

Blood types.

Budínská Xenie

Functions of the RBC

- Transport of respiratory gases
- Buffering system
- Maintaining blood viscosity
- Immune function

Blood groups

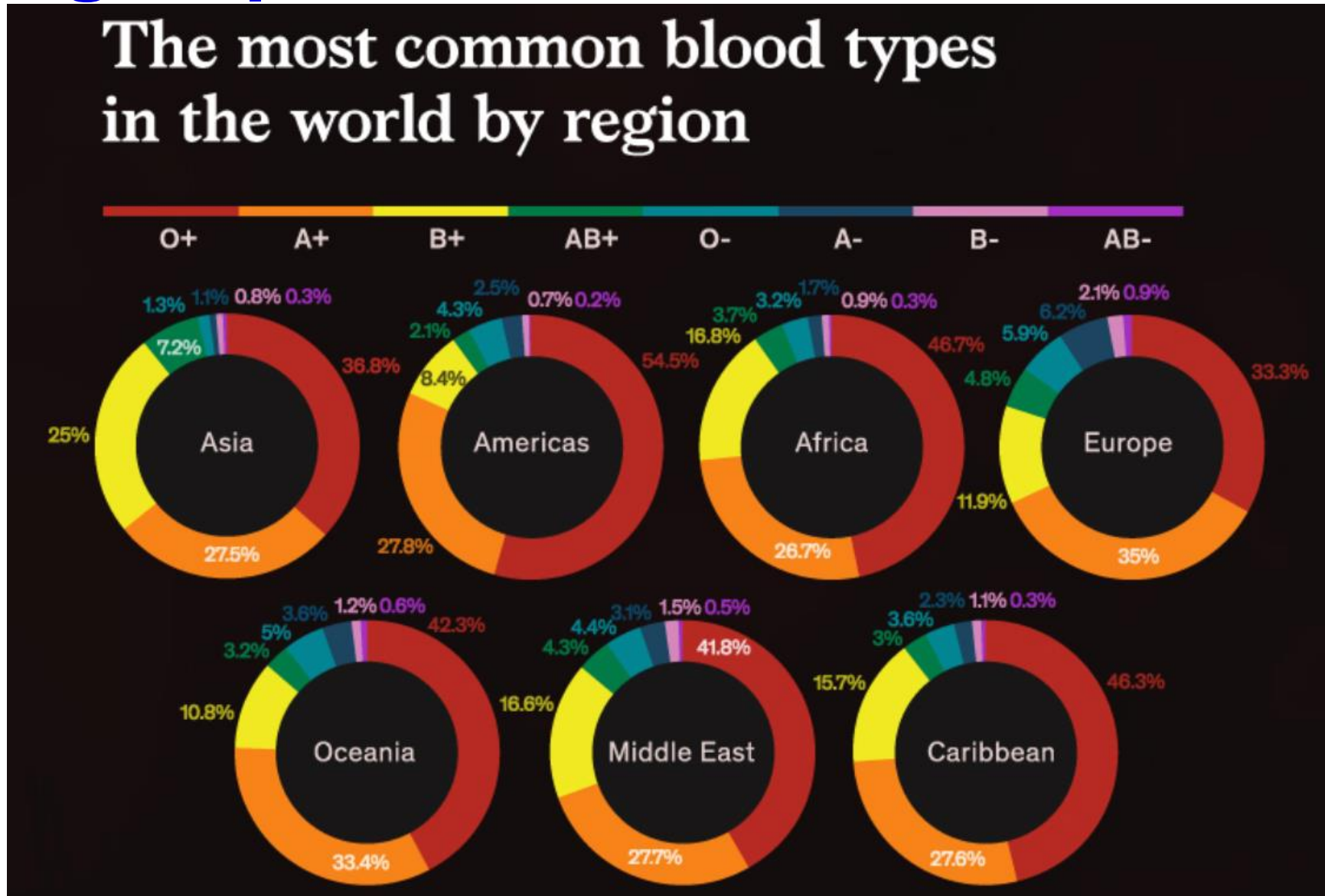
- Is a classification of blood, based on the presence and absence of antigenic substances on the surface of red blood cells.
- Antigens (depending on the blood group system):
 - proteins
 - carbohydrates
 - glycoproteins
 - glycolipids
- Some of these antigens are also present on the surface of other types of cells of various tissues.

Blood groups

– **45 human blood group systems** are recognized by the International Society of Blood Transfusion:

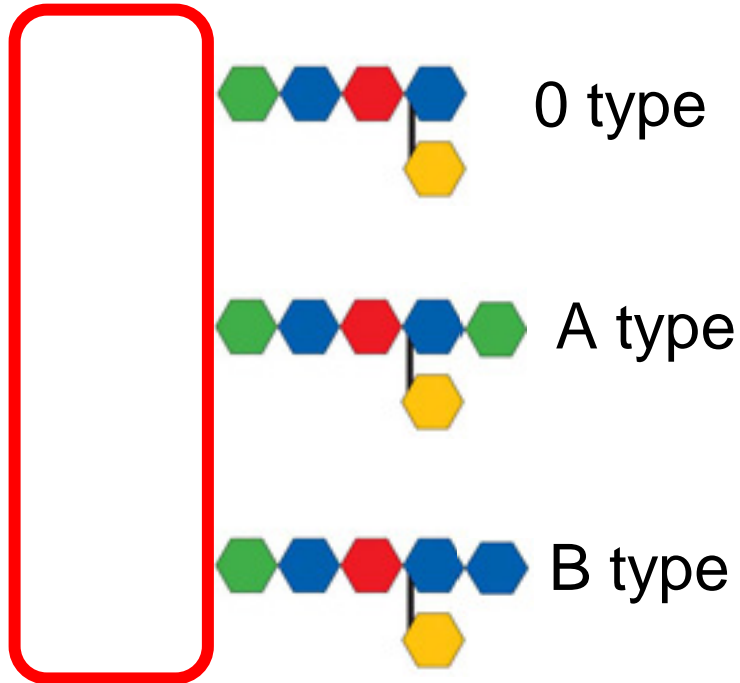
- **ABO System** (Antigens: A, B, O).
- **MNS System** (Antigens: M, N, S, s, U).
- **Rh System** (Antigens: D, C, c, E, e).
- **Lutheran System** (Antigens: Lu_a, Lu_b).
- **Kell System** (Antigens: K, k).
- **Lewis System** (Antigens: Le_a, Le_b).
- **Duffy System** (Antigens: Fya, Fyb).
- **Kidd System** (Antigens: Jka, Jkb).
- **Landsteiner-Wiener** (Antigens: LWa, LWb).
- **Chido/Rodgers System** (Antigens: Ch, Rg).
- **H System** (Antigens: H).
- ...

Blood groups



Agglutinogen

H antigen



● N-acetylgalactosamine

● N-acetylglucosamine

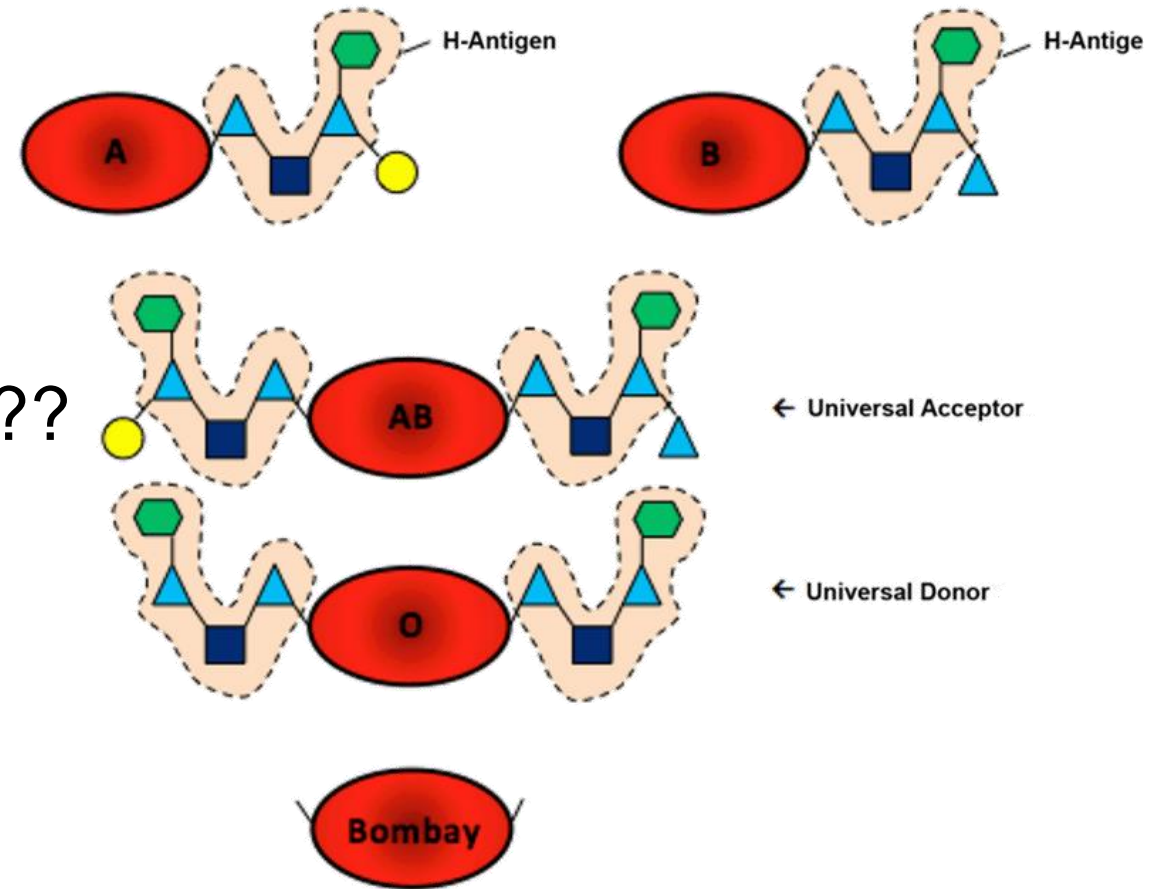
● Galactose

● Fucose

- The ABO gene is located on chromosome 9 and exists in three allelic forms:
 - The A allele encodes an enzyme that adds ***N-acetylgalactosamine*** to the H antigen.
 - The B allele encodes an enzyme that adds ***galactose*** to the H antigen.
 - The O allele does not produce a functional enzyme, so the H antigen remains unchanged.

"Bombay phenotype"

- in 1 of 10,000 individuals in India
- 1 in a million people in Europe
- H antigen deficiency
- Hemolytic disease of the newborn???


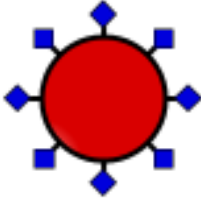
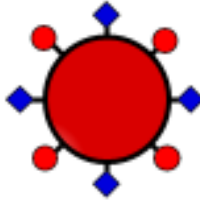
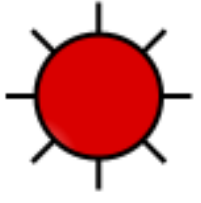










Agglutinin

- γ -globulin (IgM)
- after births almost zero concentration in blood
- production of agglutinins begins 2-8 months after birth:
 - stimulation by antigens similar to agglutinogens – in food, in GIT bacteria
- maximal concentration of antibodies is reached in 8-10 years, decreases gradually with age

ABO system

- Antigens on the surface of RBCs (agglutinogens): A, B
- Antibodies in the blood (agglutinins): anti-A, anti-B (IgM)

Blood groups	Group A	Group B	Group AB	Group 0
Prevalence in CZ	41%	18%	9%	32%
RBCs				
Antigens on RBCs	A 	B 	A a B  	none
Antibodies in the blood	anti-B 	anti-A 	none	anti-A + anti-B  

Immunization against A and B happens during the first months of life (these antigens are also in the diet) – agglutinins are then in the blood for the rest of the life

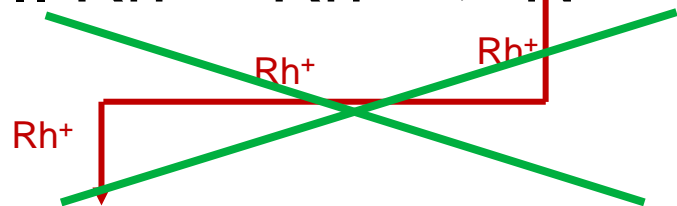
ABO system

		0 (-, anti AB)	A (A, anti B)	B (B, anti A)	AB (AB,-)
RBC	0 (-)	V	V	V	V
	A (A)	-	V	-	V
	B (B)	-	-	V	V
	AB (AB)	-	-	-	V
Plasma	0(anti AB)	V	-	-	-
	A(anti B)	V	V	-	-
	B(anti A)	V	-	V	-
	AB(-)	V	V	V	V

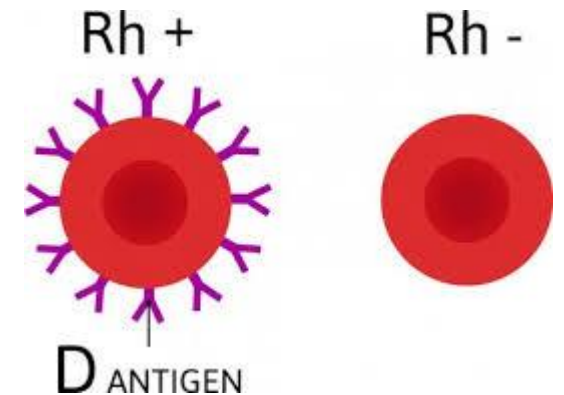
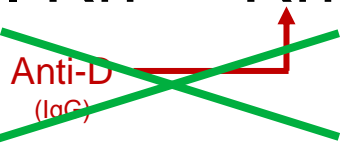
Rh factor

- Antigens D, d (also C, c, E, e, which are weaker) are only on RBCs
 - The strongest one is an antigen D – if present → Rh+ blood group
 - In recessive homozygotes (dd) → blood group Rh- (17% in Europe, <1% elsewhere)
- in Rh- blood, antibodies (anti-D, IgG) develop only after immunization
 - The first reaction is weaker, the next encounter with Rh+ blood will trigger a stronger immune response → hemolysis

~~I. Rh⁻ + Rh⁺ => N~~ ← Anti-D



~~II. Rh⁻ + Rh⁺ => hemolysis~~



Blood products for transfusion

- Whole blood contains red cells, white cells, and platelets suspended in blood plasma:
 - Trauma, Surgery
- RBCs
 - Anemia, Any blood loss, Blood disorders, such as sickle cell
- Platelets
 - Cancer treatments, Organ transplants, Surgery
- Plasma
 - Burn patients, Shock, Bleeding disorders
- Cryoprecipitated Antihemophilic Factor (Cryo)
 - Hemophilia, Coagulation abnormality

Tests conducted before a transfusion:

- Blood Typing (ABO and Rh Typing).
- Antibody Screen (Indirect Coombs Test).
- Crossmatching:
 - Immediate Spin Crossmatch.
 - Full/Extended Crossmatch.
- Complete Blood Count (CBC)
- Coagulation Tests.
- Infectious Disease Screening (Usually performed on donor blood):
 - HIV
 - Hepatitis B & C
 - Syphilis
- Direct Coombs Test (Direct Antiglobulin Test - DAT)

Blood transfusion. Early Complications.

- Hemolytic reactions (immediate and delayed)
- Non-hemolytic febrile reactions
- Allergic reactions
- Reactions secondary to bacterial contamination
- Circulatory overload
- Air embolism
- Thrombophlebitis
- Hyperkalemia
- Hypothermia
- Clotting abnormalities (after massive transfusions)

Blood transfusion. Late complications.

- Transmission of infection
- Viral (hepatitis A, B, C, HIV, CMV)
- Bacterial (Salmonella)
- Parasites (malaria, toxoplasma)
- Graft-vs-host disease
- Iron overload (after chronic transfusions)
- Immune sensitization (D antigen)