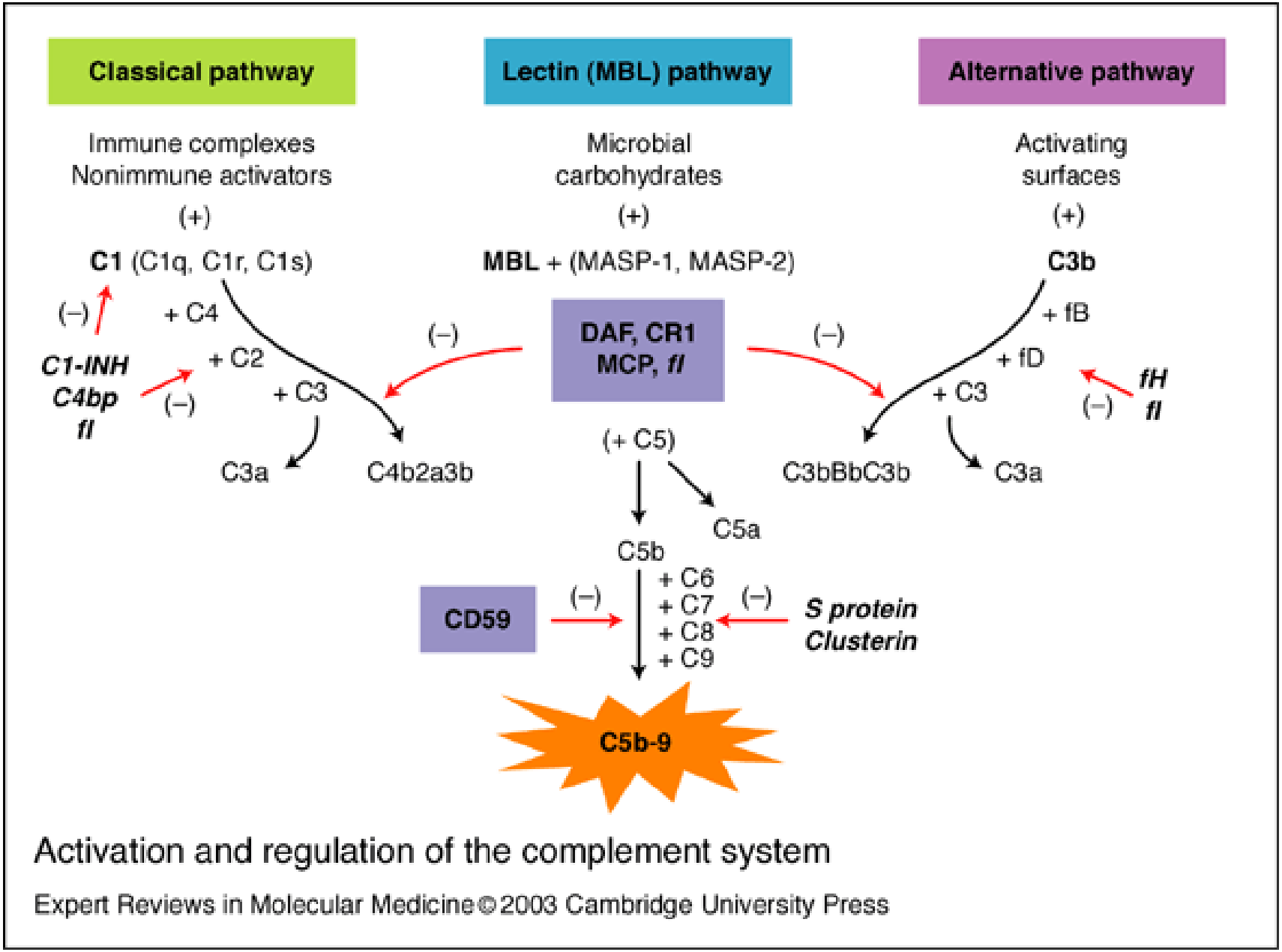


0 - 90%

90-99%



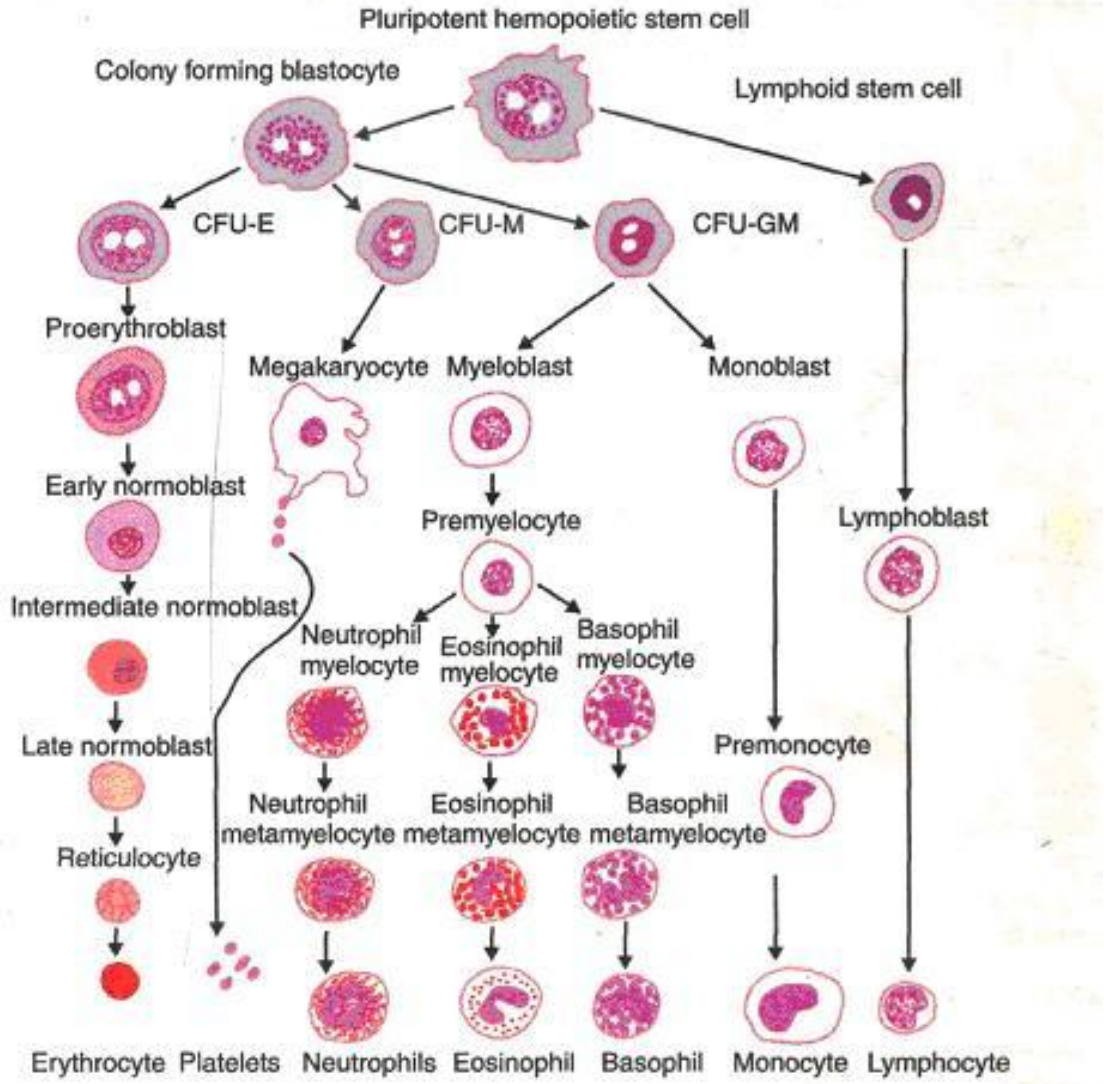
Source: Wikipedia



Activation and regulation of the complement system

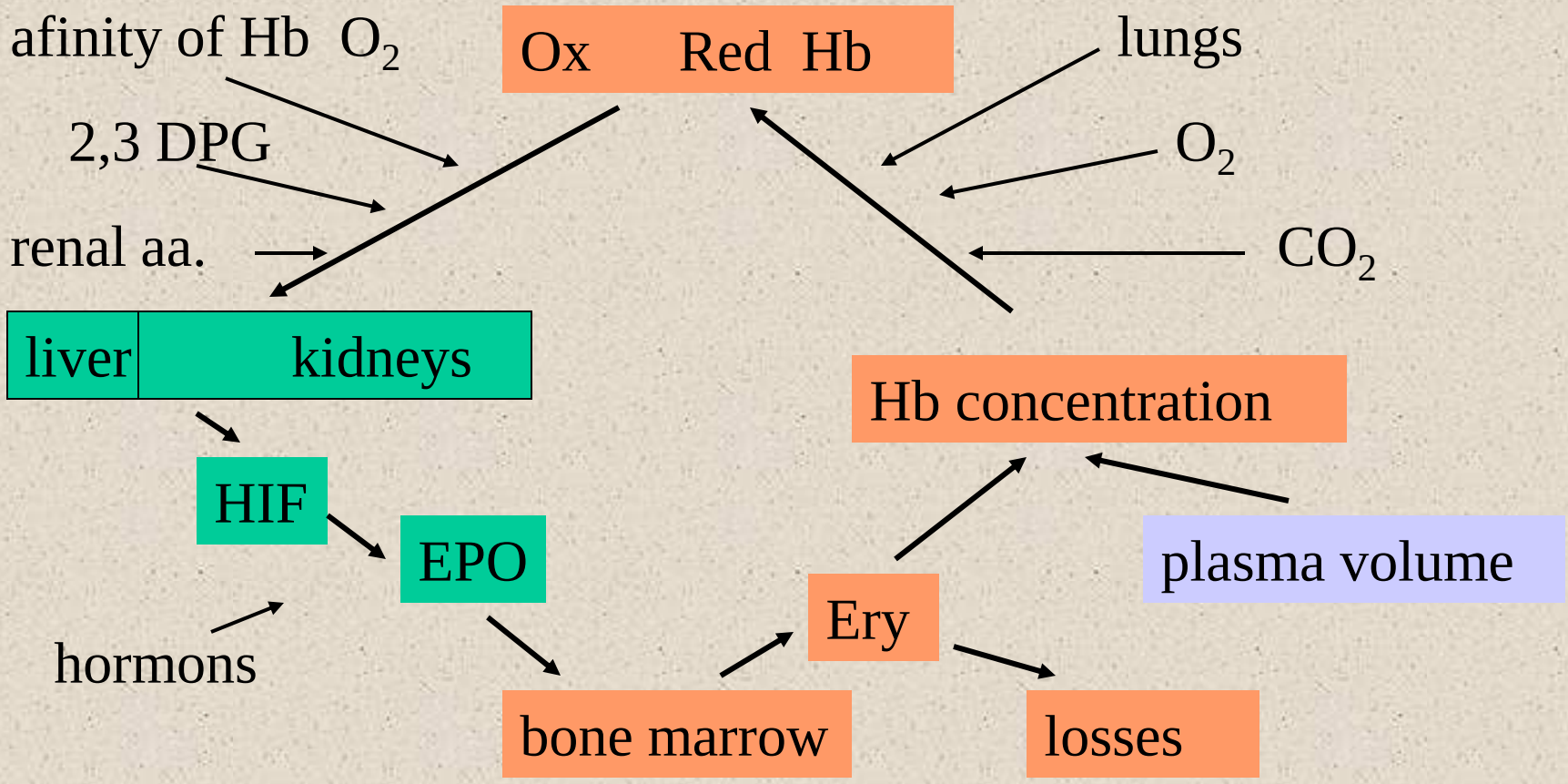
BLOOD ELEMENTS

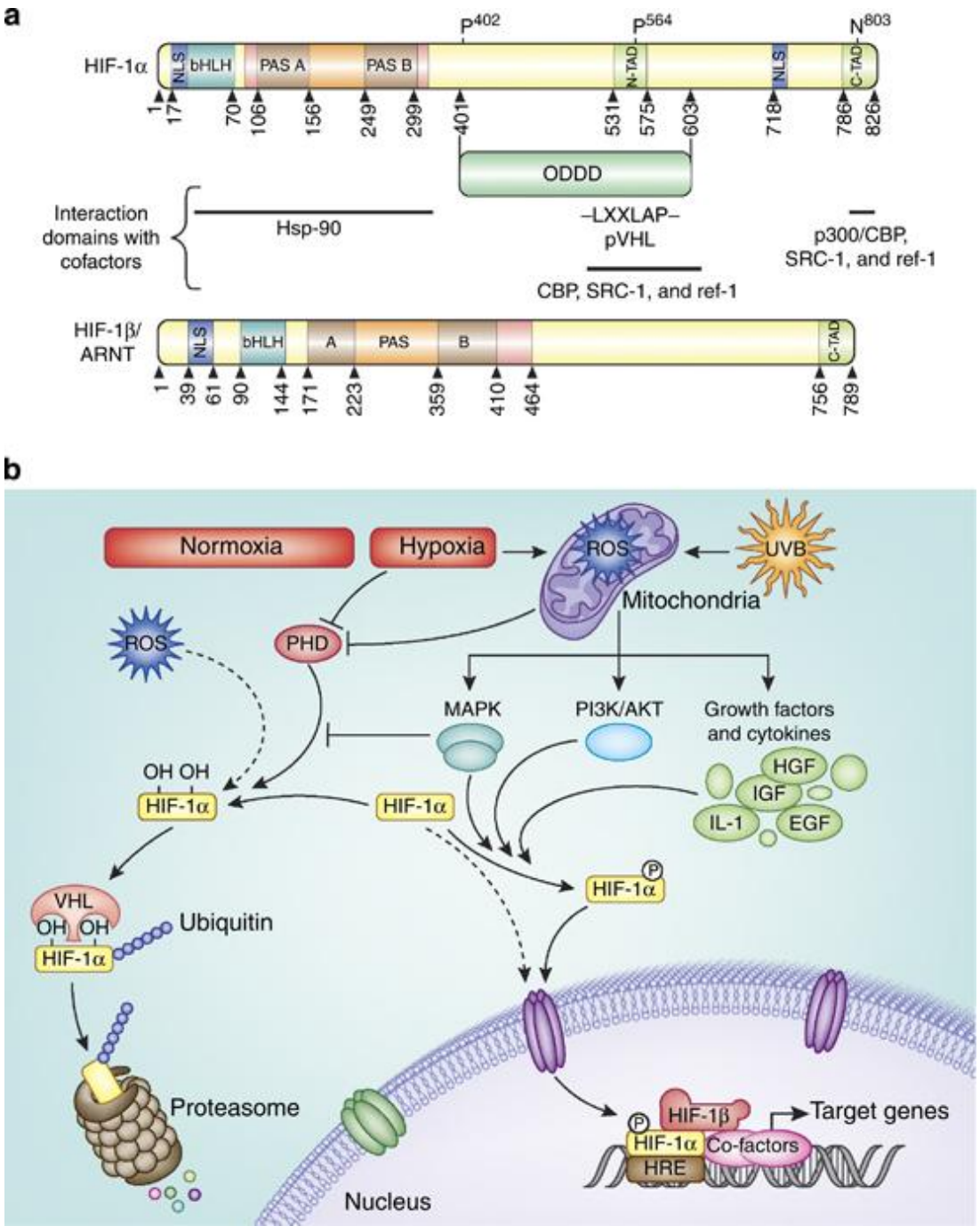
HEMATOPOESIS



E 10-2: Stages of erythropoiesis. CFU-E = Colony forming unit—Erythrocyte, CFU-M = Colony forming unit—Megakaryocyte, CFU-GM = Colony forming unit—Granulocyte/Monocyte

Ery formation





Source: researchgate

Hb – 135 –170 g/l

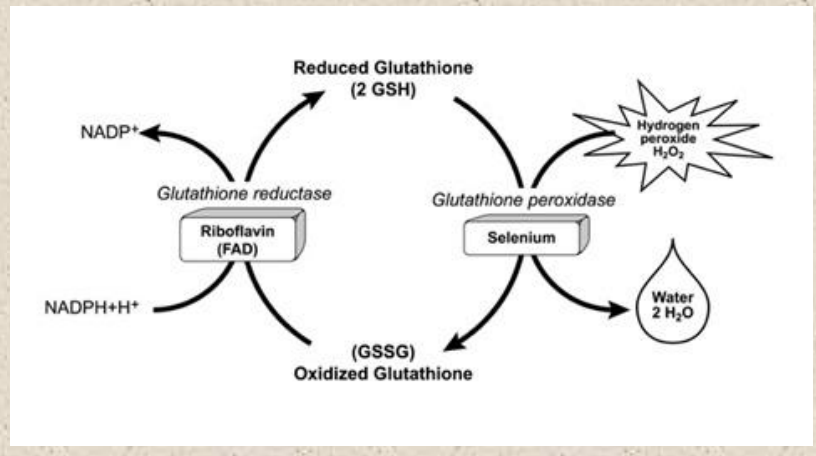
A, F, dissociation curve

Metabolism Ery - shape, deformability

- ion pumps

- hem in ferroform

- ROS scavanging



no mitochondriae → glycolysis

carboanhydrase

$H_2O + CO_2 \rightarrow H^+ + HCO_3^-$

G → **G-6P** ⇄ NAD / NADH ⇄ GSH / GSSG

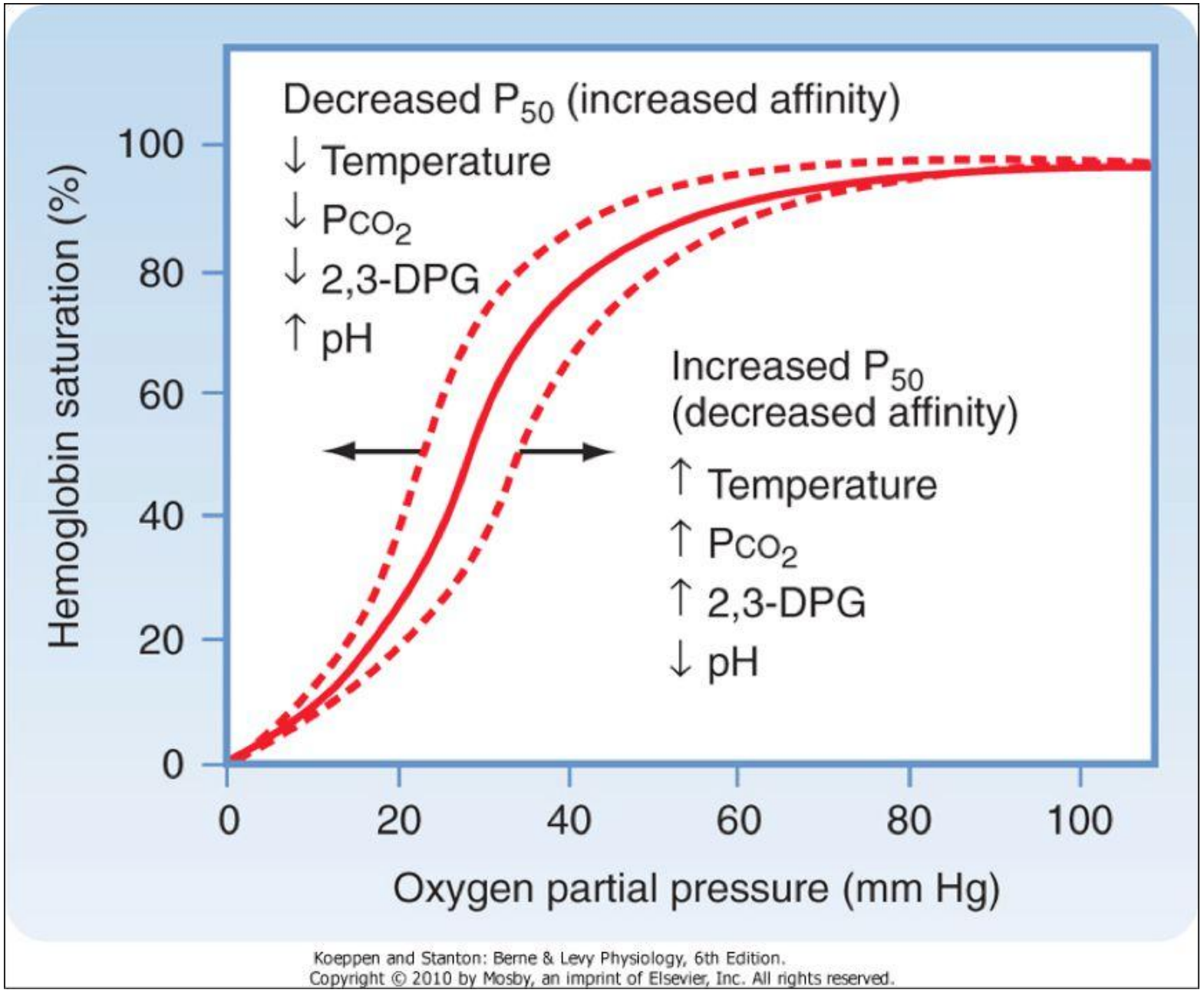
F-6P

F –1,6 P

G – 3P ⇄ NAD / NADH

1,3 DPG — difosfogycerate mutasea → **2,3 DPG**

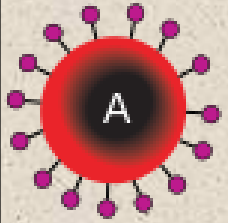
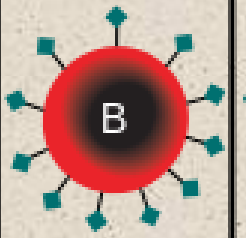
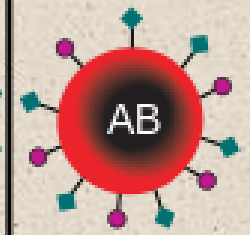
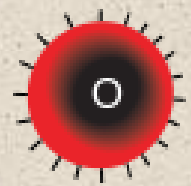
3 PG — difosfoglycerate fosfatase



Blood Groups

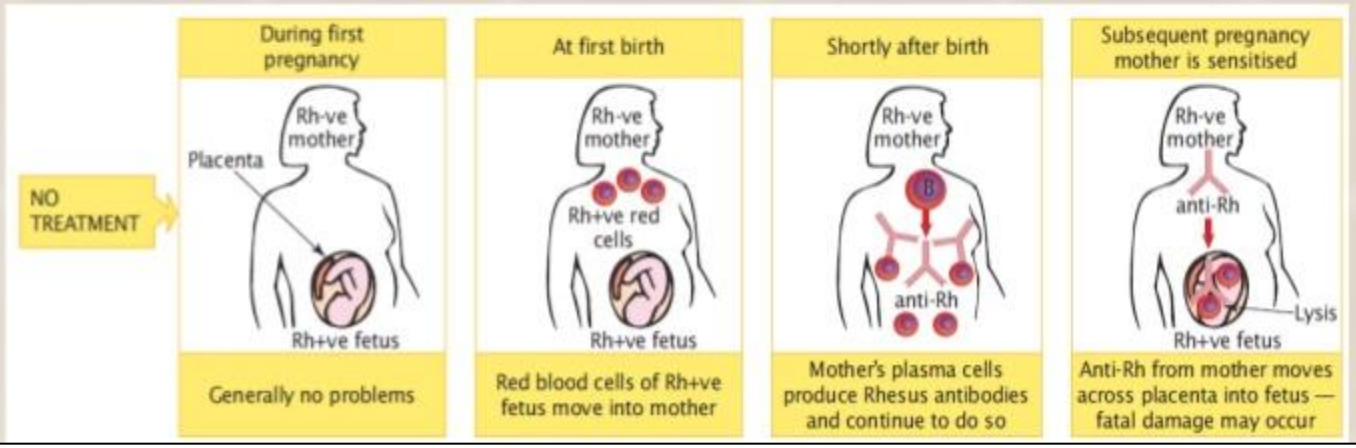
A,B,0 spontanneously produced aglutinins

Rh (C,**D**,E) aglutinins produced after exposure

	Group A	Group B	Group AB	Group O
Red blood cell type				
Antibodies in Plasma	 Anti-B	 Anti-A	None	 Anti-A and Anti-B
Antigens in Red Blood Cell	 A antigen	 B antigen	 A and B antigens	None

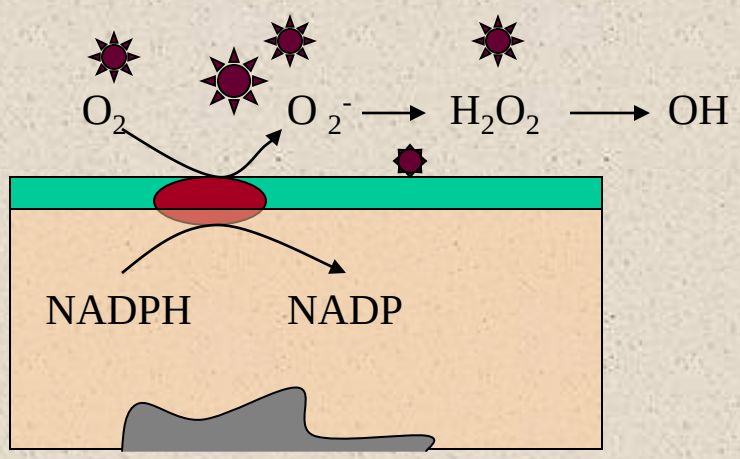
Rh Incompatibility

- During the first pregnancy, at birth the placenta will detach from the uterine wall and the foetal blood will cause the mother to create Rh antibodies
- During the second pregnancy the mother's T helper cells will produce antibodies that will cross the placenta and attack the foetus' RBCs and organs
  - Resulting in haemolytic disease of the newborn
  - If untreated, effect will worsen with each subsequent pregnancy



LEUKOCYTES - 7 x 10^9/l

	%	
neutrophils	50 – 70	granulocytes
eozinophils	1 – 4	
basophils	< 1	
monocytes	2 – 8	



chemotaxis, secretion, adhesion, diapedesis, fagocytosis, ROS (NADPH oxidase, myeloperoxidase), proteases

lymfocytes 20 – 40

T - helper/inducer - memory cells

- supressors

- cytotoxic - K

- N K

B - plasmatic - memory cells Mast cells

TROMBOCYTES 250 x 10^9/l 2 – 4 u

microtubuli, receptors for collagen, actin + myosin, granules (ADP, serotin), α granules (PDGF, PAF)

Hemostasis x coagulation

HEMOSTASIS: 1) vessels – vasoconstriction (wall)

2) platelets - adhesion (receptors, von Willebrandův f.)

- activation (change of the shape, ADP, TXA, 5HT vasoconstriction)

- aggregation (platelet plug)

COAGULATION