

Red Blood Cells

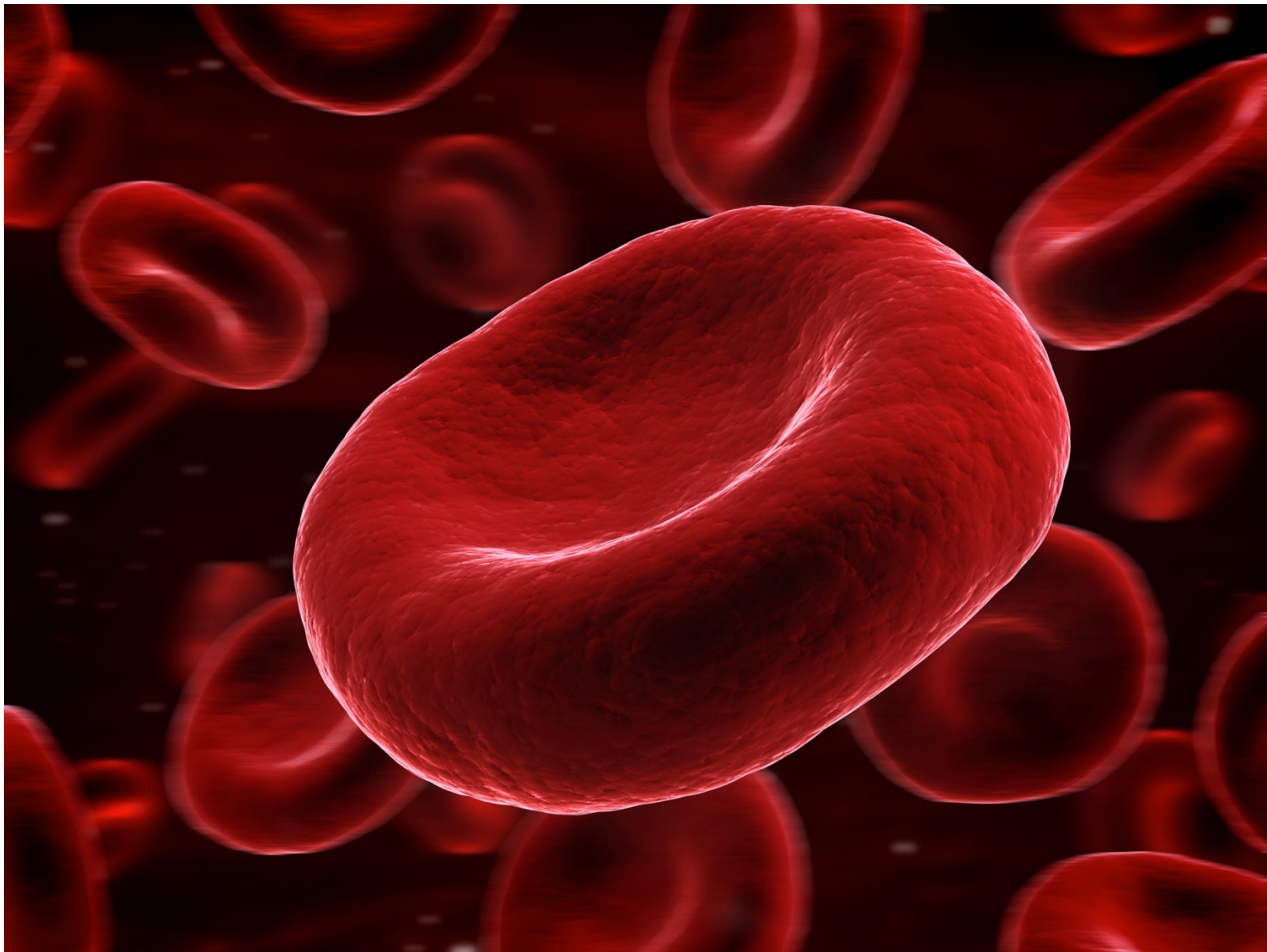
Cardiovascular System - Part IV

Red Blood Cells

- Most abundant blood cell
 - Make up 99.9% of the formed elements
- Red colored due to hemoglobin
- Males: 4.5-6.3 million RBCs/mL
- Females: 4.2-5.5 million RBCs/mL
 - Male hormones (androgens) stimulate RBC production; female hormones (estrogens) do not

Red Blood Cell Structure

- Biconcave disc allows:
 - large surface area-to-volume ratio
 - RBCs to stack
 - RBCs to bend and flex when entering small vessels
- No nuclei; only a cytoskeleton
- No mitochondria
 - Obtain energy through anaerobic metabolism
- Few organelles = cannot perform repairs = short lifespan (<120 days)



Hemoglobin

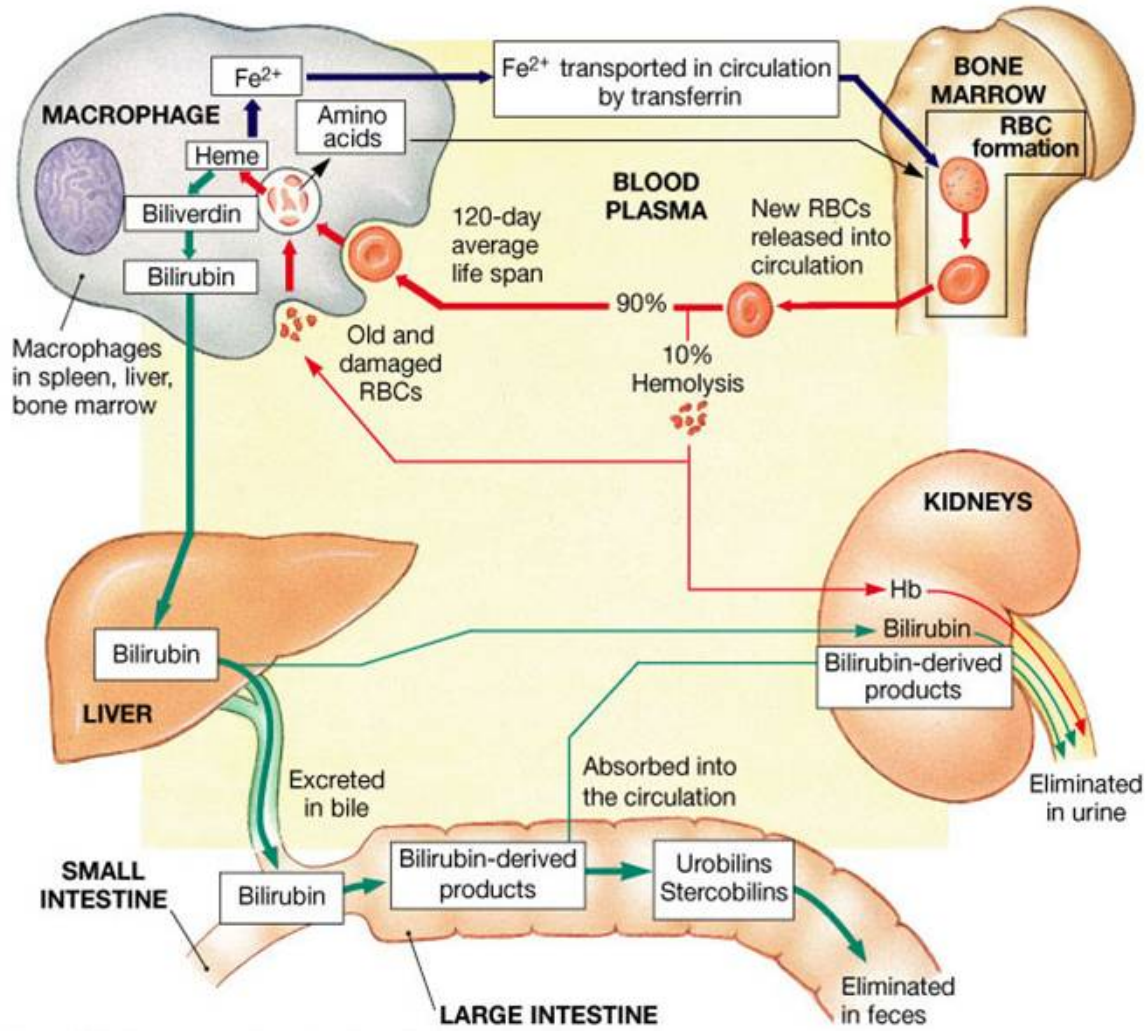
- >95% of RBC intracellular proteins
- Males: 14-18 g/dL; Females: 12-16 g/dL
- Transports oxygen and carbon dioxide
- 2 alpha and 2 beta chains of polypeptides
 - Each chain has a non-protein pigment, heme
 - holds an iron ion to interact with oxygen
- 280 million/RBC

Different Hemoglobins

- Different based upon what ions are/aren't being held
- Oxyhemoglobin
 - heme is holding onto oxygen
- Deoxyhemoglobin
 - heme without oxygen
- Carbaminohemoglobin
 - heme bound with carbon dioxide

RBC Lifespan

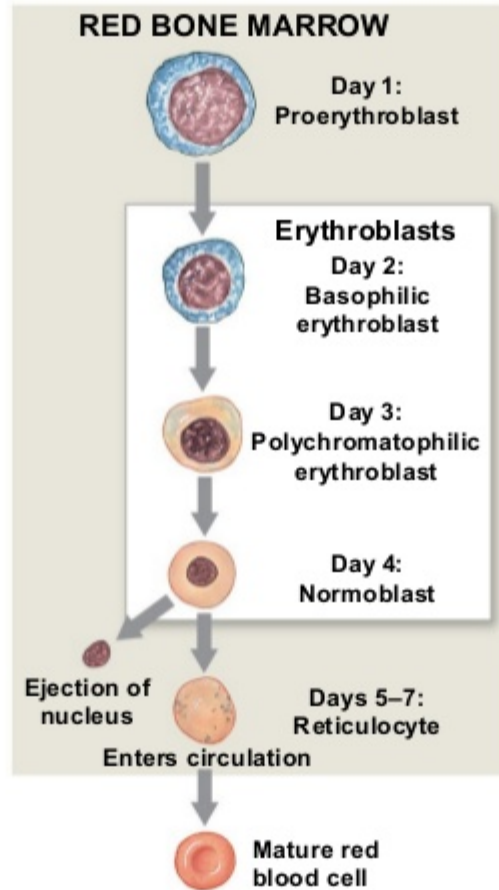
- ~3 million new RBC enter the bloodstream each second
- Traveling from heart to tissue back to heart takes less than a minute
- No repair mechanisms = short life
 - Will either rupture (hemolyze) or be engulfed by macrophages
 - Liver, spleen, & bone marrow constantly monitor circulating RBCs



Red Blood Cell Production

- Hemopoiesis during embryonic development
 - RBC production in liver and spleen
- Erythropoiesis in adults
 - RBC production in red bone marrow
 - Iron & vitamins (B12, B6, & folic acid) are required for production
 - Regulated by erythropoietin (EPO)
 - glycoprotein formed by the liver and kidneys that stimulates RBC production when oxygen levels are low

Figure 19-6 Stages of RBC Maturation



ABO Blood Types

- Blood type is determined by the presence/absence of surface antigens in RBCs
 - A, B, & Rh
- Surface antigens are located in the plasma membranes
- Antigen - a substance that triggers an immune response when the substance is unrecognized by the immune system

Blood Types

Type A - only A surface antigen	40%
Type B - only B surface antigen	10%
Type AB - both A & B surface antigens	4%
Type O - no surface antigens	46%

Rh Factor

Rh surface antigen

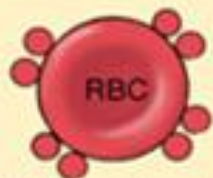
present = Rh positive (Rh+)

absent = Rh negative (Rh-)

So A antigen + Rh antigen = A+

No surface antigens = O-

TYPE A



Surface antigen A



Anti-B antibodies

TYPE B



Surface antigen B



Anti-A antibodies

TYPE AB



Surface antigens A and B

Neither anti-A nor
anti-B antibodies

TYPE O



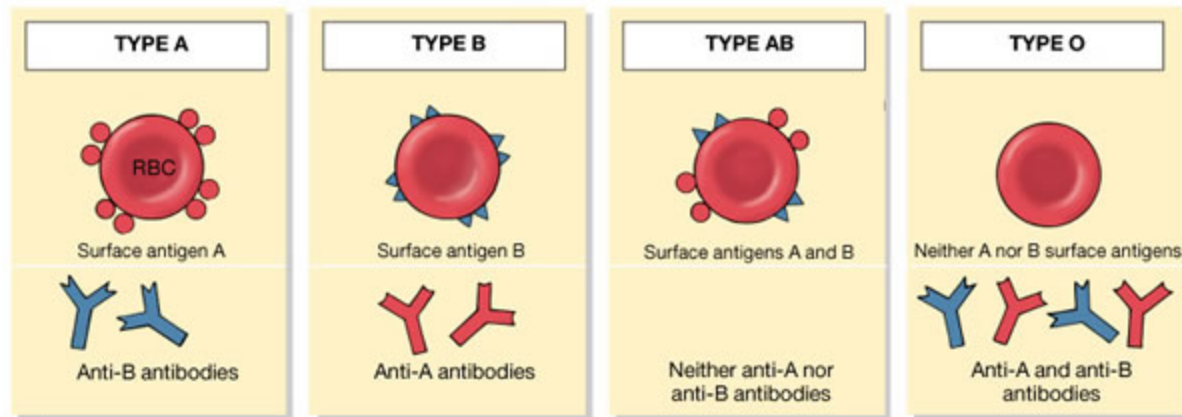
Neither A nor B surface antigens



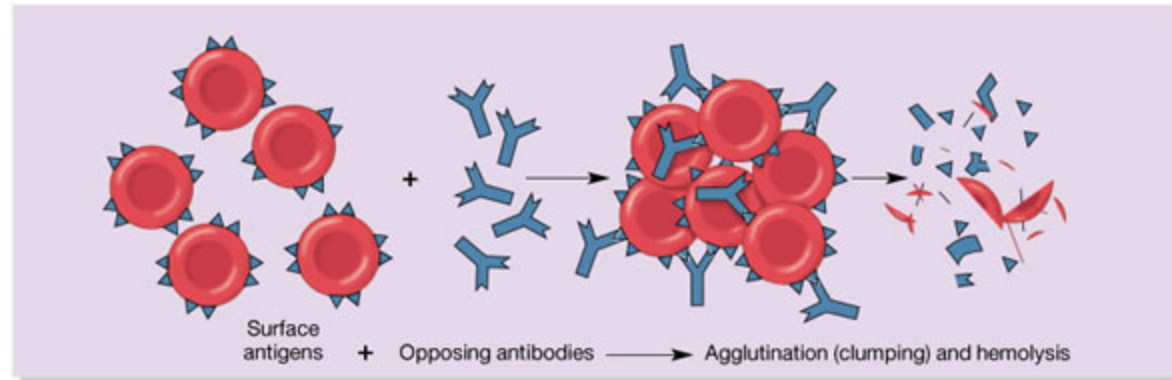
Anti-A and anti-B
antibodies

Agglutination

- The process of antibodies attacking foreign cells & clumping together
 - Antibodies - globulin proteins
- Antibodies in the blood will attack the antigens on foreign RBCs
- anti-Rh antibodies are only present if the individual is positive for the Rh antigen



(a)



(b)