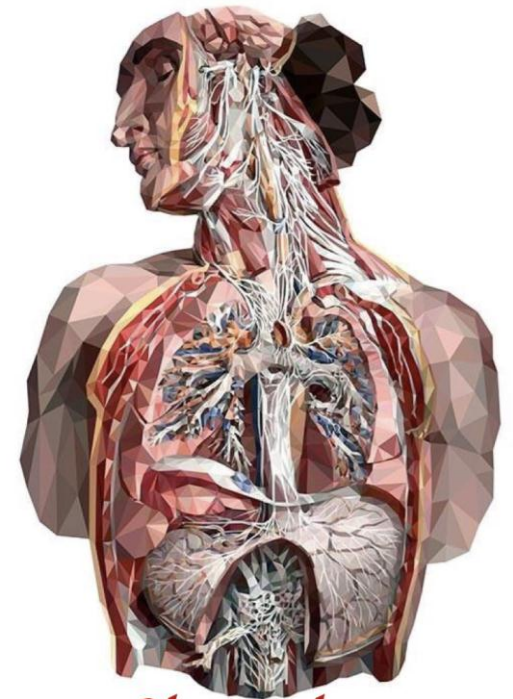


BLOOD PHYSIOLOGY (II)

Erythropoiesis (Males)



Physiology

Team 438
KSU



- **Red** : important
- **Black** : in male / female slides
- **Pink** : in girls slides only
- **Blue** : in male slides only
- **Green** : notes, Extra

Objectives

- Describe essential elements needed for RBC formation.
 - Describe the process of Vit B12 absorption and its malabsorption.
 - Recognize haemoglobin structure and its functions.
 - Discuss iron metabolism (absorption, storage and transport)
- Describe the fate of old RBC.
- Describe the fate of old RBC.
 - Describe anemia and its causes.
 - Recognize causes of polycythemia.



HAEMOGLOBIN

Function of Hemoglobin

1) Buffer

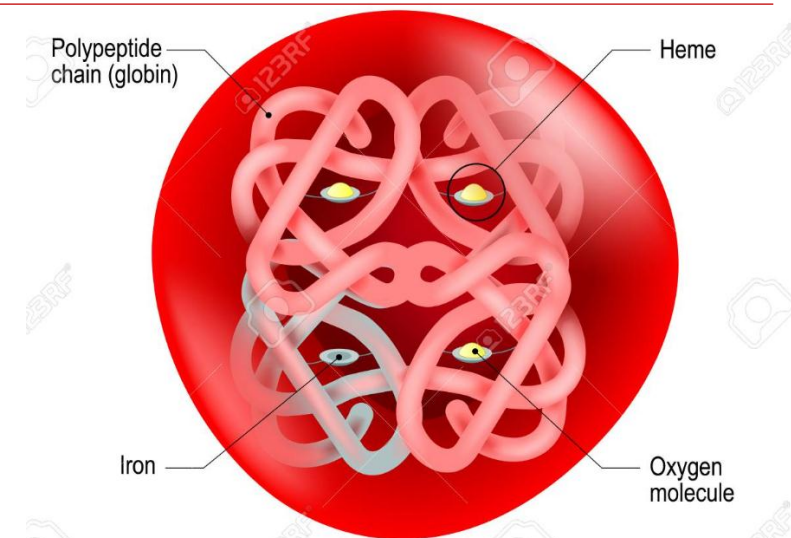
Any protein act as a buffer

2) Carriage of CO₂

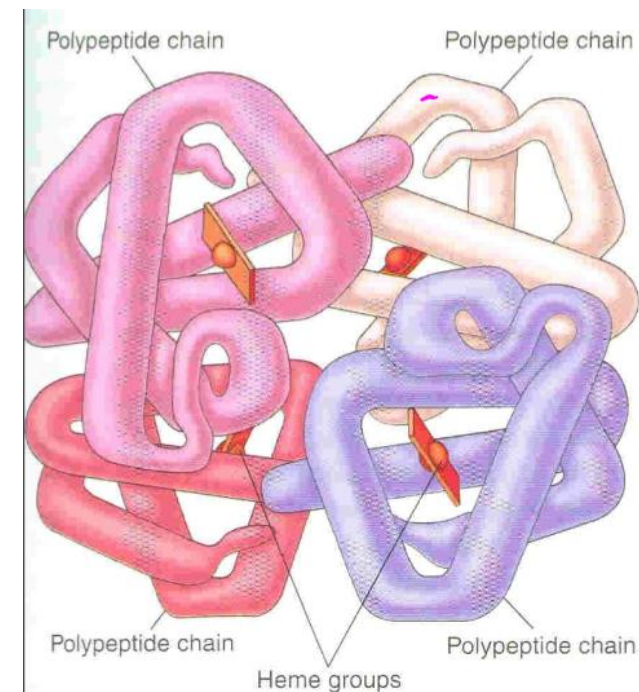
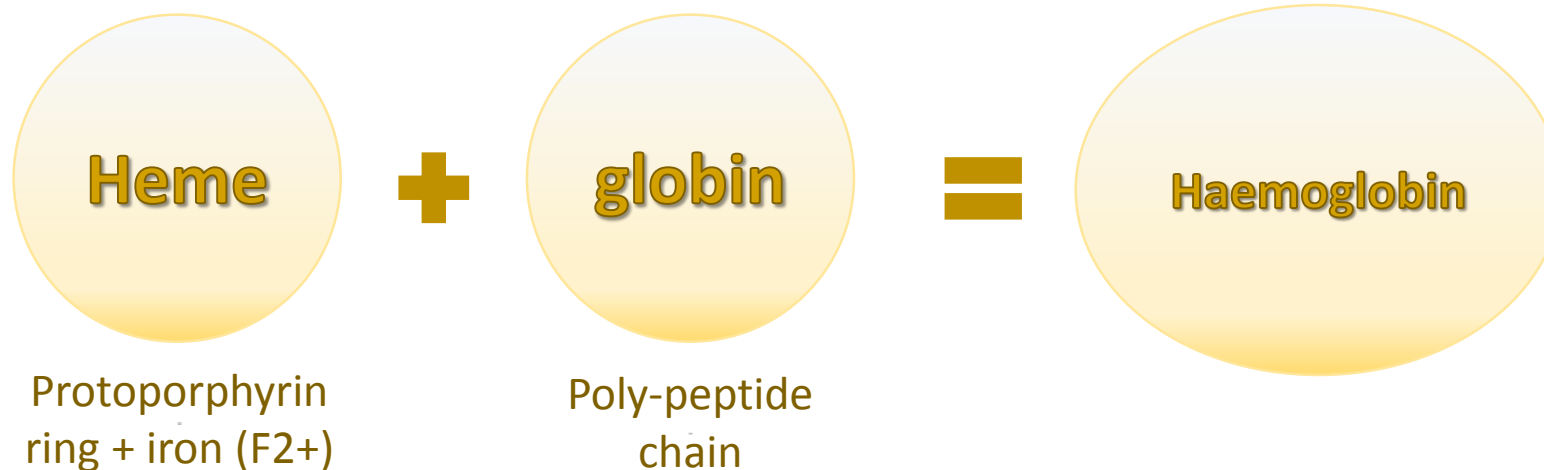
- Hb bind CO₂ = **carboxy-hemoglobin**

3) Carriage of O₂

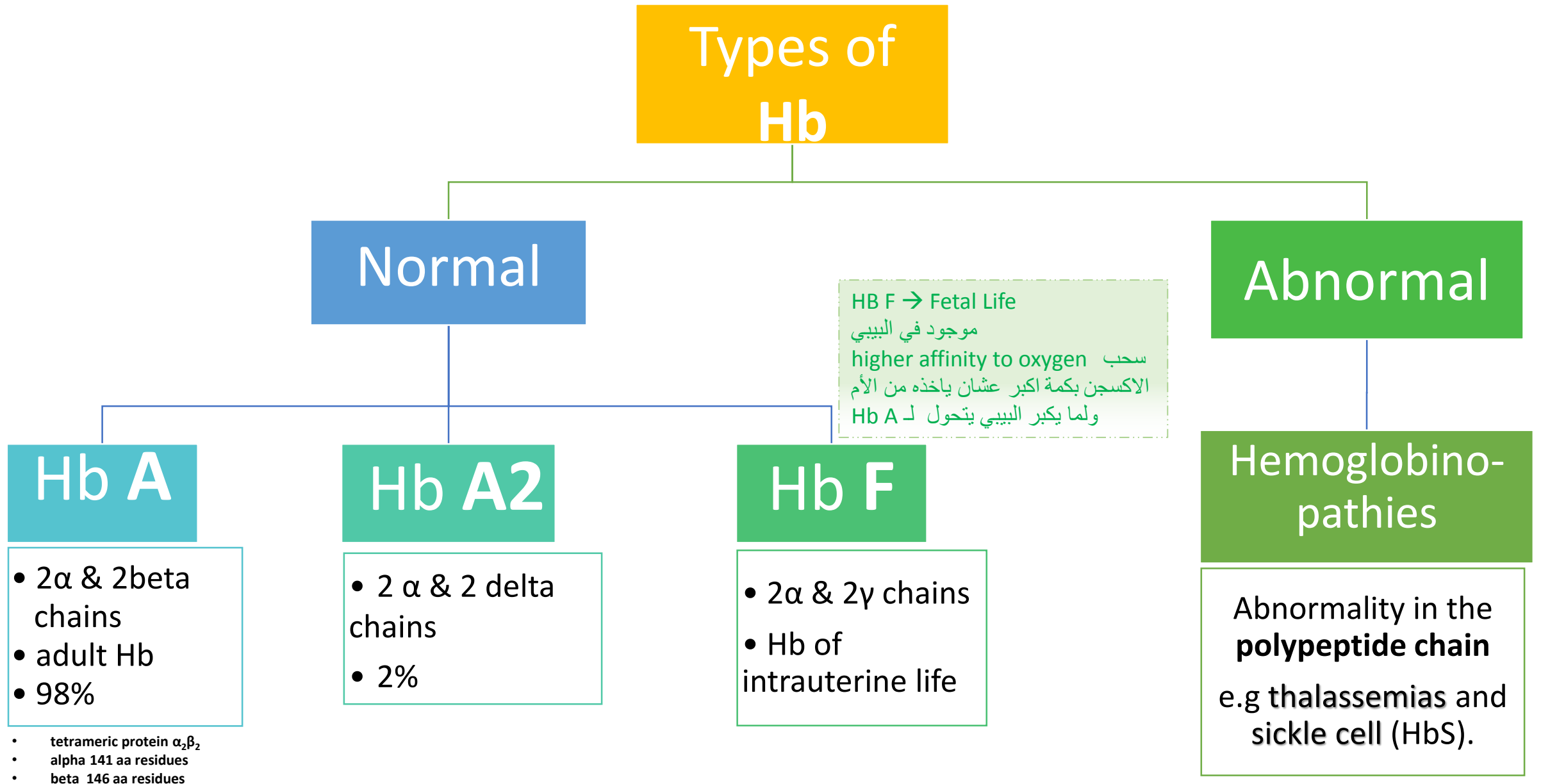
- Hb **reversibly** bind O₂ to form **oxy-hemoglobin** affect by
 - pH
 - Temperatre
 - H⁺



Hb molecules consist **4 chains** each formed of



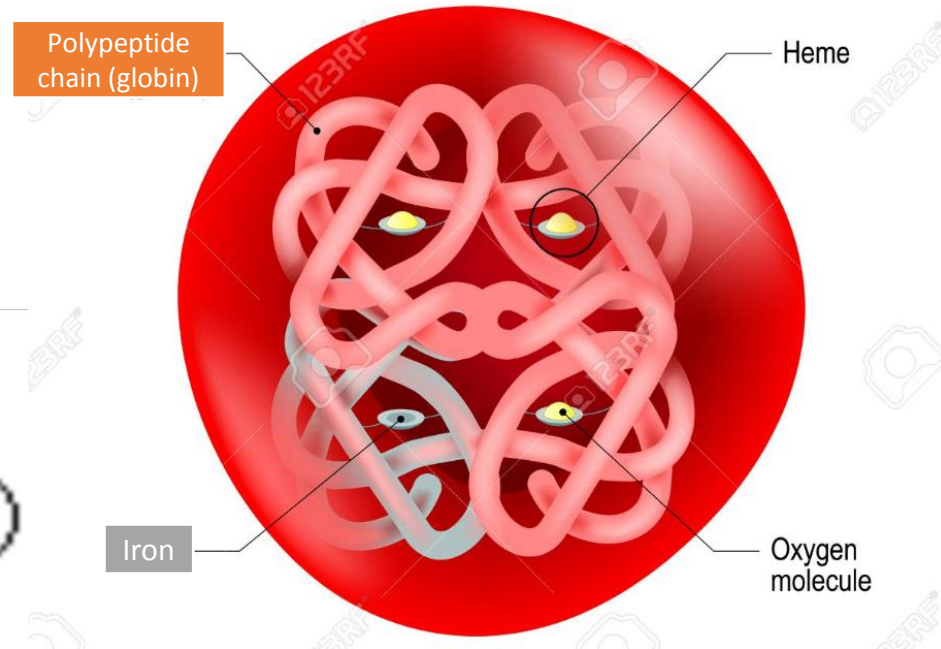
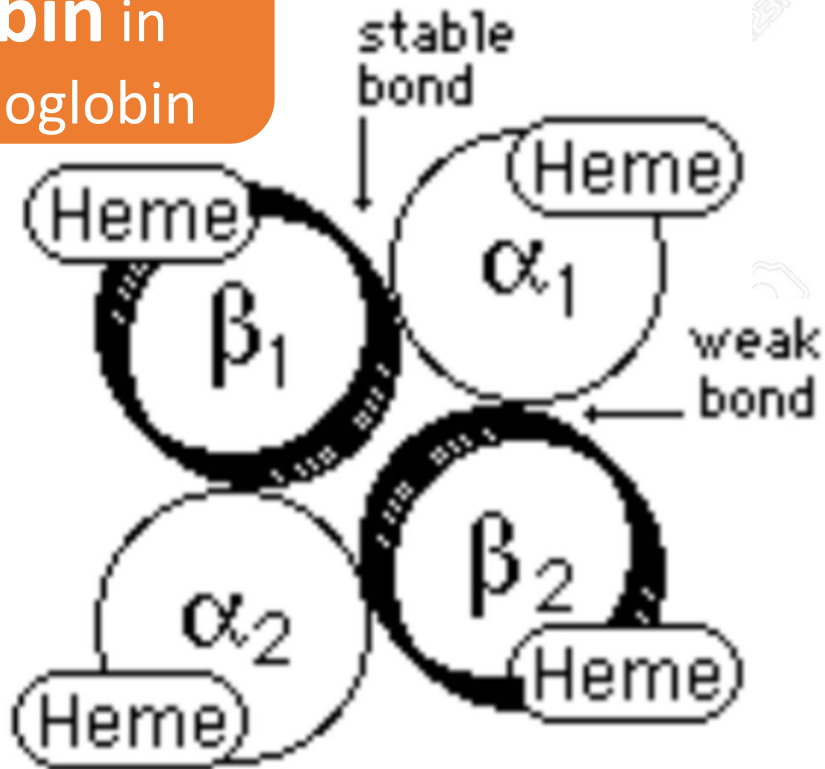
HAEMOGLOBIN



Hemoglobin

Amino acids

formation of
globin in
haemoglobin



Iron

formation of
haemoglobin

Synthesis:

1. In Mitochondria
2. Attach to transferrin
3. Combine with α and β protein chains

Essential elements for RBC formation & Maturation

Elements

Amino acids

Iron

Vitamins

Essential elements

Hormones

Function

formation of
globin in
haemoglobin

formation of
haemoglobin

Synthesis of
nucleoprotein

Hemo-globin
Hemo:iron Globin:protein

Deficiency Lead To

Anemia
(Hemoglobinopathies)

Anemia
(Micro-cytic hypochromic)

Anemia
(Macro-cytic megaloblastic)

anemia means deficiency of hemoglobin

Examples

Vit B12 and Folic acid

Other: Vit B6, Riboflavin, nicotinic acid, biotin, Vit C, Vit E

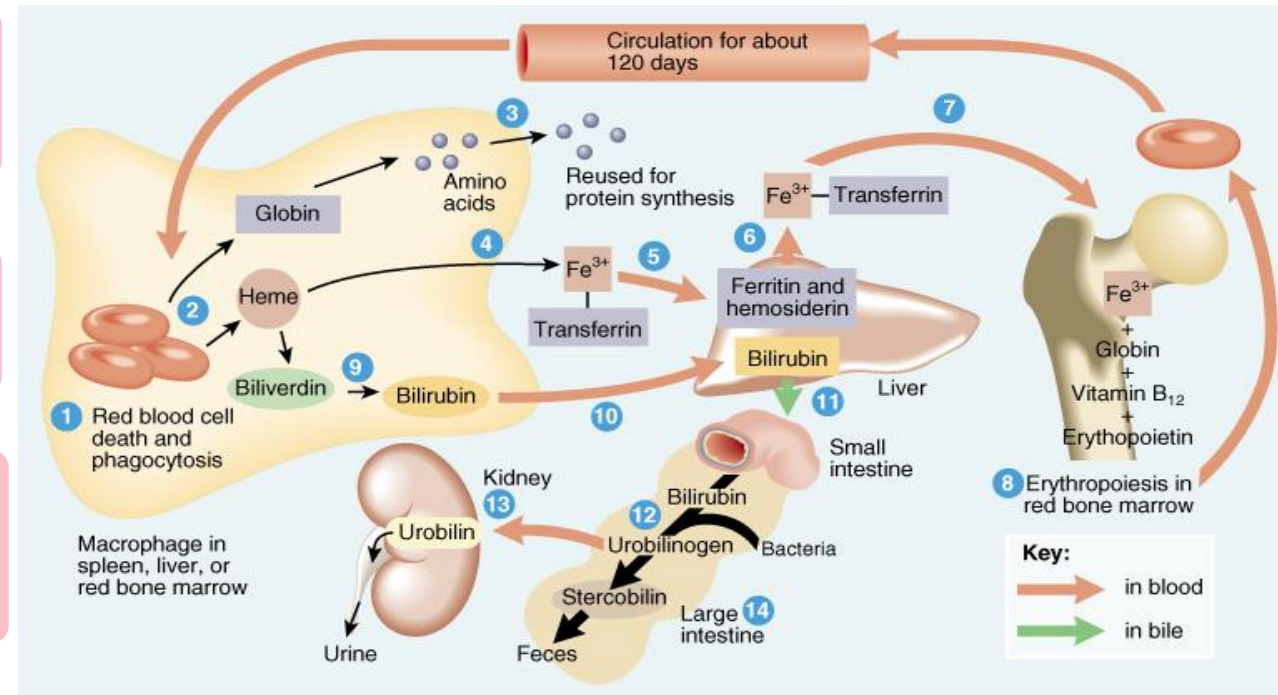
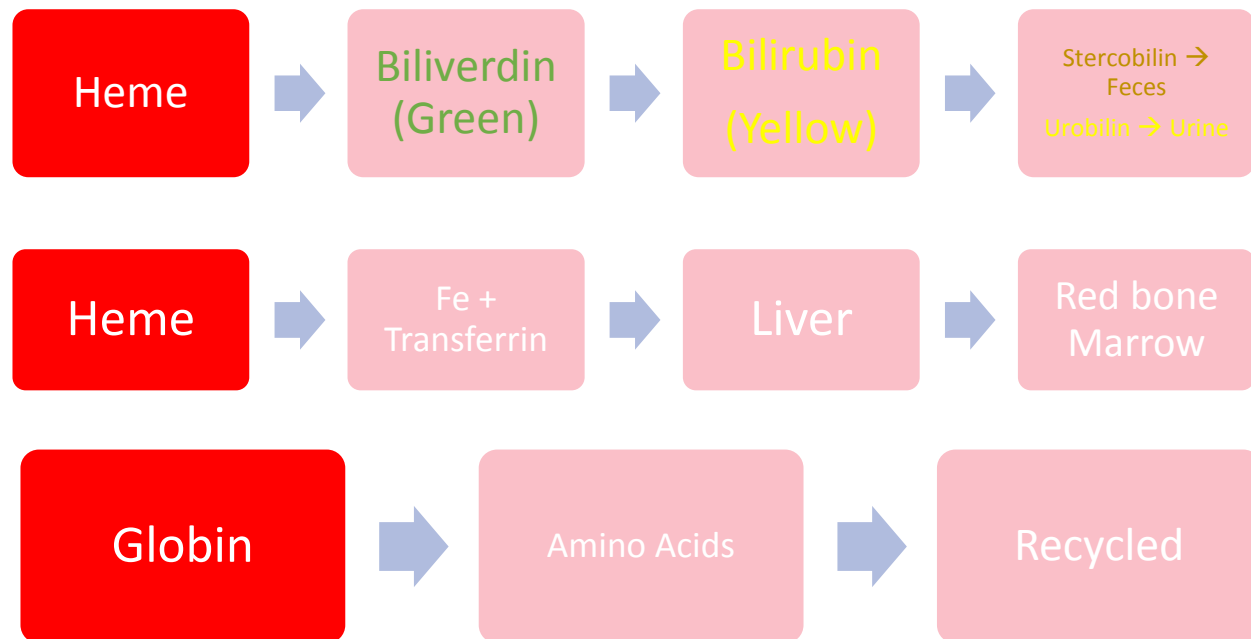
Essential elements
Copper, Cobalt, zinc, manganese

Hormones
Androgens, Thyroid, cortisol & growth hormones

RBC Life Cycle

- RBCs live only 120 days
- Cells wear out from bending to fit through capillaries
- Repair is not possible due to lack of organelles
- Worn out cells are removed by macrophages in spleen and liver
- Breakdown products are recycled

- In macrophages of liver or spleen:
 - Globin portion is broken down into amino acids and recycled
 - Heme portion is split into iron (Fe^{3+}) and biliverdin (green pigment)



Anemia and Polycythemia

Normal:
5 million
Polycythemia:
15 million

ANEMIA

- **Decrease** number of RBC
- **Decrease** Hb
- For the same age and sex.

POLYCYTHEMIA

- **Increase** number of RBC

Types

Symptoms

- Tired
- Fatigue
- short of breath
- heart failure.

Types

- Macrocytic anemia
- Microcytic hypochromic anemia

Primary (Polycythemia Rubra Vera - PRV)

uncontrolled RBC production.

سبب حقيقي

Secondary to hypoxia

high altitude (physiological), chronic respiratory or cardiac disease

سبب غير حقيقي يعوض الجسم عن نقص Oxygen (Type of Adaption)

Anemia

Causes of Anemia

Blood Loss

acute

Accident
(RBC return to normal 3-6weeks)

Acute -> حاد
خساره دم كثير في وقت قصير

Chronic

microcytic hypochromic anaemia (ulcer,worms)

خساره كميات قليلة من الدم في وقت طويل مثل الدورة الشهرية، البواسير و قرحة المعدة.

Decrease RBC production

Nutritional causes

- Iron → **Microcytic hypochromic anaemia.**
- Vit B12 & Folic acid → megaloblastic anaemia (**Macrocytic**)

Example: wrong diet, vegetarian

Bone marrow failure

- destruction by
- cancer
 - radiation
 - Drugs → **Aplastic anaemia.**

Haemolytic excessive destruction

Abnormal cells or Hb

- Spherocytosis
- sickle cells

Spherocytosis → مشكلة بـ cell membrane تتكسر الـ RBCs بسرعة

sickle cells → تغير في شفرة وحدة فحدثت طفرة، وراثي. (الأنيميا المنجلية)

Incompatible blood transfusion

لما يُنقل للشخص دم غير مناسب

Erythroblastosis fetalis .

Vitamin B12 & Folic acid

Dietary source: meat, milk, liver, fat, green vegetables.

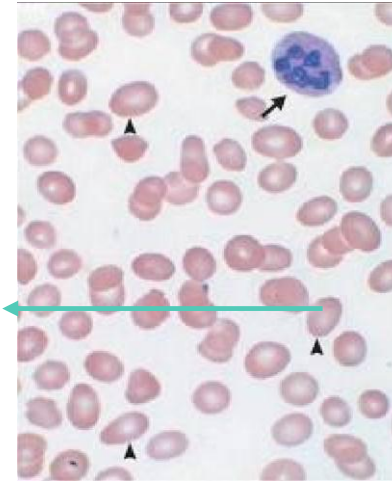
Importance

- **DNA** synthesis
- Final **maturation** of RBC.

استنادًا على أهمية الفيتامين نستنتج نقصه ايش يآثر فيه

Deficiency ?

Failure of



Nuclear division

Maturation

Lead to

Lead to

Type of Anemia
Macro-cytic
(megaloblastic)

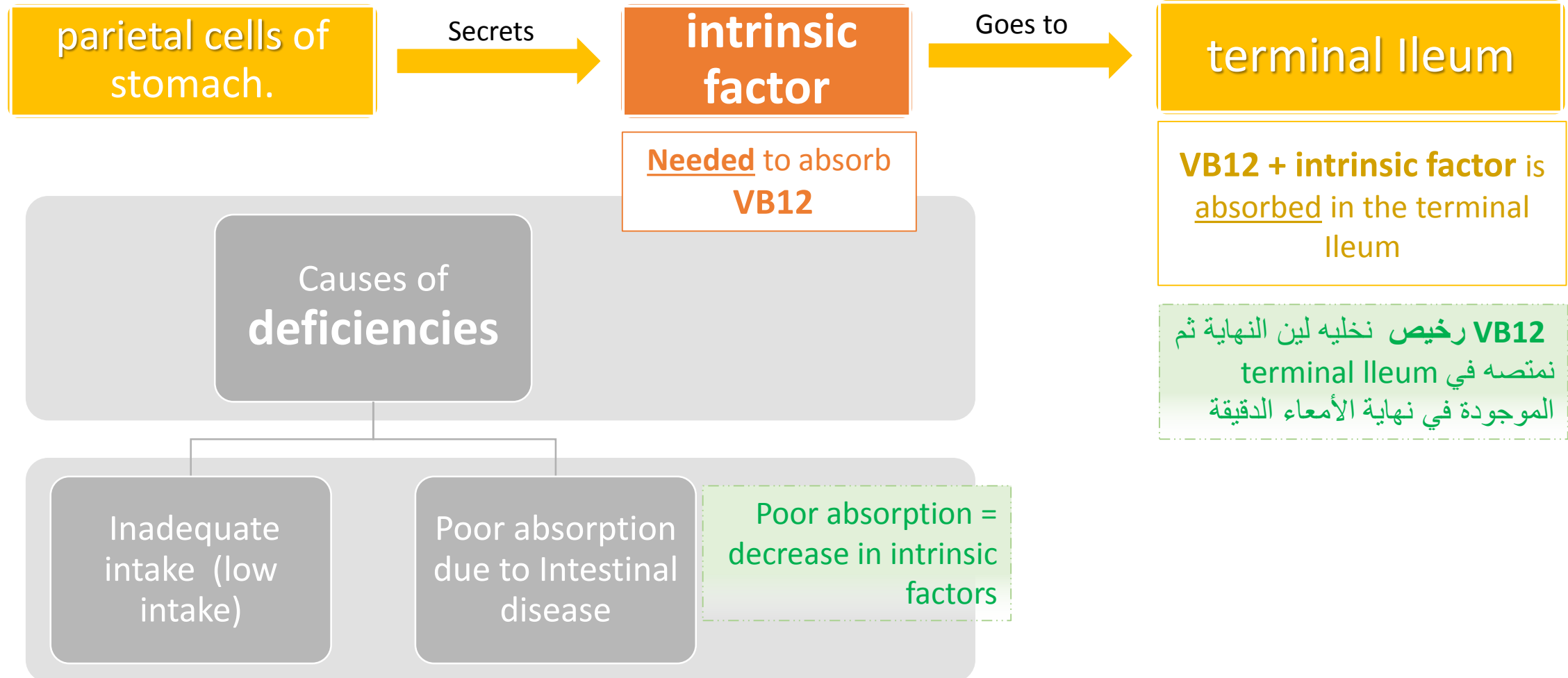
- **reduced** RBC count & Hb

- Abnormally **large**
- **oval** shape RBC
- Short life span

Malabsorption of Vit. B12

Pernicious Anemia

Pernicious anemia is a type of megaloblastic anemia in which the body isn't able to absorb vitamin **B12** due to a **lack of intrinsic factor** in stomach secretions.



Anemia Types

Macro-cytic anemia

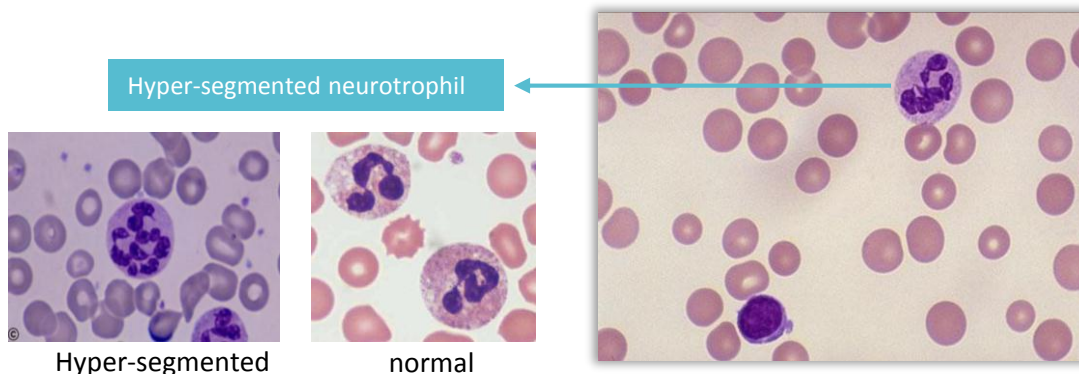
VERY IMP. You compare for the same AGE and the same SEX (female Hb count to normal female Hb count. NOT to a male)

RBC are almost as **large** as the lymphocyte

caused by the deficiency of **vitB12 and Folic Acid**

Hyper-segmented neurotrophil

fewer RBCs



Micro-cytic hypochromic anemia

RBC's are **smaller** than normal

Caused by the deficiency of **Iron and Thalassemia**.

increased zone of **central pallor**

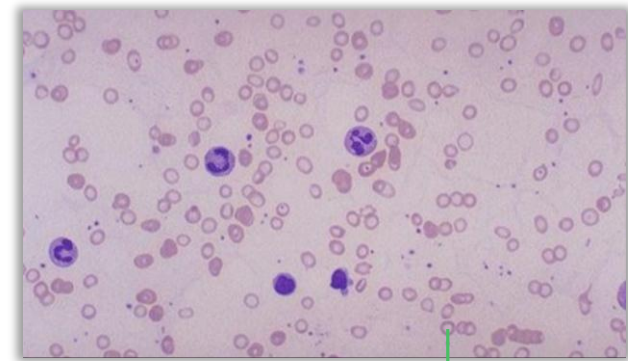
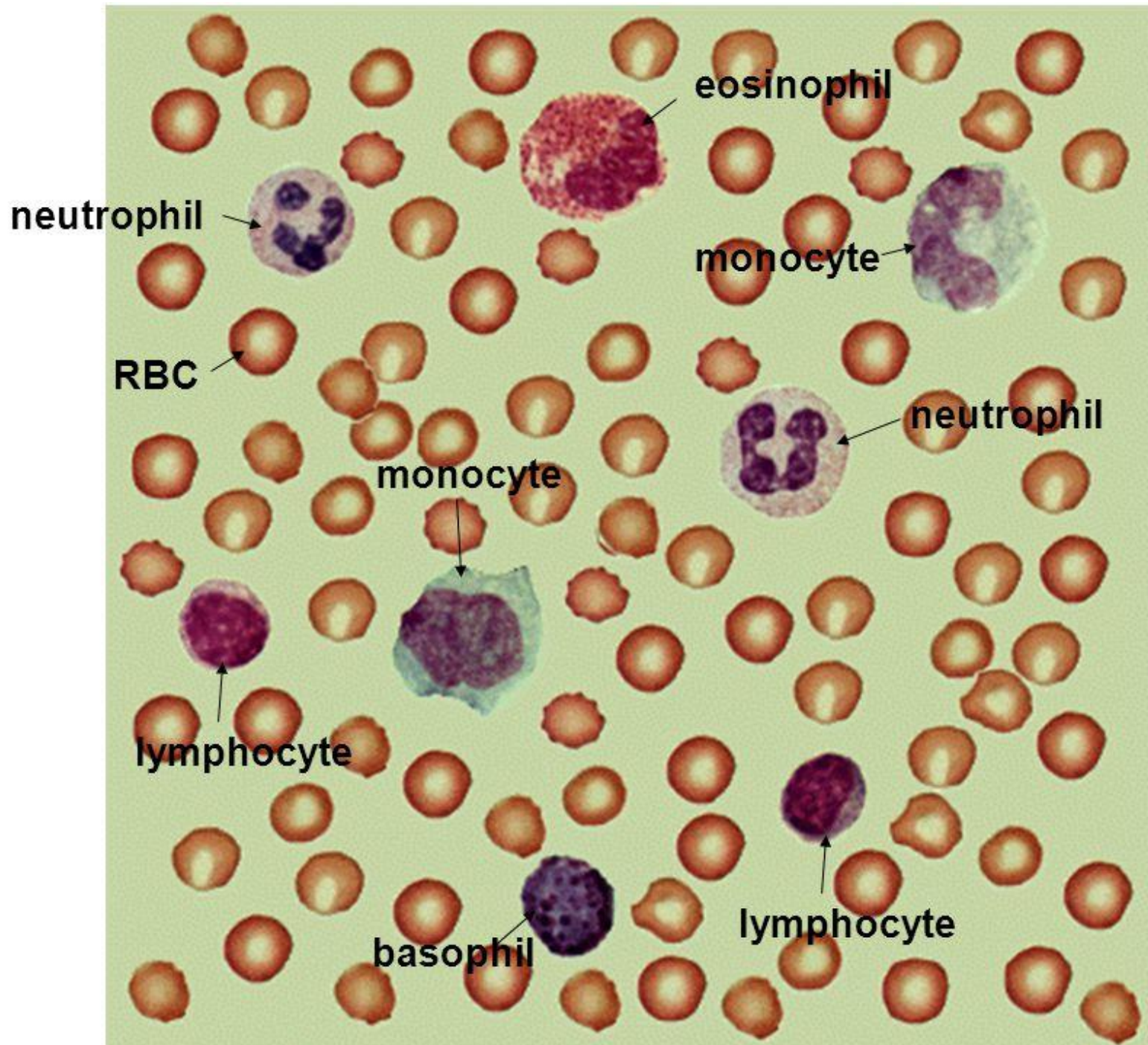
microcytic/hypochromic/anemia

smaller size of each RBC

less hemoglobin in each RBC

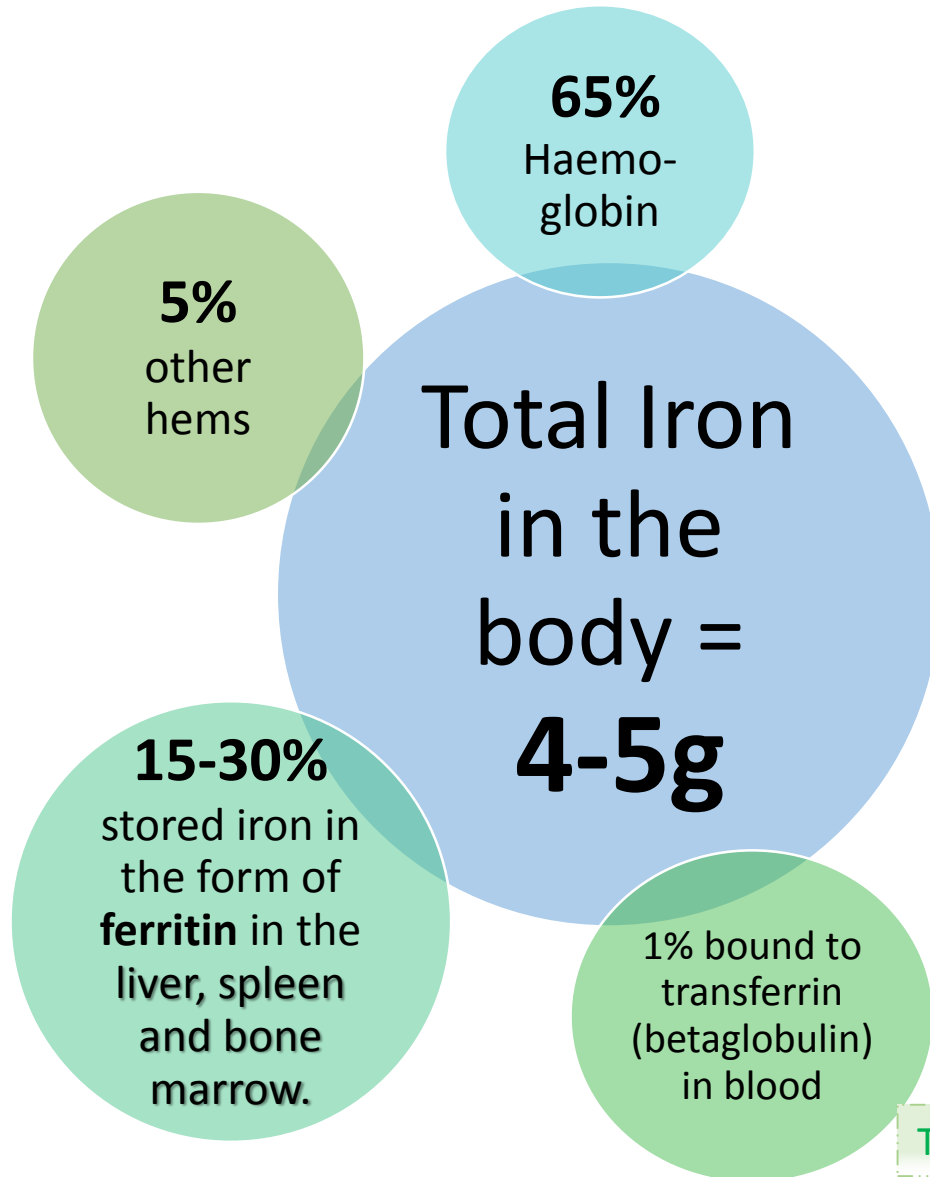
↑ **anisocytosis** (variation in size)

↑ **poikilocytosis** (variation in shape)



Central polar

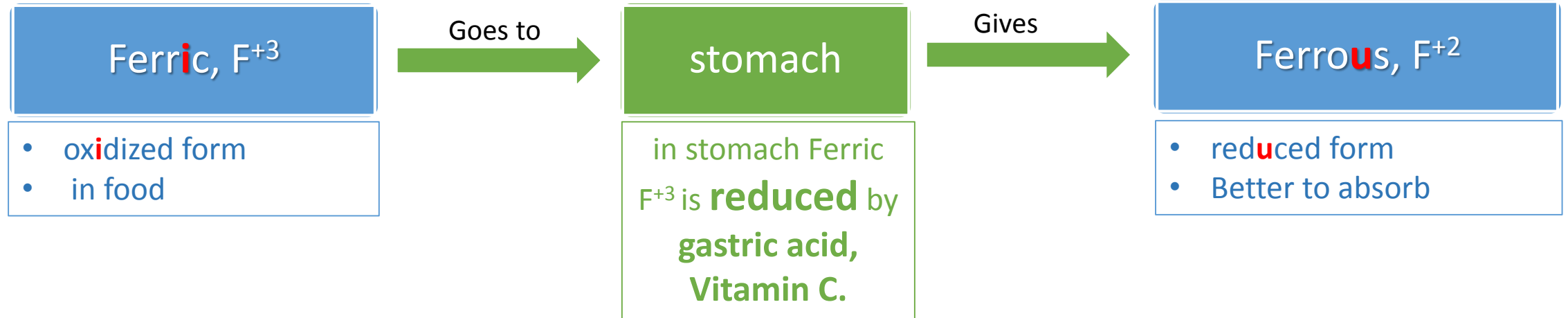
Iron metabolism (Fe)



Iron is needed for the synthesis of

- **haemoglobin**
- **myoglobin cytochrome oxidase**
- **peroxidase**
- **catalase**

Iron absorption

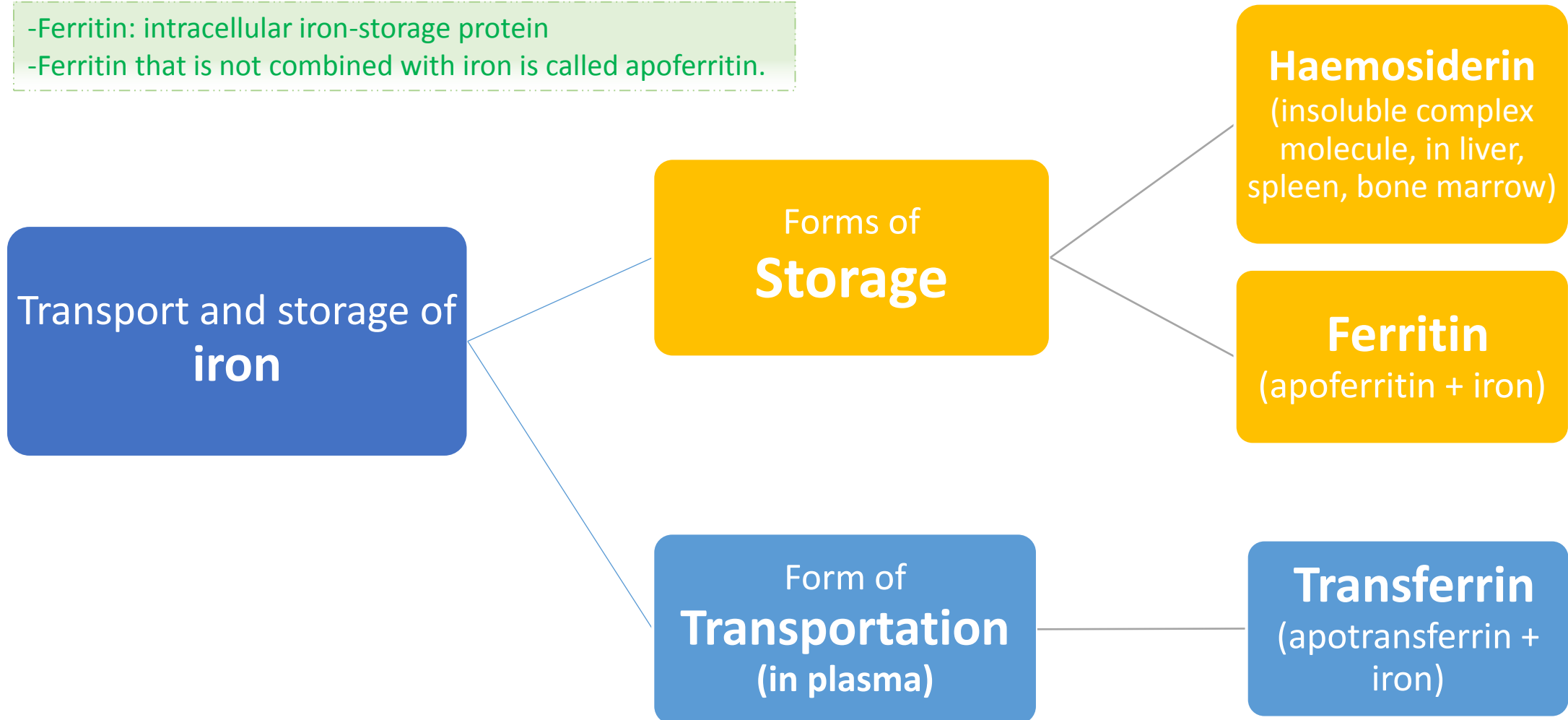


عشان كذا لما ناخذ حديد (Iron) ينصحون نشرب معه
عصير برتقال (vitamin C) لأنه يساعد بالامتصاص

Rate of iron absorption depend
on the amount of **iron stored**

Transport and storage of iron

- Ferritin: intracellular iron-storage protein
- Ferritin that is not combined with iron is called apoferritin.



Daily loss of iron is 0.6 mg in male & 1.3mg/day in females.

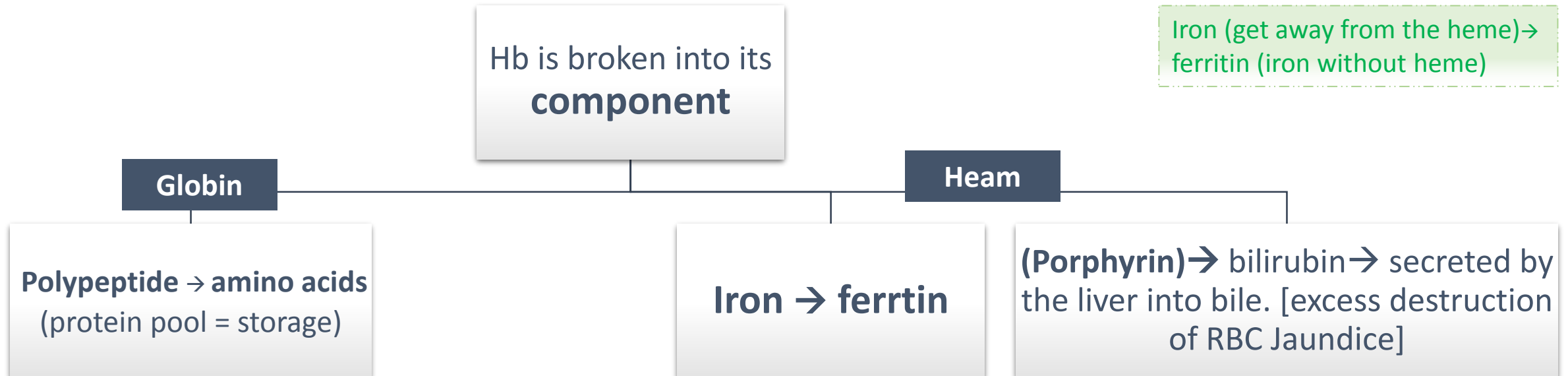
Destruction of RBC

RBC life span in circulation = **120 days**

Metabolic active cells.

Old cell has a fragile cell membrane, cell will rupture as it passes in **narrow capillaries (and spleen).**

Released Hemoglobin is taken up by **macrophages in liver, spleen & bone marrow**



Quiz

1) Which of the following nutrient deficiencies is most often associated with microcytic hypochromic anemia?

A) Cobalamin

B) Folic acid

C) Iron

D))

2) The protein responsible for iron transport in plasma is

A) α 1 -anti trypsin

B) Ferritin

C) Apo-transferrin

D) Apo-ferritin

3) A 30 years old male is brought to the hospital with history of gastrectomy. His skin appears lemon-yellow. Investigations reveal hemoglobin 10 g/dl, odd shaped RBCs and Serum Vitamin B 12 is low. He is likely to be suffering from:

A) Hemolytic Anemia

B) Aplastic Anemia

C) Pernicious Anemia

D) Megaloblastic Anemia

4) A 34-year-old man with schizophrenia has chronic fatigue for 6 months. He has a good appetite but has developed a dislike for vegetables since last 1 year. His physical and neurological examinations are normal. His hemoglobin level is 9.1 g/dl, leukocyte count is 10,000/mm³ and Mean Corpuscular Volume is 122 fl (normal 77-93 fl). Which of the following is the most likely diagnosis?

A) Folic acid deficiency

B) Aplastic anemia

C) Sickle cell anemia

D) Hemolytic anemia

5) The form of hemoglobin that has carbon dioxide attached is called

A) oxyhemoglobin

B) deoxyhemoglobin

C) carboxyhemoglobin

D) carbaminohemoglobin

key answers:

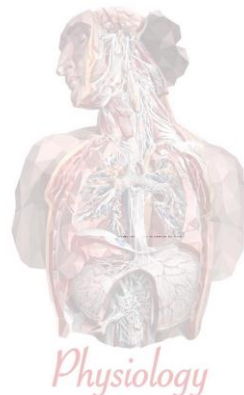
1) C

2) C

3) D

4) A

5) C



Physiology

Year 1 FSU

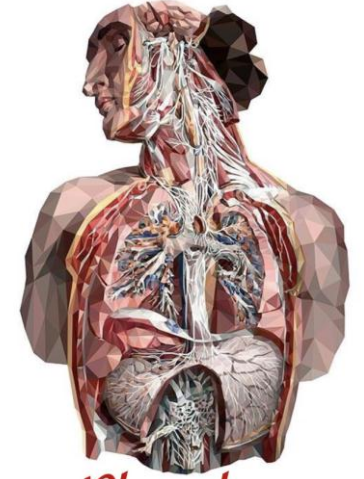
Thank you

Boys team members

- عمر الدوسري
- زياد الدوسري
- محمد الحمد
- فيصل القفاري
- عبدالله باسمح
- جهاد العريني

Girls team members

- اروى الامام
- ديما المزيد
- جود الخليفة
- جود العتيبي
- رغد المبارك
- ريناد المطوع
- ريما المطوع
- طرفة آل كلثم
- مي بابعير
- نجود العلي
- نورة المزروع



Physiology

Team 438
KSU

Team leaders:

- عمر الشيناوي
- ايلاف المسيحل

