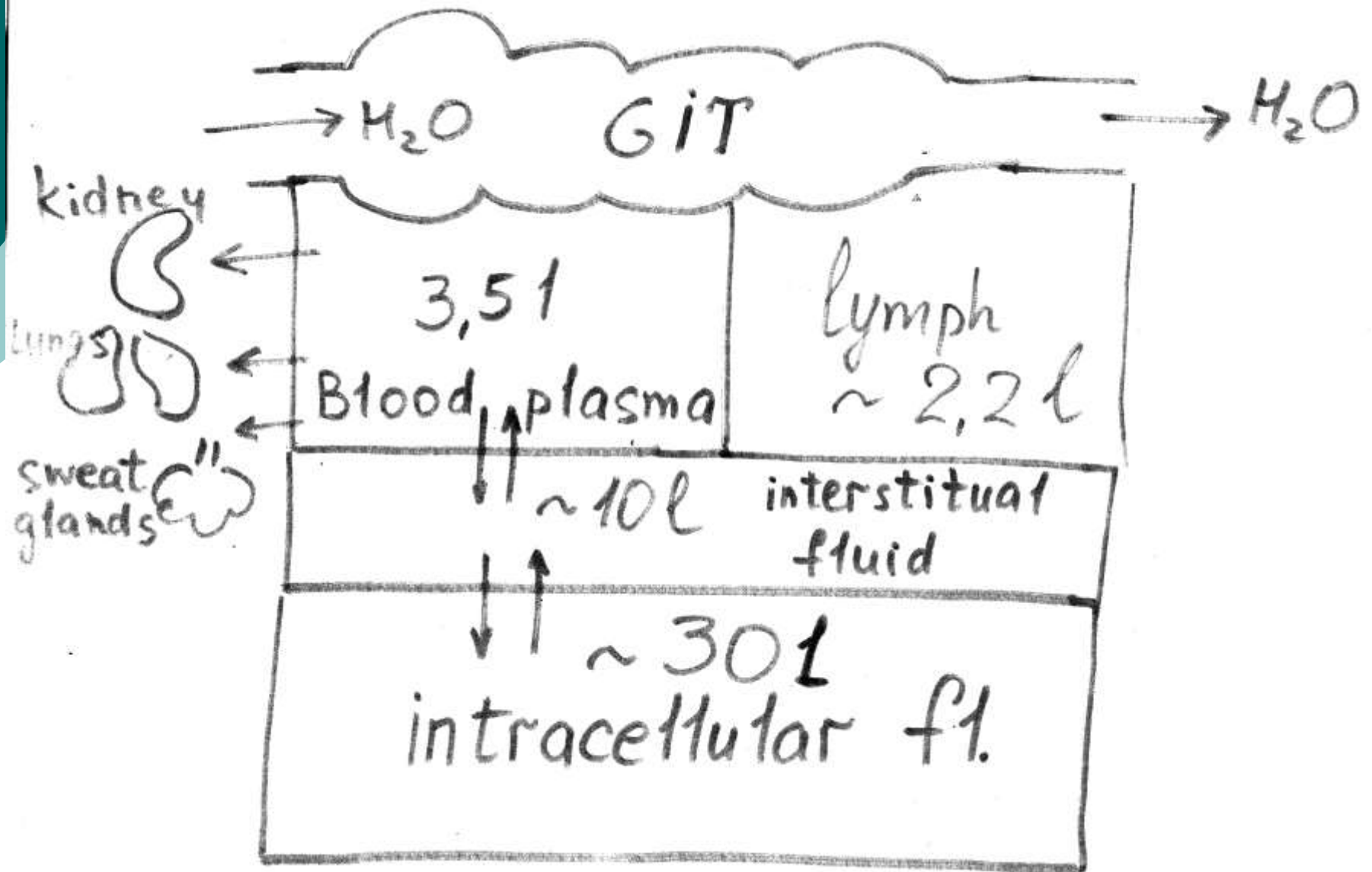




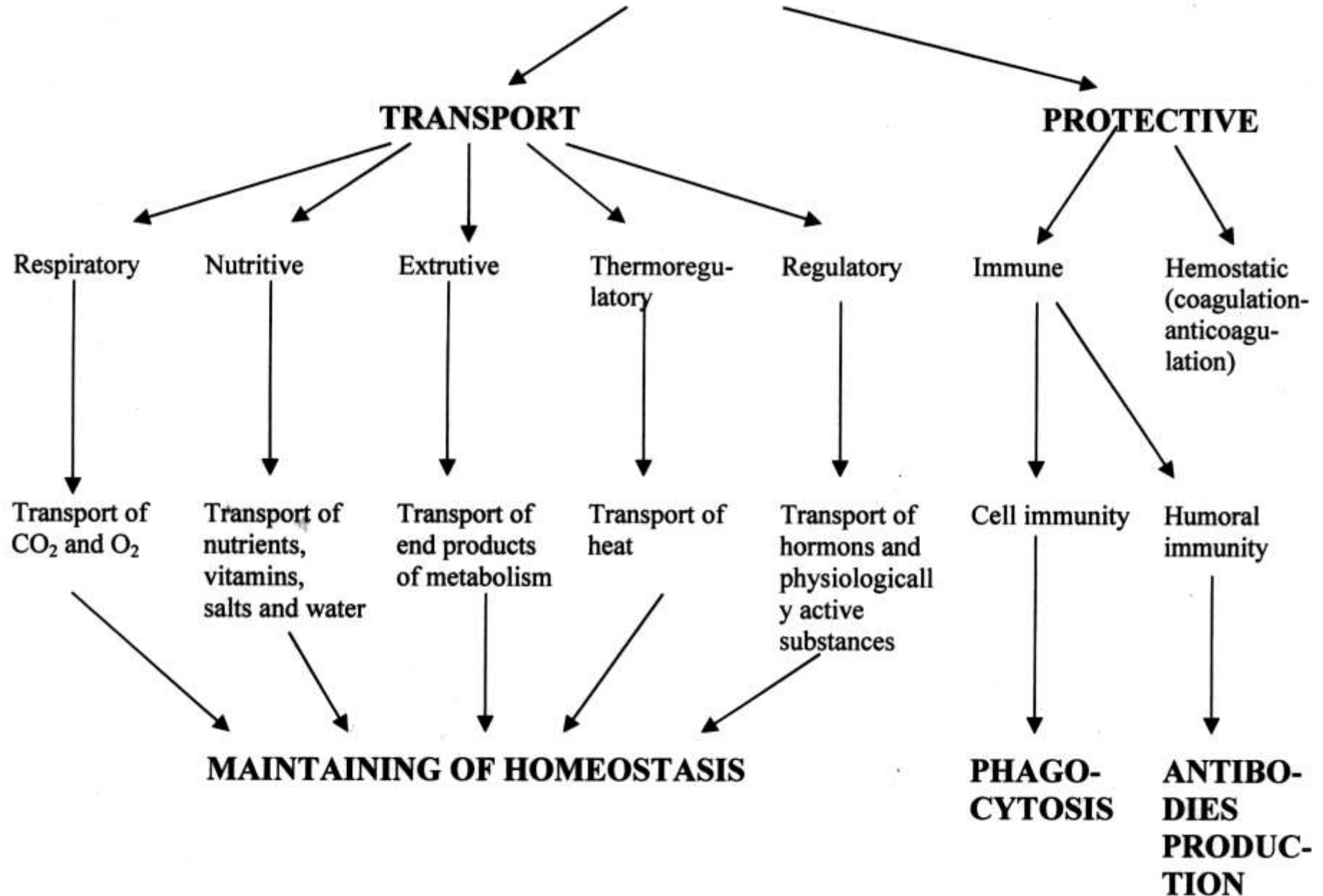
Physiology of Blood

Lecture 15. General characteristics of the blood system. Blood as a means of transport and the internal environment of the body. Physico-chemical properties of blood. Physiological properties of erythrocytes

Blood in the system of body fluids



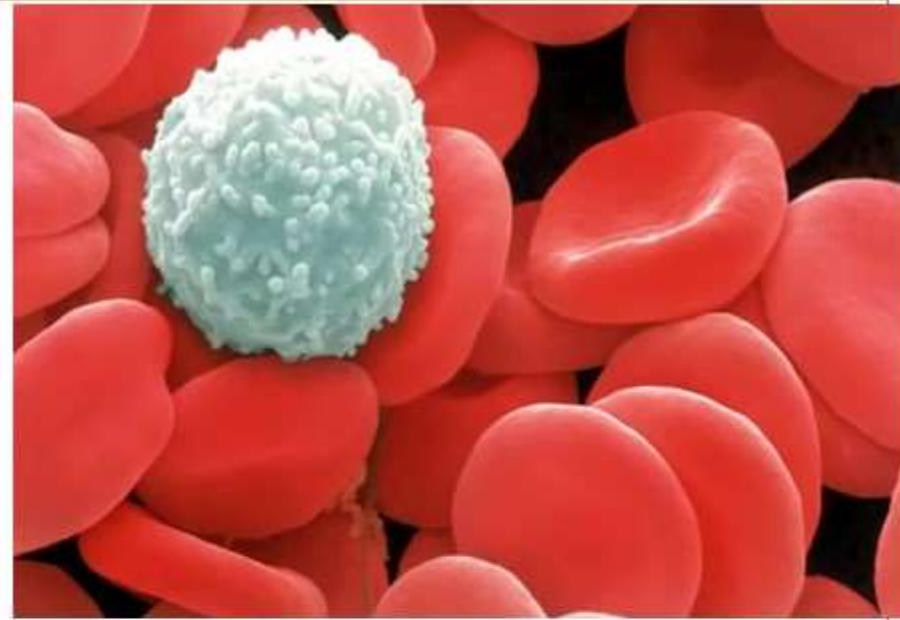
BLOOD FUNCTIONS



Functions of Blood

- **Transport;**

- Oxygen / Carbon dioxide
- Nutrients
- Hormones



- **Regulation of pH** -'buffering' ; **7.35 - 7.45**

- **Body temperature** regulation

- **Protection** - antibodies

- **Clot formation**



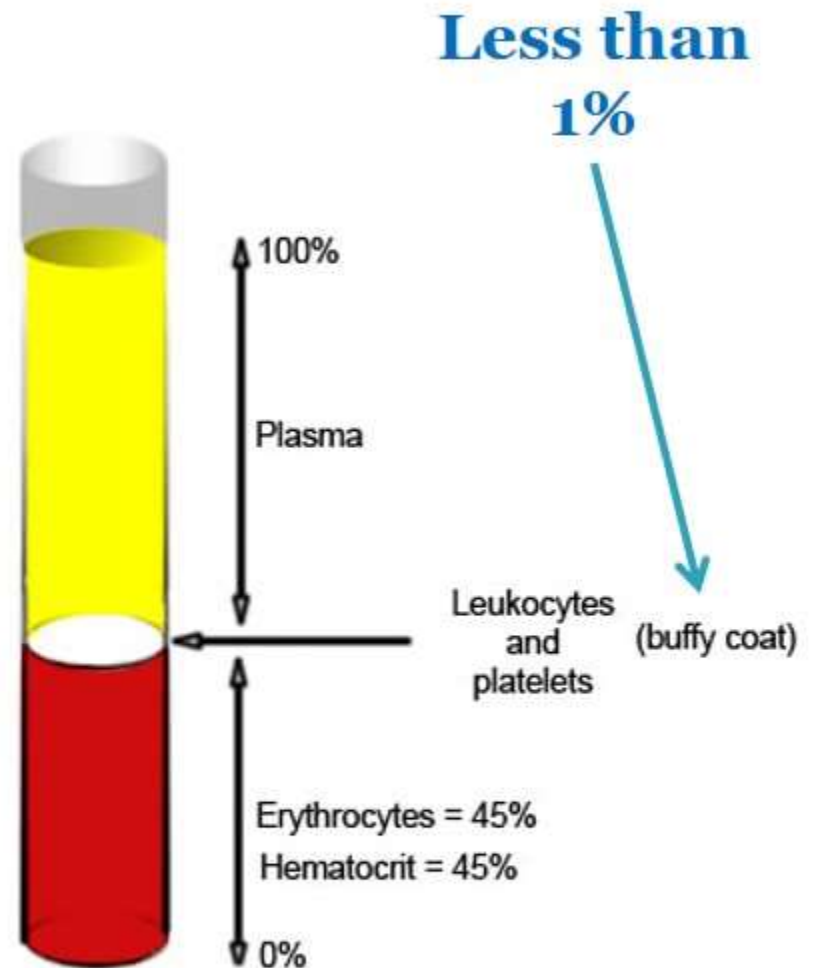
Blood content

- liquid portion or plasma (52-64%)
- cells or formed elements (36-48%):
erythrocytes (red blood cells),
leucocytes (white blood corpuscles),
and *thrombocytes* (blood platelets).
- Definite volumetric correlation
between the plasma and formed
elements is *haematocrit* (36-48%)

Hematocrit;

% of **RBC** by volume
in whole blood
(usually about 45%)

Red Blood Cell count
number of
RBCs in 1mm^3 of blood



Plasma

- Liquid part of blood

- **91 % water**
- **7% plasma proteins**
- **Remainder composed of gases, nutrients, ions, waste products (remember blood transports these things)**

- **Proteins** (made by the liver):

- **Albumins (60%)**: osmotic pressure of blood, buffer (pH), & transports fatty acids
- **Globulins(36%)**: transport proteins binds lipids
gamma globulins –antibodies (immunoglobulins)
- **Fibrinogen (4%)**: blood clotting – forms fibrin threads

Blood plasma composition

- 90 to 92 % water
- 8 to 10 % dry matter, mainly proteins and salts.
- The total protein content is 7 to 8 %; *albumins* (about 4.5 per cent), *globulins* (2 to 3 %), and *fibrinogen* (0.2-0.4 %).
- non-protein nitrogenous compounds (amino acids and polypeptides), and products of protein decomposition (urea, uric acid, creatine, creatinine).
- nitrogen-free organic substances are glucose 4.4-6.6 mmol/l, neutral fats and lipoids.
- Mineral substances - 0.9 %. (Na^+ , K^+ , Ca^{2+} cations and Cl^- , HPO_4^{2-} , and HCO_3^- anions).



Parameters of blood homeostasis

- Viscosity (5,0)
- pH (7,4 for arterial, 7,35 for venous)
- Osmotic pressure (7,6 atm)
- Glucose content (3,3-5,5 mmol/l)
- Protein content (65-85 gr/l)
- Ionic content

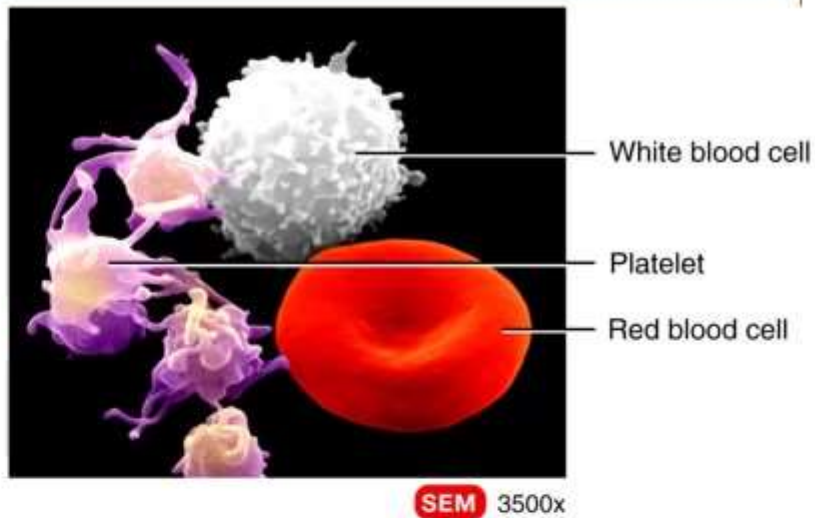


Functions of plasma proteins

- Create oncotic pressure
- Buffer system
- Create blood viscosity
- Partake in blood coagulation
- Partake in humoral immunity
- Transport function
- Nutritive function

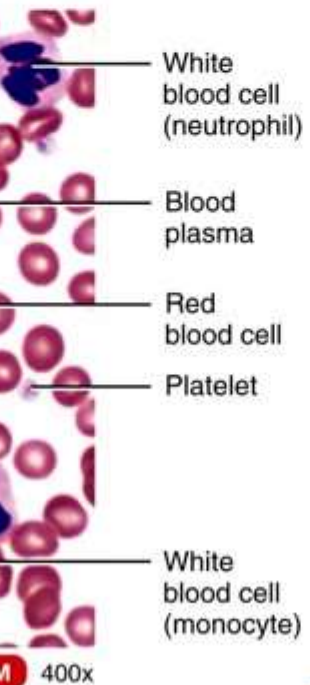
f Blood

s - 45%



(a)

Figure 19.22a. Tortora - PAP 12/e
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Formed Elements

- **Red blood cells (erythrocytes)**

- Hemoglobin

- **White blood cells (leukocytes):**

- **Granulocytes:**

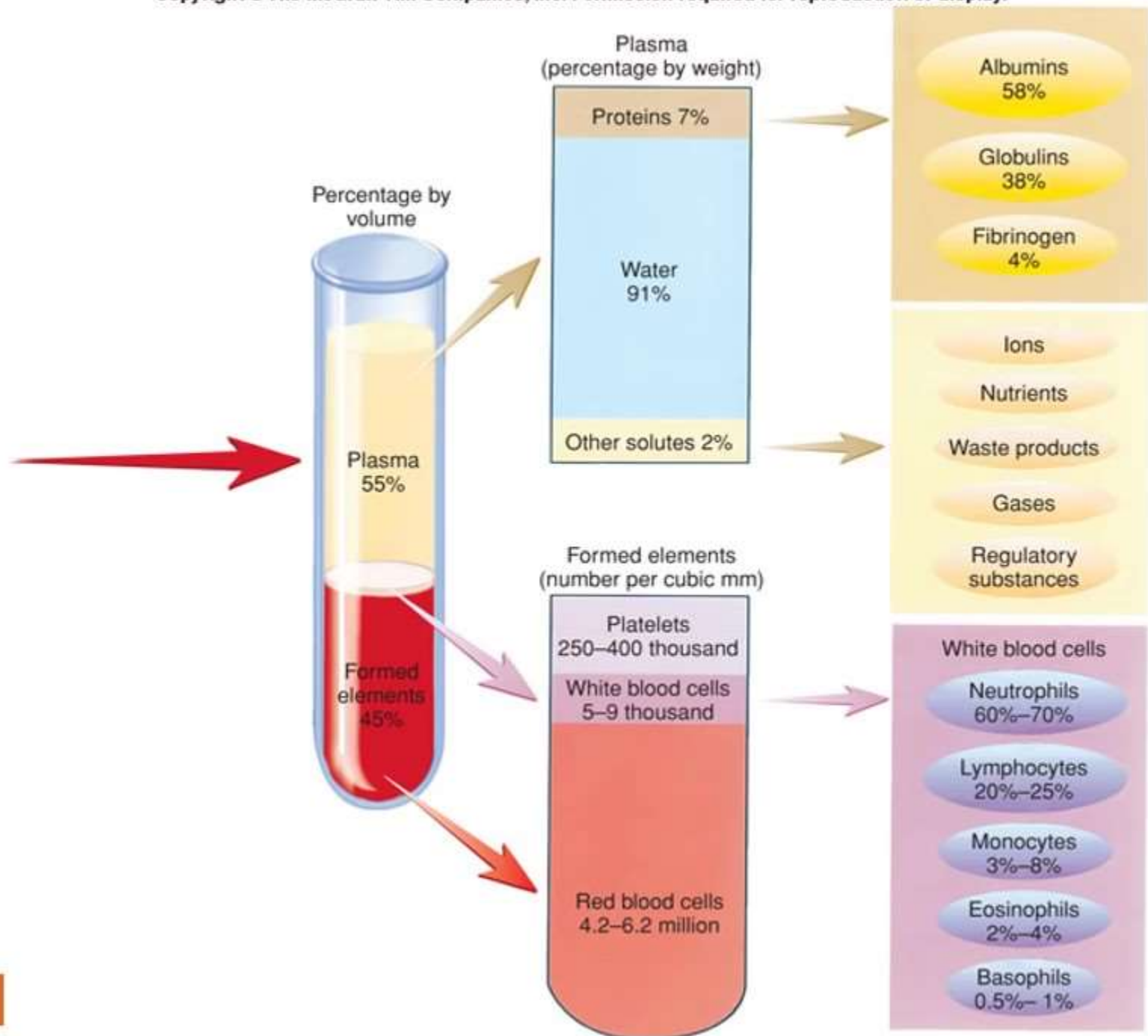
- ✦ neutrophils
- ✦ eosinophils
- ✦ basophils

- **Agranulocytes:**

- ✦ lymphocytes
- ✦ monocytes

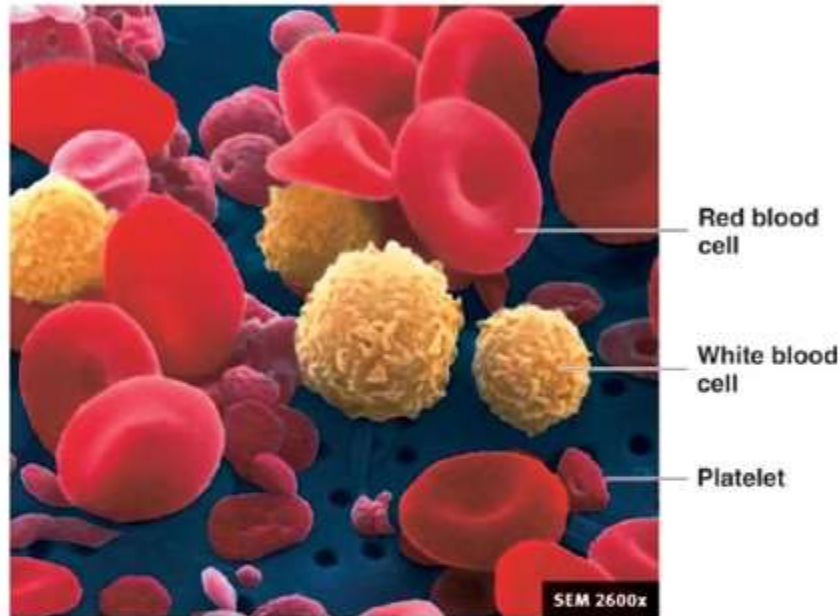
- **Platelets (thrombocytes)**

- Necessary for blood clotting



Red Blood Cells (Erythrocytes)

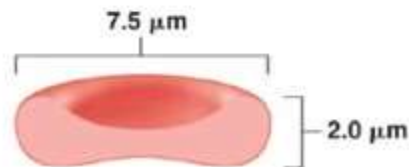
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(a)

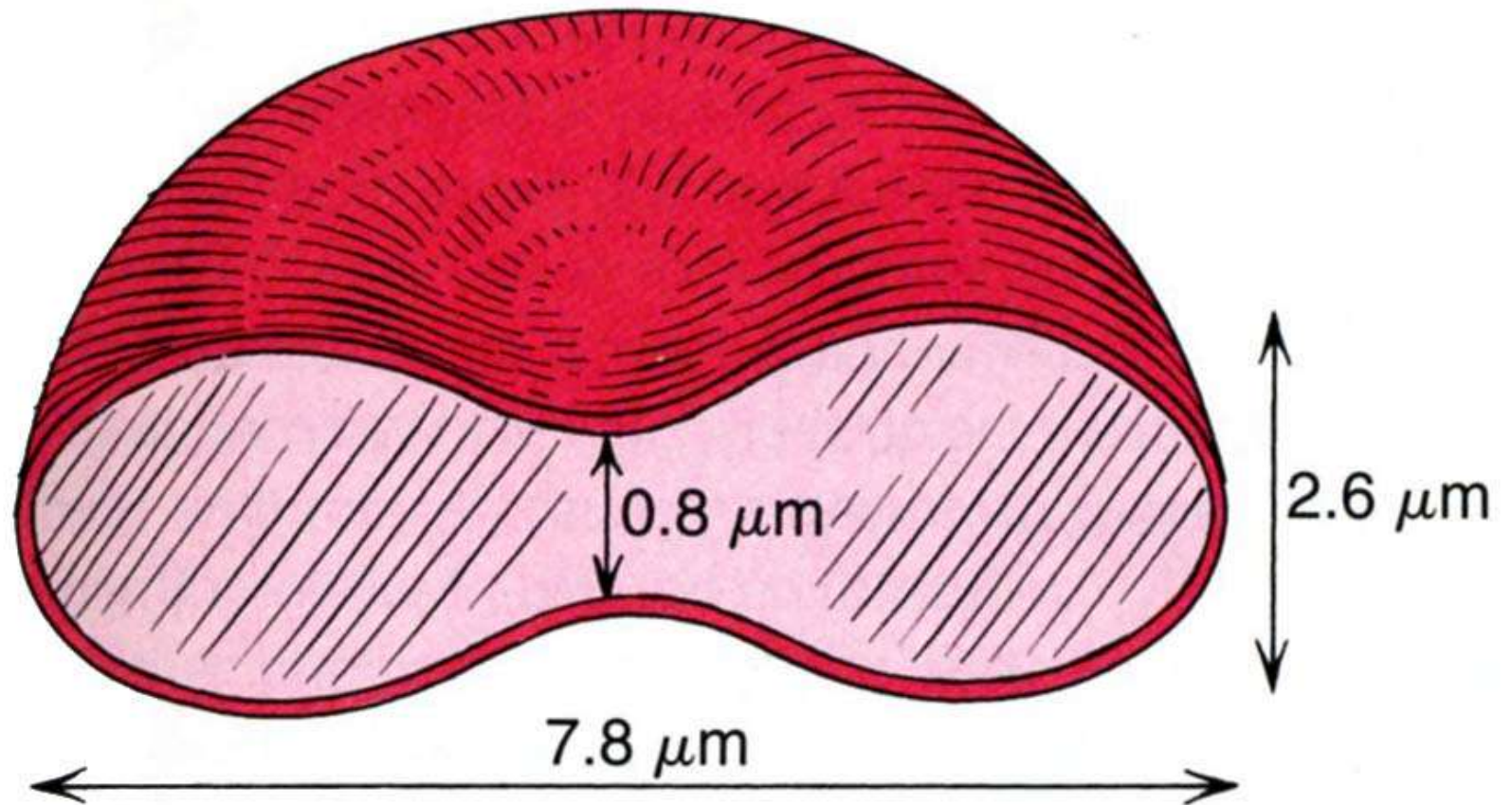


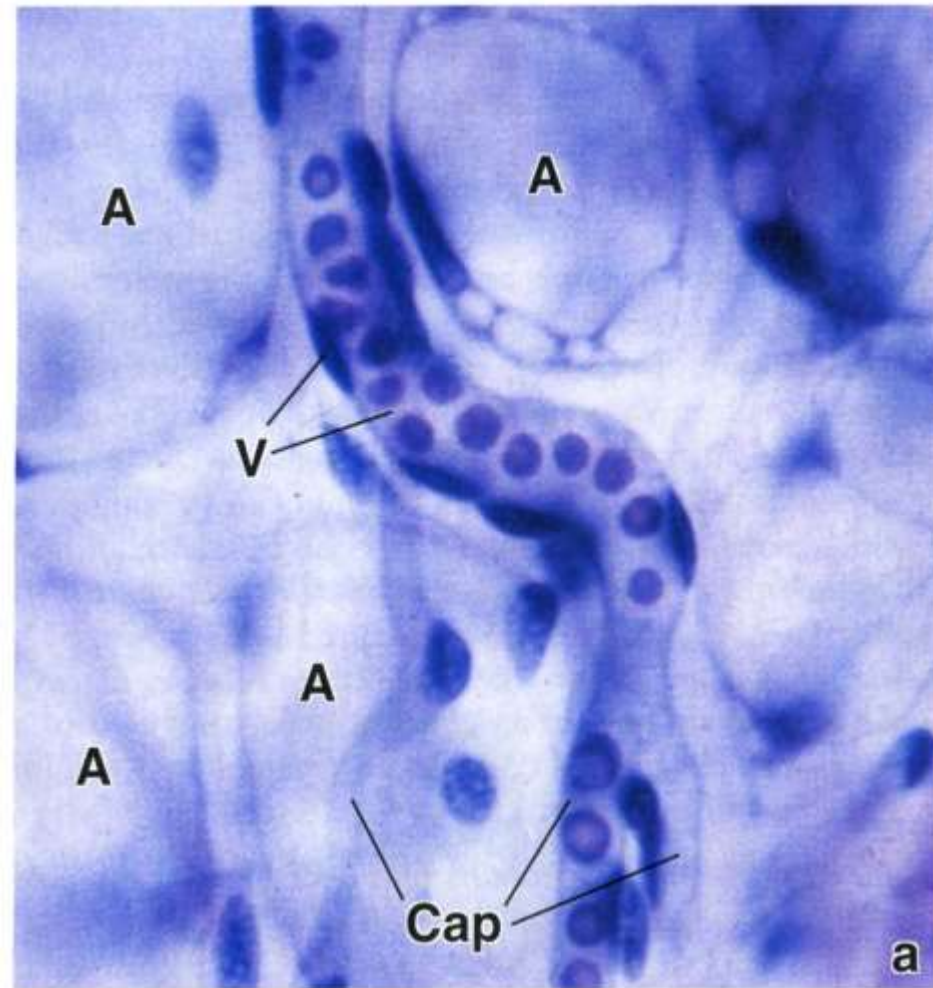
(b) Top view



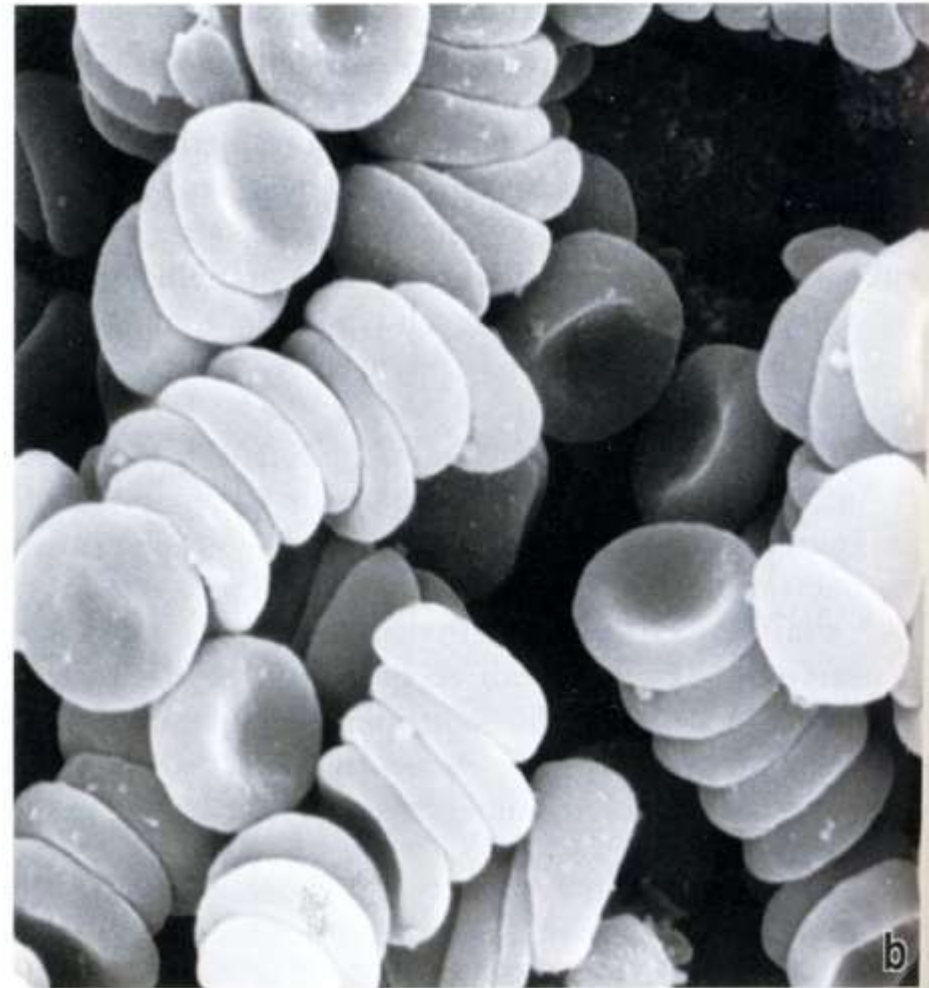
Side view

- **Components;**
 - Hemoglobin (protein)
 - ✦ binds oxygen
 - No nucleus or organelles
 - Biconcave disc provides large surface area
 - Are very flexible and deformable
 - *Oxyhemoglobin vs. Deoxyhemoglobin*





**Erythrocytes in
blood capillaries**



Erythrocytes in blood tube

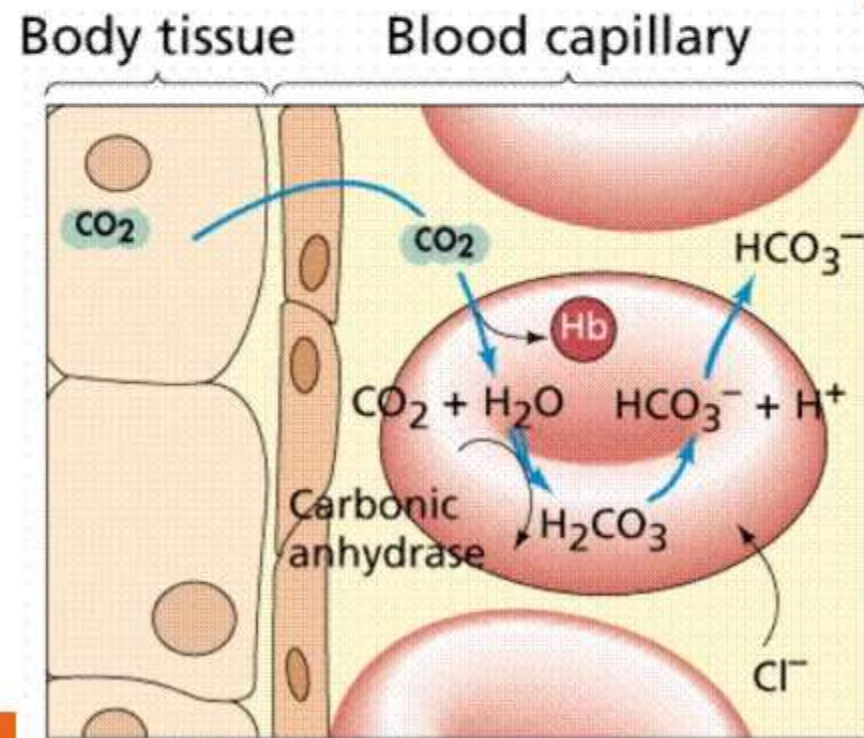
RBC Function: Transport

- **Oxygen** from lungs to tissues:
 - 98.5 % attached to hemoglobin
 - 1.5 % dissolved in plasma
- **Carbon dioxide** from tissues to lungs
 - 7% dissolved in plasma
 - 23% in combination with hemoglobin (carboxyhemoglobin)
 - 70% transported as bicarbonate ions (HCO_3^-) in plasma

The following reaction occurs inside the RBC and is catalyzed by the enzyme ***carbonic anhydrase***

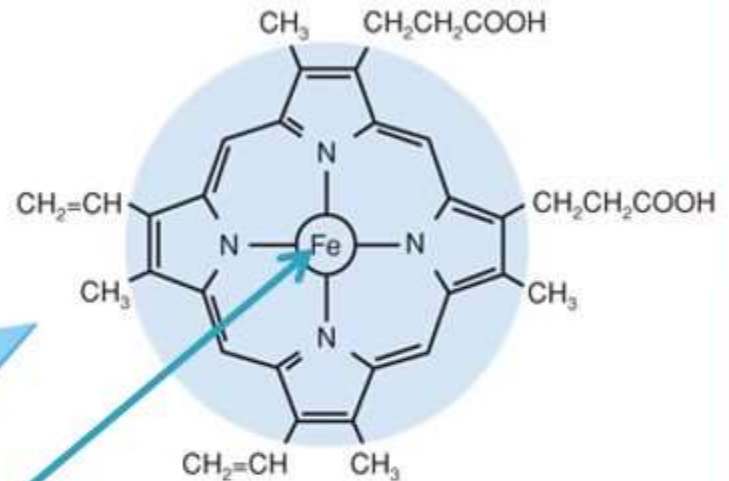
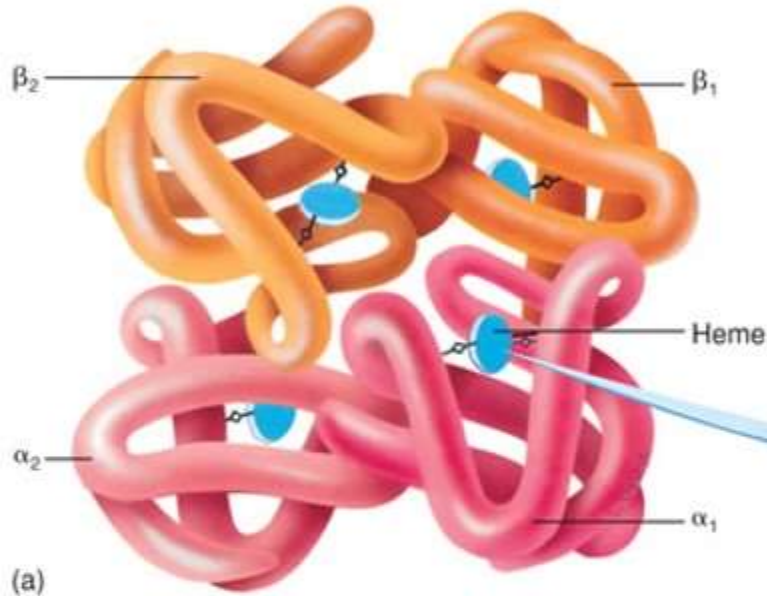


Carbonic anhydrase



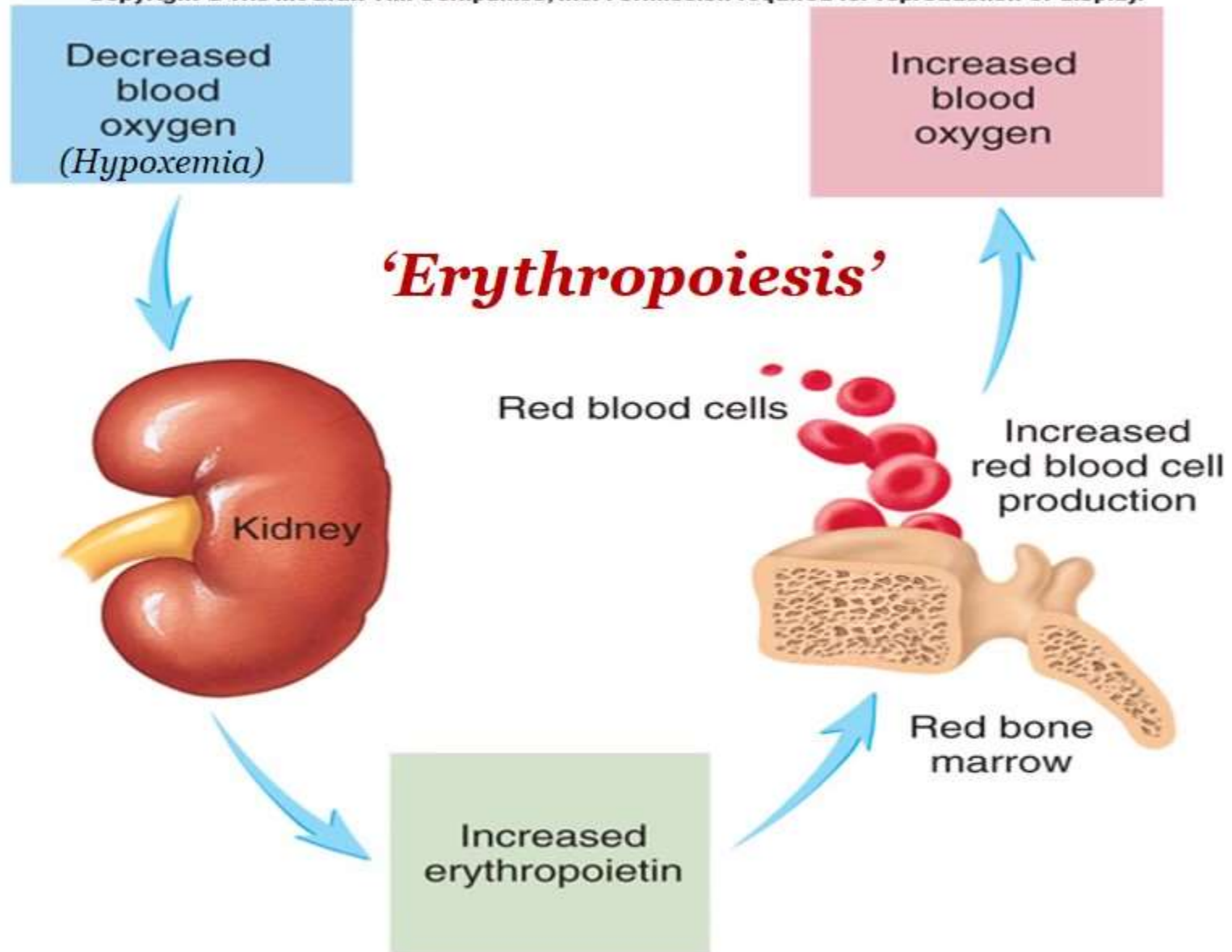
HEMOGLOBIN

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Hemoglobin Heme



**Iron is lost in
urine, feces, &
menstrual
blood**

**Iron required for oxygen
transport.**

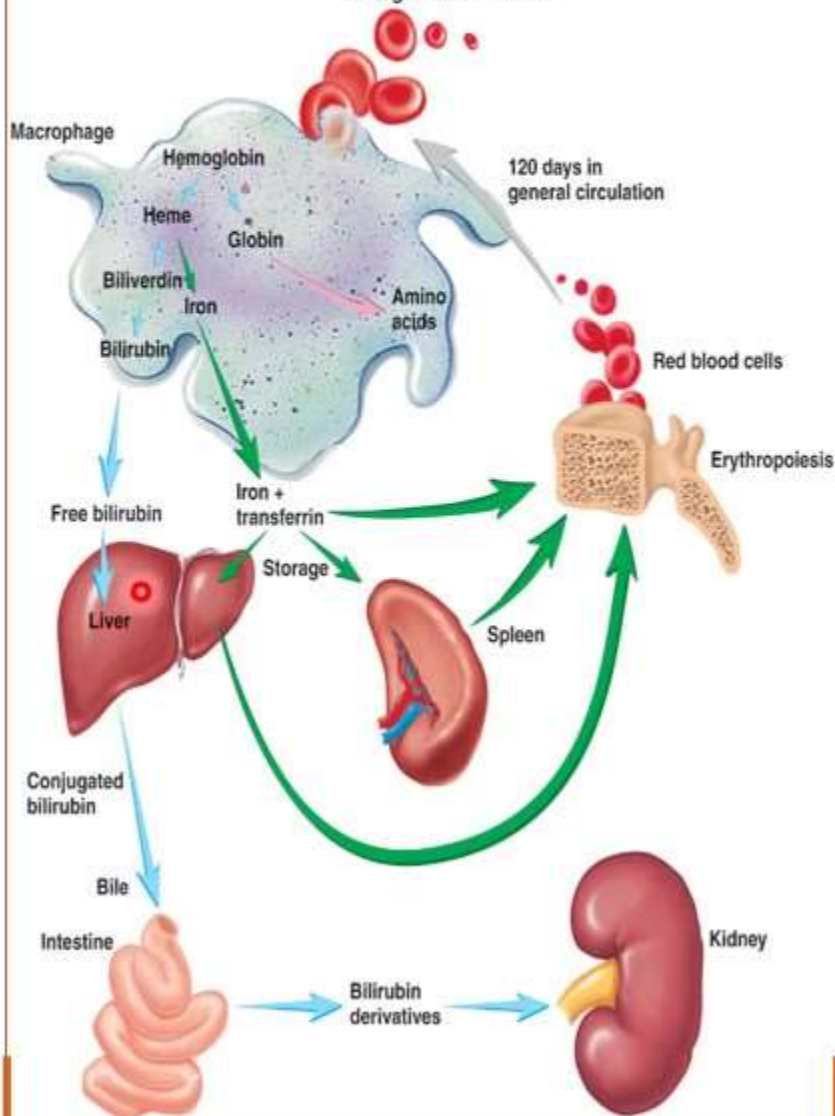


Production of red blood cells – requires B complex vitamins **folic acid** and **B12** as well as **iron**

Hemoglobin Breakdown

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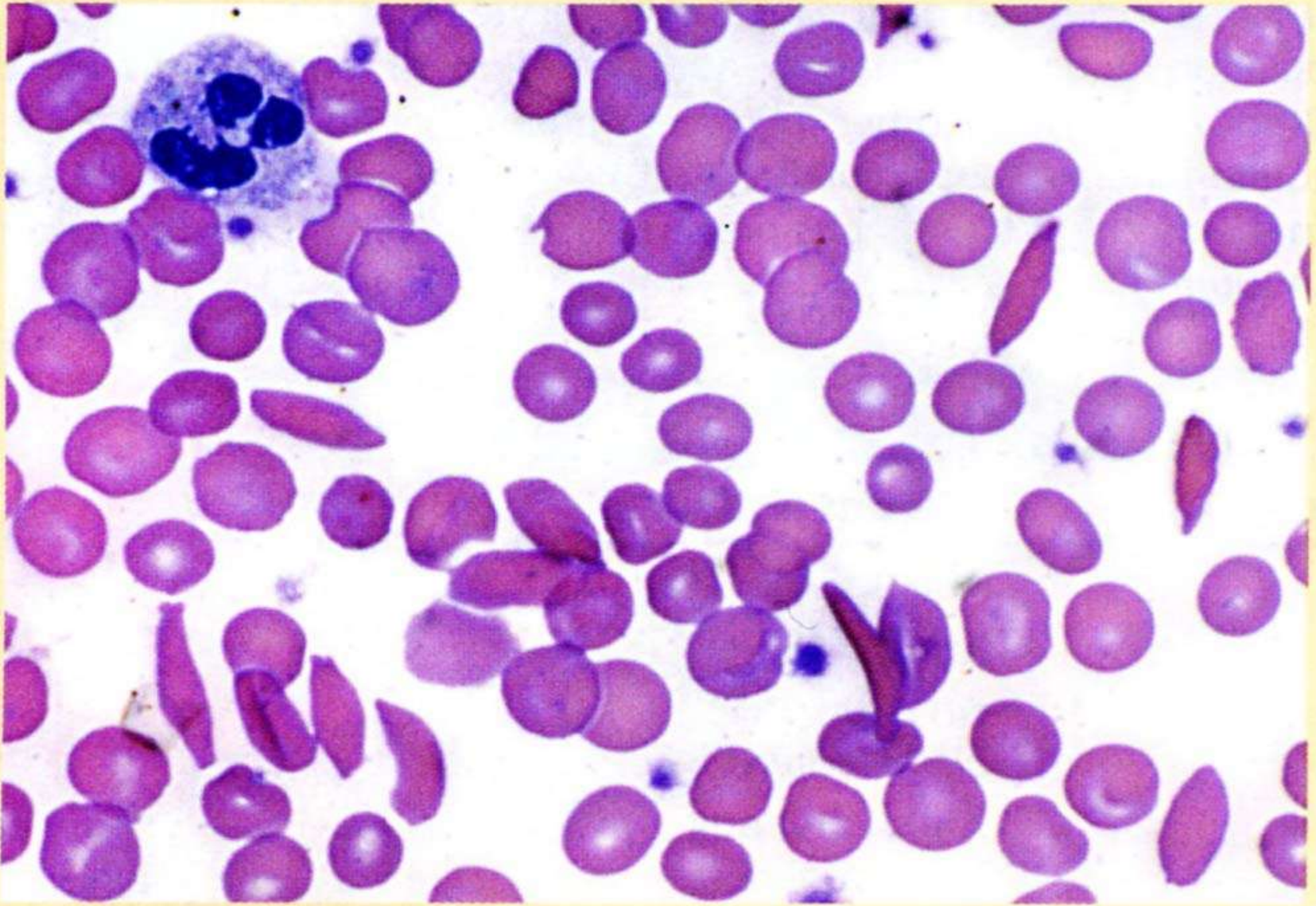
Aged, abnormal, or
damaged red blood cells



RBC life cycle;

Live only about 120 days

Ruptured red blood cells removed from circulation and destroyed by phagocytic macrophages in spleen and liver



Sickle cell disease