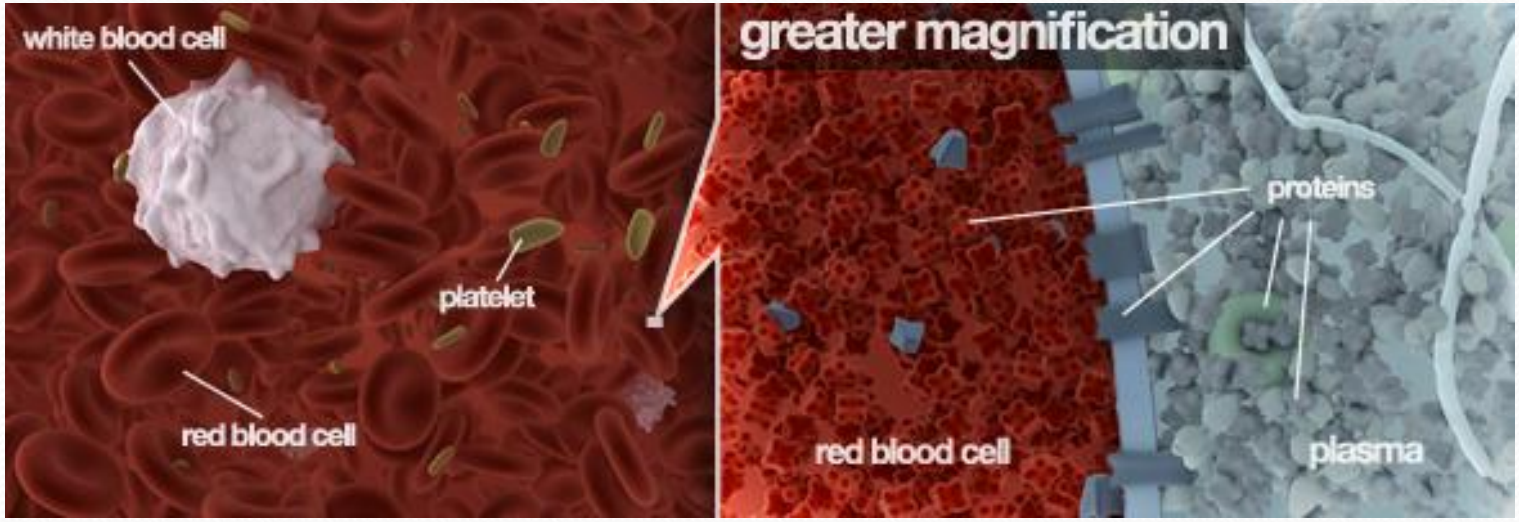
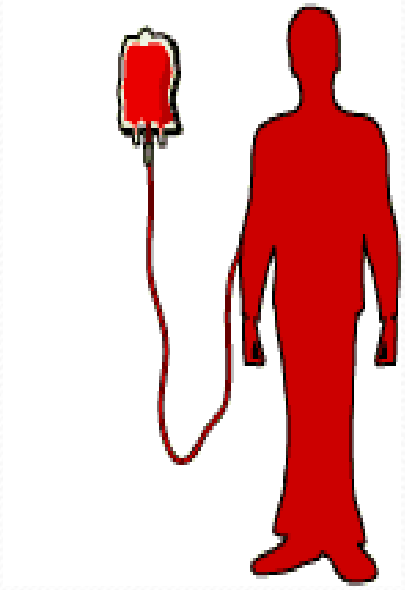
Zoo-352 Principles of genetics
Lecture 10

Genetic of the human blood group



- Blood is a complex, living tissue that contains many cell types and proteins. A transporter, regulator, and defender, blood courses through the body carrying out many important functions.

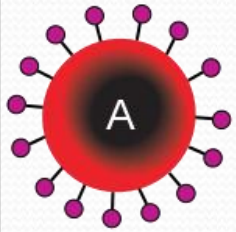
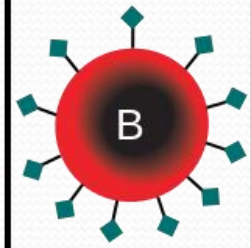
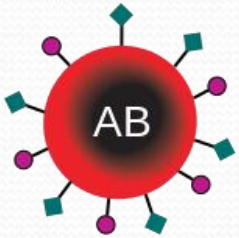
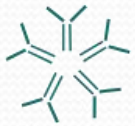
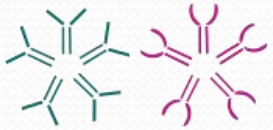
History of discoveries of the blood types



- The ABO blood group system is discovered by the Austrian scientist **Karl Landsteiner** who identified the blood types in 1900.

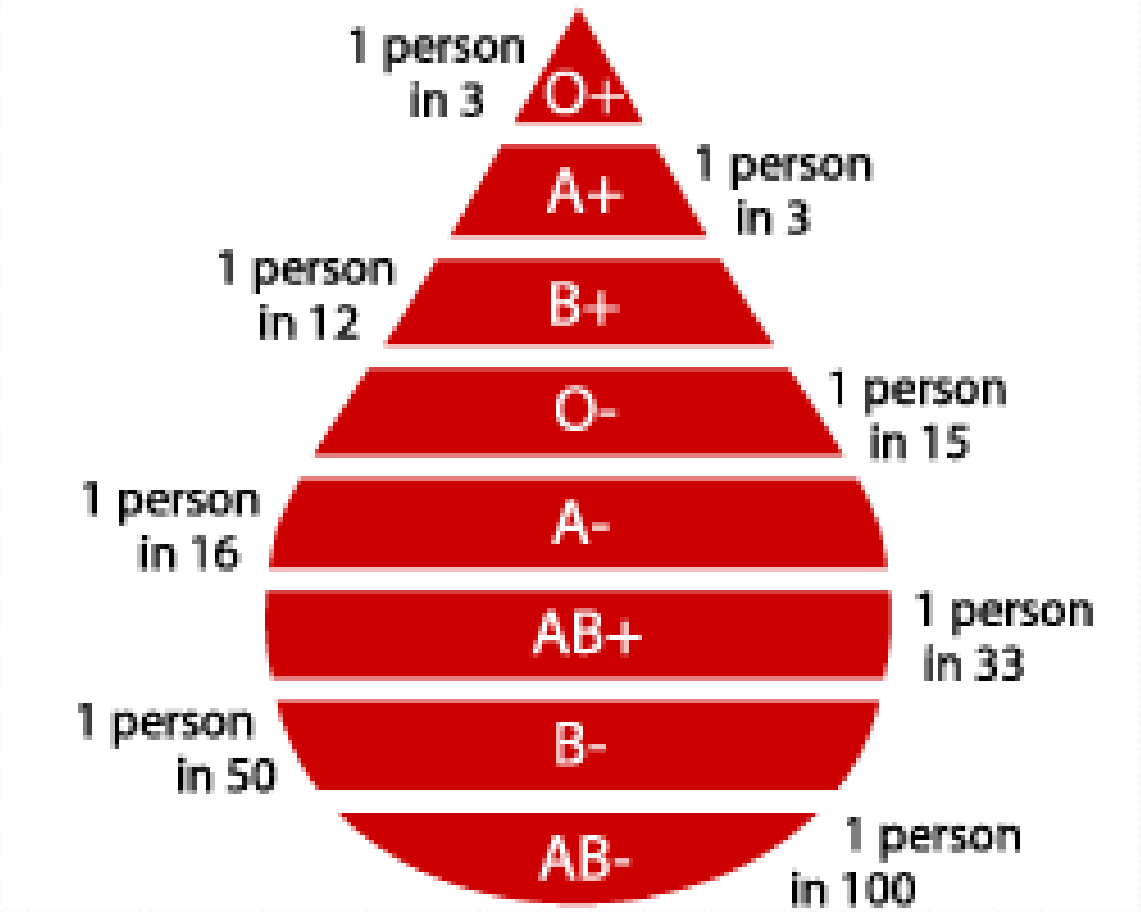
Types of blood group

- The ABO blood type classification system uses the presence or absence of antigens (type A and type B) to categorize blood into four types.

	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

The Rhesus (Rh) System

- Another level of specificity is added to blood type by examining the presence or absence of the Rh protein.
- They are named for the rhesus monkey in which they were first discovered.
- For example, a person whose blood type is "A positive" (A +), has both type A and Rh proteins on the surface of their red blood cells.
- A person with Rh- blood does not have Rh antigen in the surface of red blood cells.
- A person with Rh positive has Rh antigen in the surface of red blood cells.
- 85% of the population is Rh positive, the other 15% of the population is Rh negative blood.
- Blood that is Rh-negative can be transfused into a person who is Rh-positive.


1 person in 3
O+
A+
1 person in 3
1 person in 12
B+
O-
1 person in 15
1 person in 16
A-
AB+
1 person in 33
1 person in 50
B-
AB-
1 person in 100

Blood transfusions–who can receive blood from whom?

		Donors							
		O+	A+	B+	AB+	O–	A–	B–	AB–
Receivers	O+	✔				✔			
	A+	✔	✔			✔	✔		
	B+	✔		✔		✔		✔	
	AB+	✔	✔	✔	✔	✔	✔	✔	✔
	O–					✔			
	A–					✔	✔		
	B–					✔		✔	
	AB–					✔	✔	✔	✔

- People with type O blood are called universal donors because they do not have any molecules on the surface of the red blood cells that can trigger an immune response.
- People with type AB blood are called universal receivers because they do not have any antibodies that will recognize type A or B surface molecules.

Inheritance of the ABO blood group system

- The **ABO gene is autosomal** (the gene is not on either sex chromosomes).
- The **ABO gene** locus is located on the **chromosome 9**.
- A and B blood groups are **dominant** over the O blood group.
- There are three different alleles: A, B, O.
- A and B are the dominant alleles and O is the recessive allele.

Blood group	Genotype
A (Homozygous)	AA
A (Heterozygous)	AO
B (Homozygous)	BB
B (Heterozygous)	BO
AB	AB
O	OO

Inheritance of the Rh blood group system

Blood group	Genotype
Rh positive (Rh+) (Homozygous)	RR
Rh positive (Rh+) (Heterozygous)	Rr
Rh negative (Rh-)	rr

Practices

Question 1: Suppose that a mother has blood type A and the father has blood type AB. Draw a Punnett square to show the possible genotypes of their children. What are the possible phenotypes of their kids?

F genotype: AA X AB

Gametes: A | A B

F generation=

	A
A	AA (A)
B	AB (AB)

F genotype: AO X AB

Gametes: A O | A B

	A	O
A	AA (A)	AO (A)
B	AB (AB)	BO (B)

What are the possible phenotypes of their kids? A, B and AB

Question 2: A family of six includes four children, each of whom has a different blood type: A, B, AB and O. What are the genotypes of parents for this trait?

F genotype: AO X BO

Gametes: A O B O

F generation=

	A	O
B	AB (AB)	BO (B)
O	AO (A)	OO (O)

What are the genotypes of parents for this trait? AO and BO

Question 3: A man with blood type B, with one parent of blood type O, marries a woman with blood type AB. What will be the percentage of their children with blood type B?

F genotype: BO X AB

Gametes: B O A B

F generation=

	B	O
A	AB (AB)	AO (A)
B	BB (B)	BO (B)

What will be the percentage of their children with blood type B? 50%

Question 4: It was suspected that two babies had been exchanged in a hospital. Mr. and Mrs. Jones received baby-1 and Mr. and Mrs. Simon received baby-2. Blood typing tests on the parents and the babies showed the following: Were the babies switched? How do you know whether they were or they weren't?

Mr. Jones: type A	Mr. Simon: type AB
Mrs. Jones: type O	Mrs. Simons: type O
Baby-1: type A	Baby-2: type O

Jones:

F genotype: AA X OO

Gametes: A O

F generation=

	A
O	AO (A)

AO X OO

A O O

	A	O
O	AO (A)	OO (O)

Blood types of Jones children: A and O

Simon:

AB X OO

A B O

	A	B
O	AO (A)	BO (B)

Blood types of Simon children: A and B

- Baby-1 for Mr and Mrs Simon
- Baby-2 for Mr and Mrs Jones