

Medico-Legal Use of Blood Types

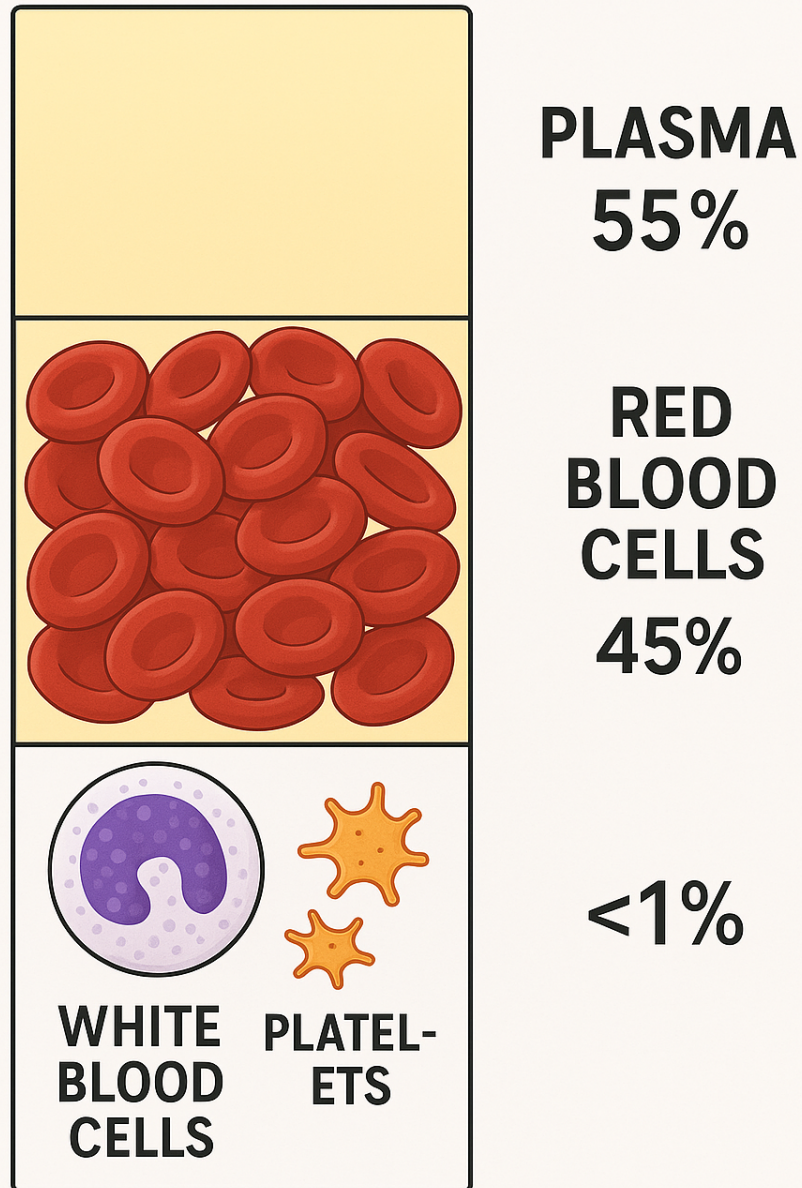
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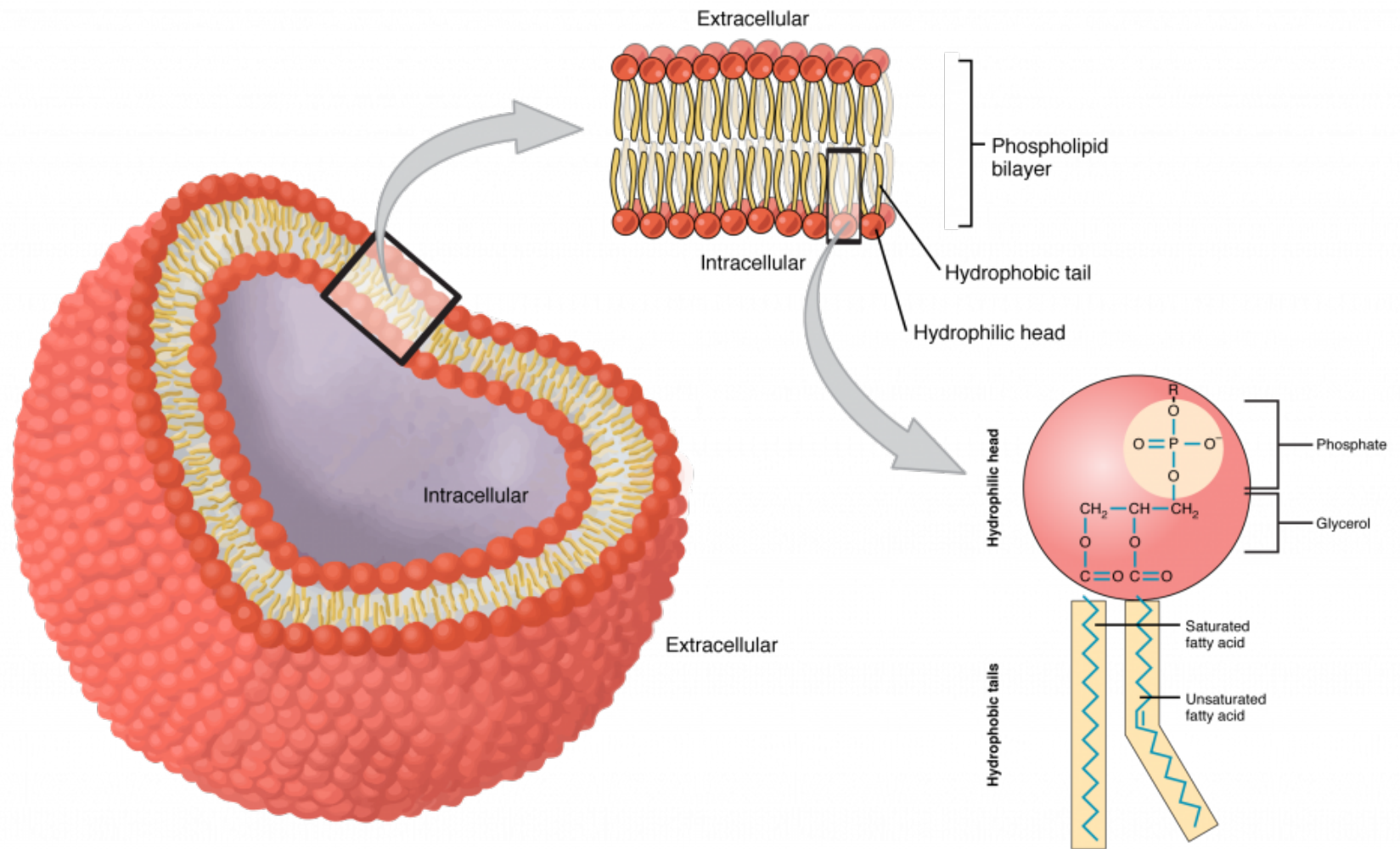
Objectives

- What are blood types?
- How are blood types determined?
- What are the medico-legal uses of blood types?
- How do we present blood type evidence in court?
- How do we test the validity of blood type evidence presented in court?

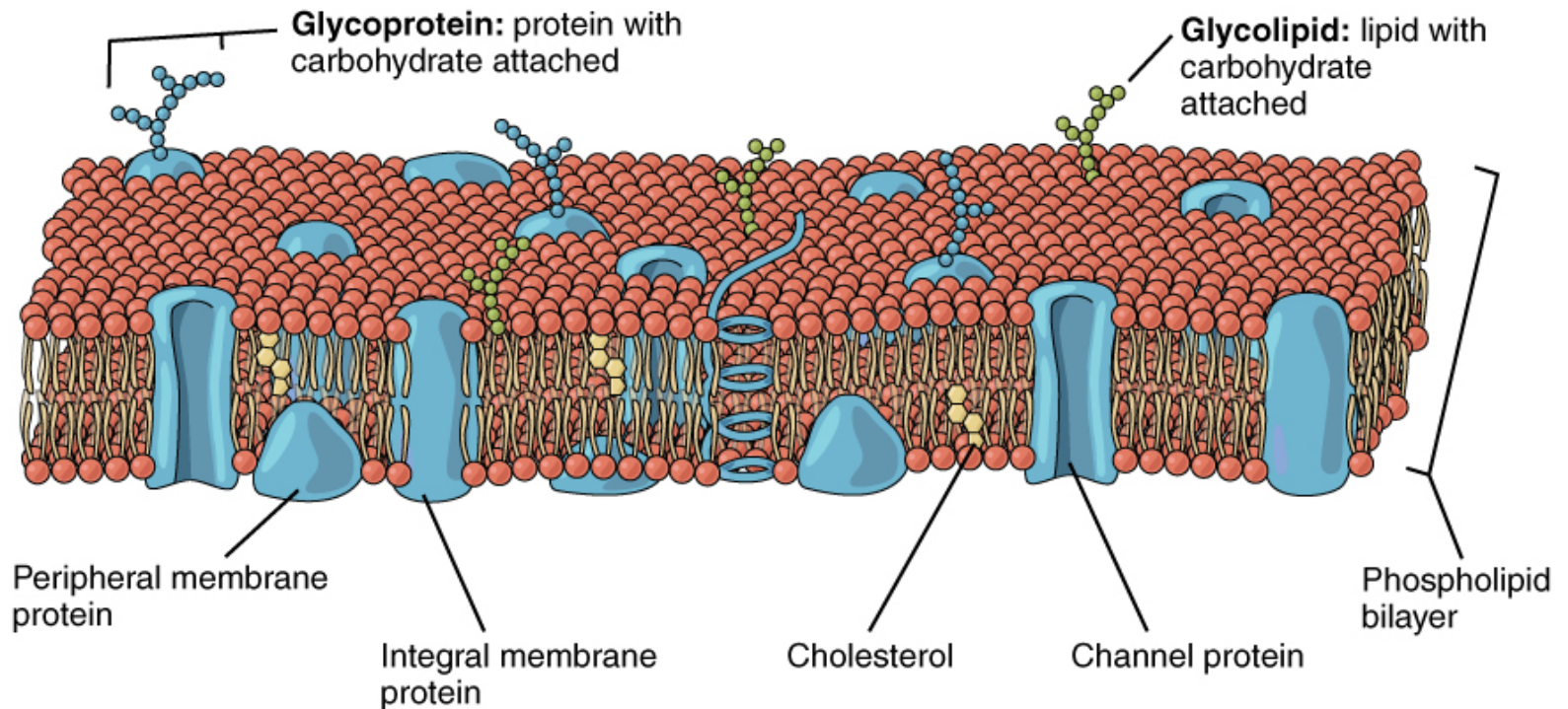
BLOOD COMPONENTS



CELL MEMBRANES

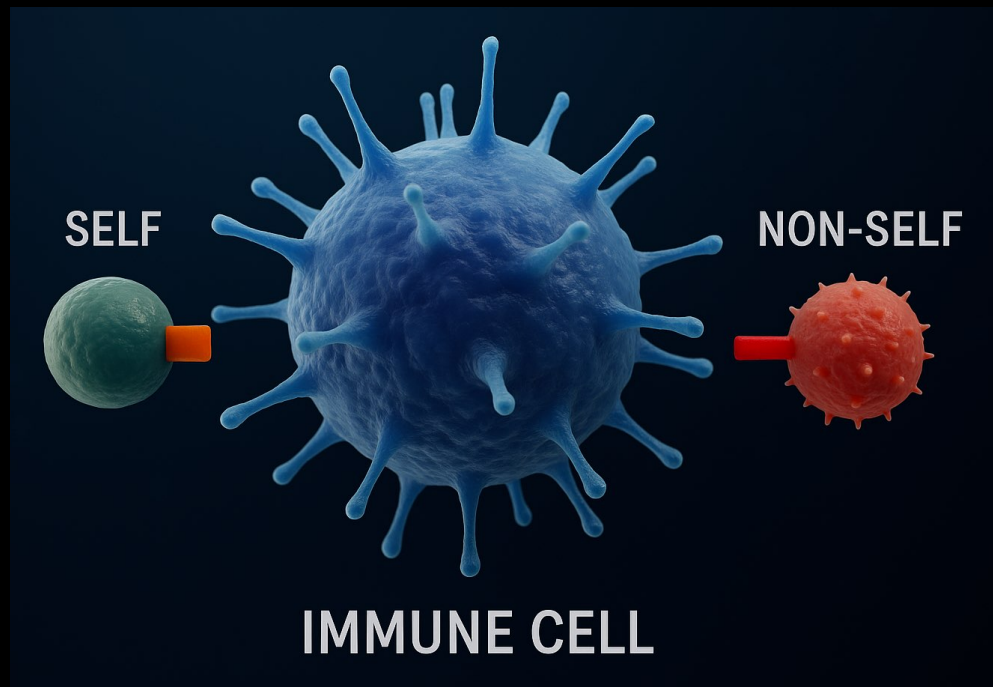


CELL MEMBRANES



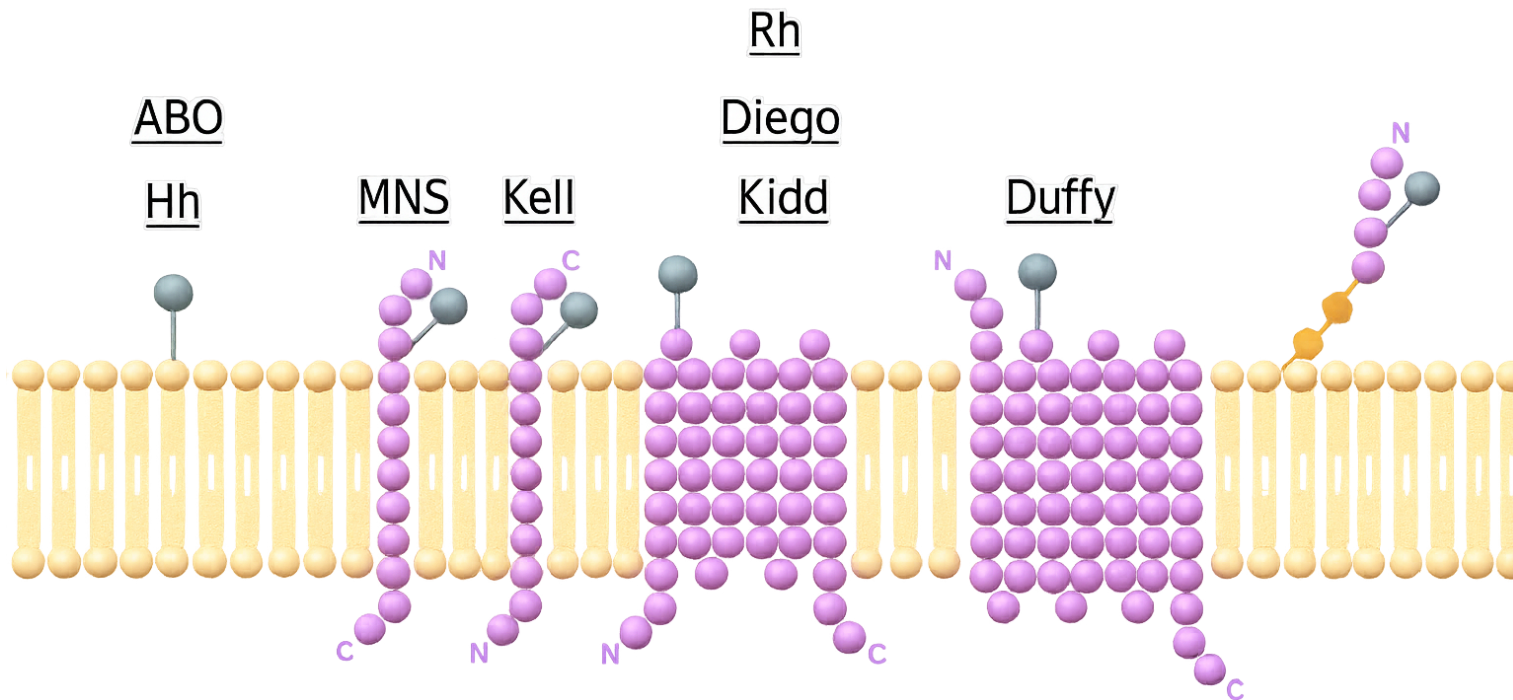
ANTIGENS

Self vs. non-self: The immune system “reads” these tags to decide whether something belongs in the body (self) or is foreign (non-self).



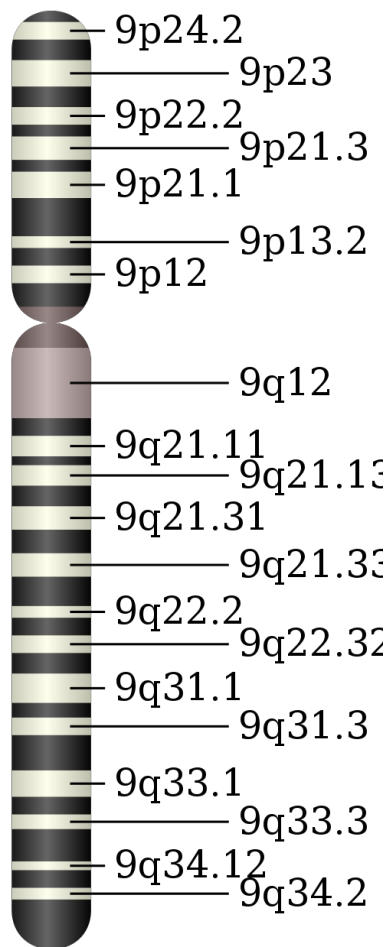
ANTIGENS

What they are: Antigens are molecular identity tags – usually proteins, carbohydrates, or lipids – that sit on the surface of cells, viruses, bacteria, or other particles.

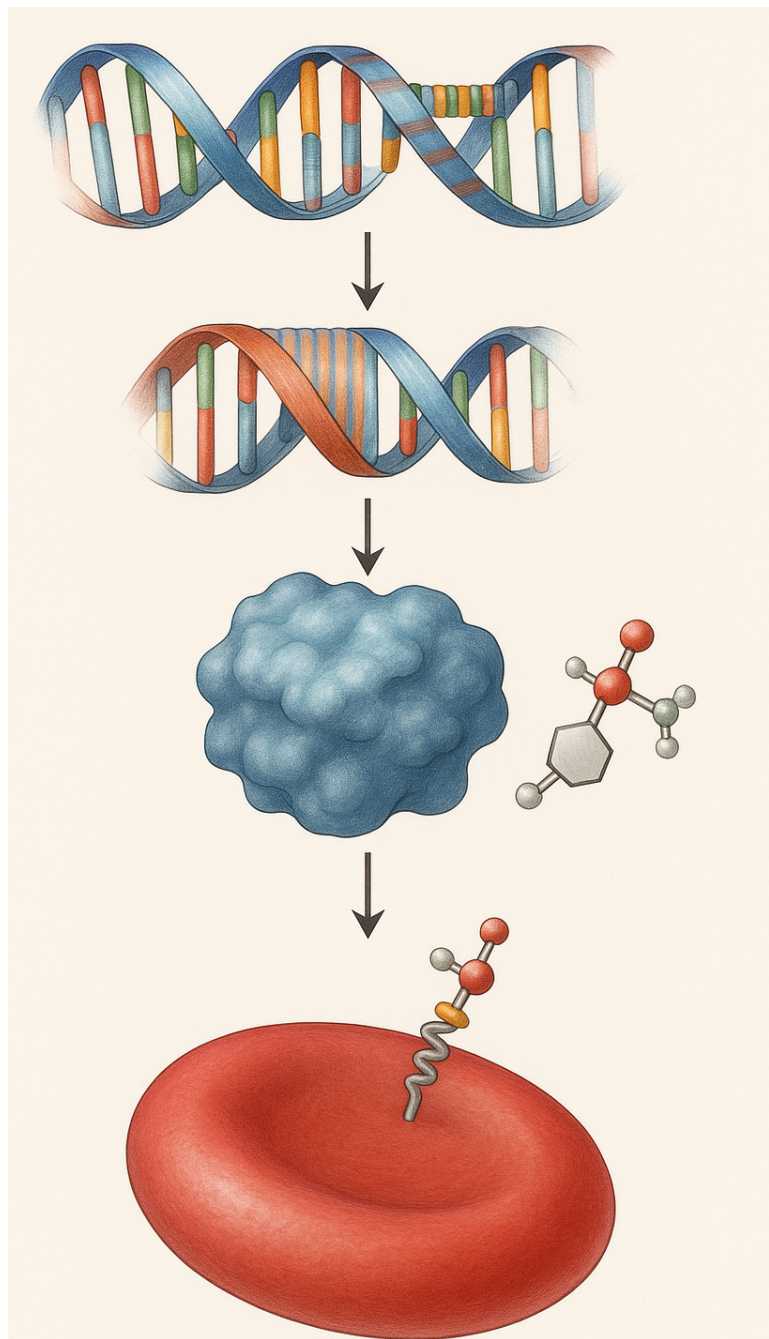


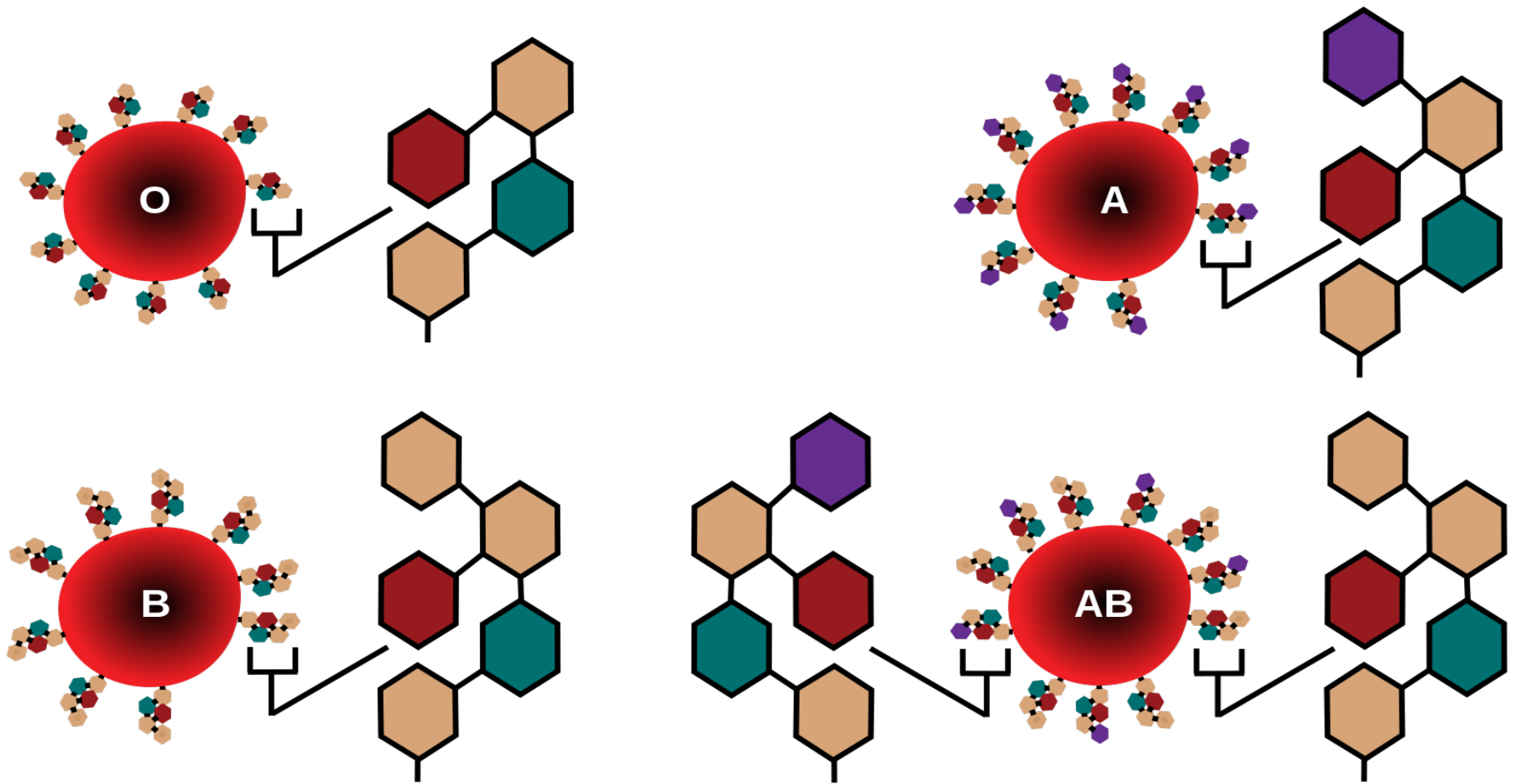
77 exons
145 M bp
3 alleles: ABO

ABO gene →

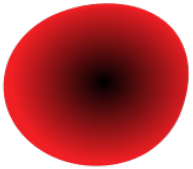


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Legend



Red blood cell



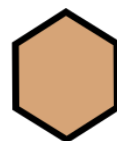
N acetyl-galactosamine



Fucose

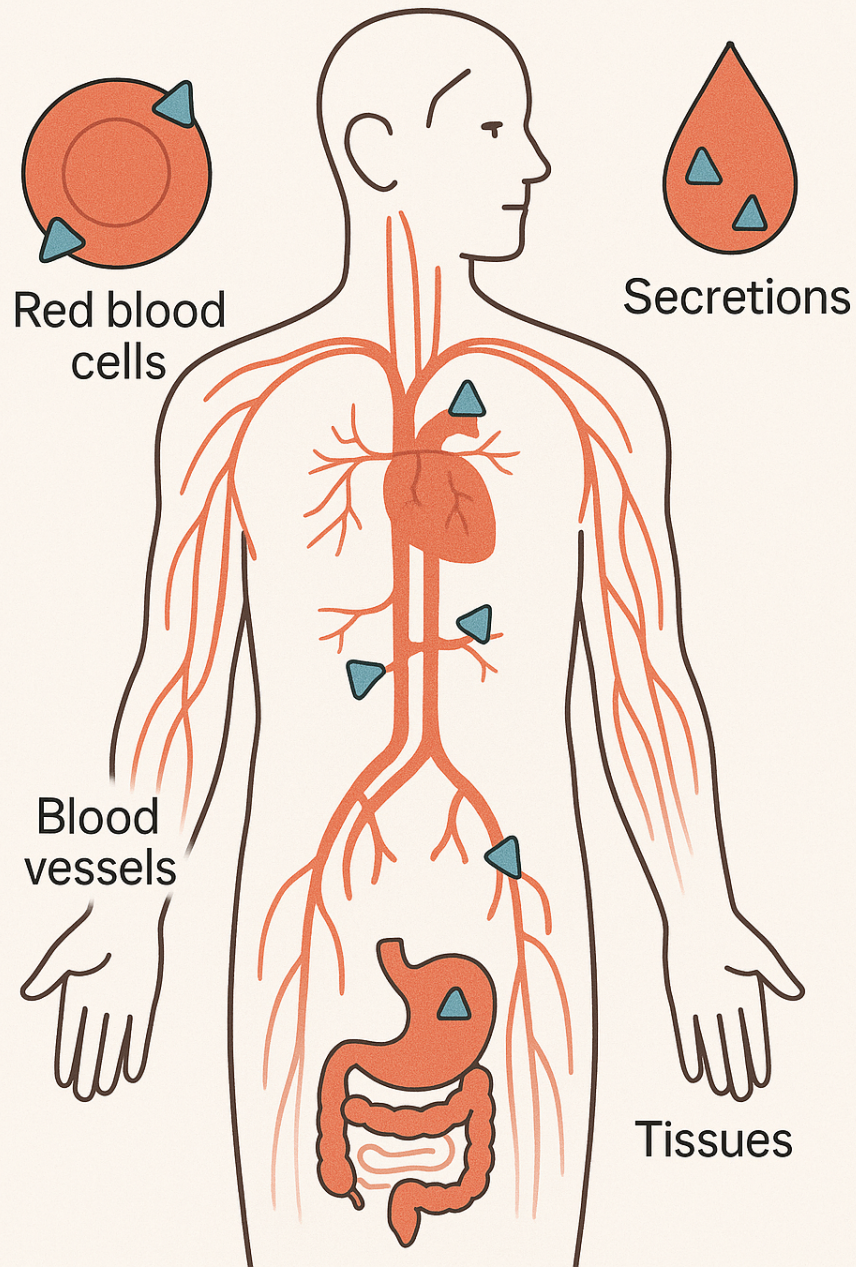


N acetyl-glucosamine



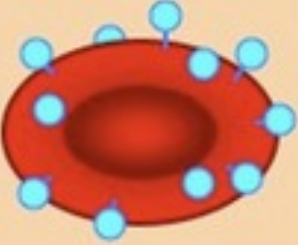
Galactose

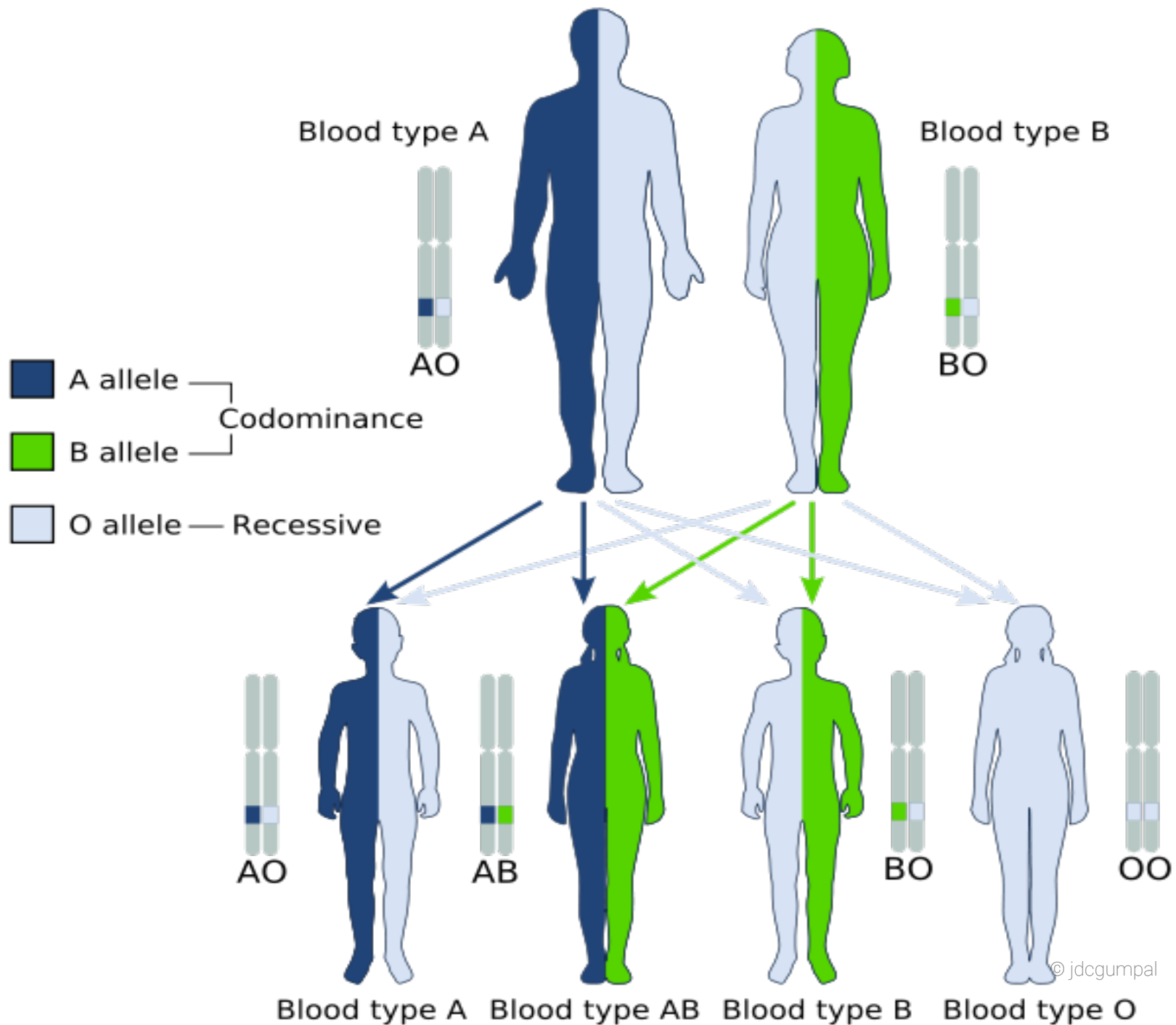
ABO Antigen Distribution



System	Key Antigens	Forensic Use	Case Example
 ABO	A, B, O	Links blood, saliva, semen to suspects/victims; still useful when DNA is degraded.	Macadangdang v. Court of Appeals (1980) – ABO blood typing as evidence.
 Rh	D, C, c, E, e	Boosts exclusion/inclusion power with ABO.	Paternity disputes (pre-DNA).
 Lewis	Lea, Leb	Found in saliva/semen of 'secretors'; fluid ID.	Sexual assault cases (pre-DNA).
 Kidd	Jka, Jkb	Rare phenotypes help in parentage exclusion.	Paternity disputes (pre-DNA).
 Duffy	Fya, Fyb	Ancestry/population marker.	Immigration/ancestry disputes.
 MNS	M, N, S, s	Adds extra discrimination.	Population genetics studies.
 Kell	K, k	Rare phenotypes aid exclusion.	Mass grave victim ID (Europe).
 Others	Lutheran, P, Diego	Rare, population-specific.	Diego antigen in East Asian/Indigenous cases.

ABO Blood Groups

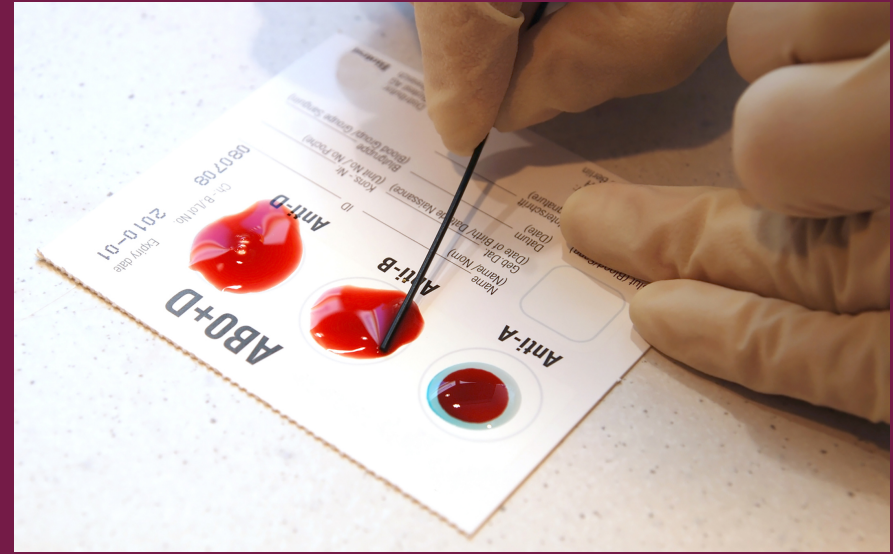
Antigen (on RBC)	Antigen A 	Antigen B 	Antigens A + B 	Neither A or B 
Antibody (in plasma)	Anti-B Antibody 	Anti-A Antibody 	Neither Antibody	Both Antibodies 
Blood Type	Type A Cannot have B or AB blood Can have A or O blood	Type B Cannot have A or AB blood Can have B or O blood	Type AB Can have any type of blood Is the universal recipient	Type O Can only have O blood Is the universal donor



		Father's Blood Type				Child's Blood type Must Be
		A	B	AB	O	
Mother's Blood Type	A	A or O	A, B, AB, or O	A, B, or AB	A or O	
	B	A, B, AB or O	B or O	A, B, or AB	B or O	
	AB	A, B, or AB	A, B, or AB	A, B, or AB	A or B	
	O	A or O	B or O	A or B	O	

		Child's Blood Type				Father's Blood Type Must Be
		A	B	AB	O	
Mother's Blood Type	A	A, B, AB or O	B or AB	B or AB	A, B, or O	
	B	A or AB	A, B, AB or O	A or AB	A, B, or O	
	AB	A, B, AB or O	A, B, AB or O	A, B, or AB		
	O	A or AB	B or AB		A, B, or O	

How to determine blood type



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Collection & preparation of reagents

1. Collect the Sample

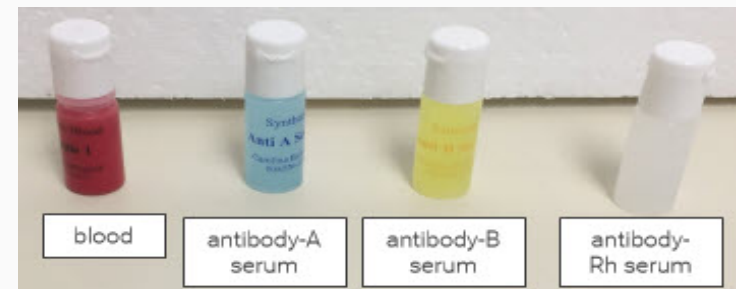
Blood is taken from the crime scene (**crime scene sample**) and also **reference samples** from the victim, suspects).



2. Prepare Reagents (Known Antibodies)

Use three test wells/slides containing:

- **Anti-A serum** (antibodies against A antigen)
- **Anti-B serum** (antibodies against B antigen)
- **Anti-D serum** (antibodies against Rh D antigen)



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3. Mix Blood with Reagents

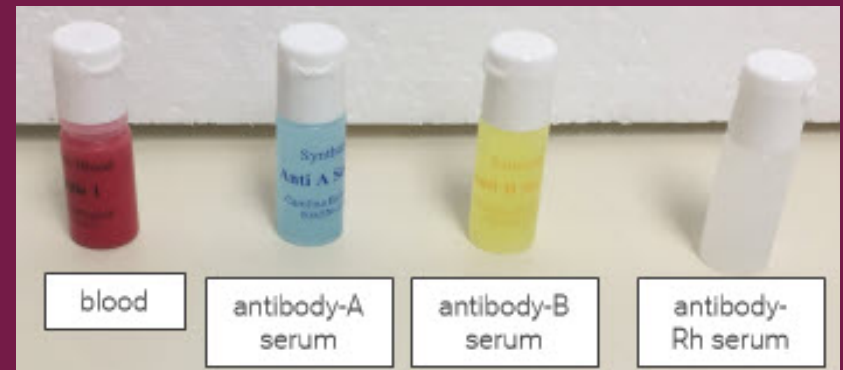
A drop of the person's blood is mixed separately with each reagent.

4. Observe for Agglutination (Clumping)

Agglutination = positive reaction
→ the antigen is present.

No agglutination = negative reaction
→ antigen is absent.

Mixing blood with reagents & observe for agglutination



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- Body
- o E

Type AB (contains agglutinogens A and B; agglutinates with both sera)

Type A (contains agglutinin A; agglutinates with anti-A)

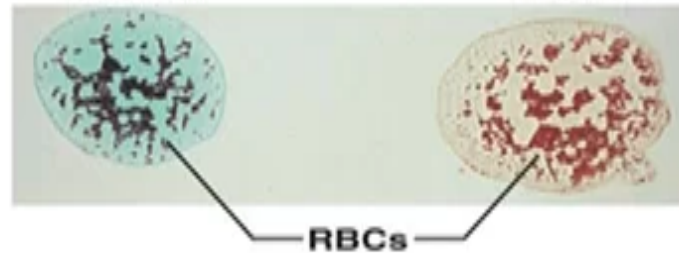
Type B (contains agglutinin B; agglutinates with anti-B)

Type O (contains no agglutinogens; does not agglutinate with either serum)

Serum

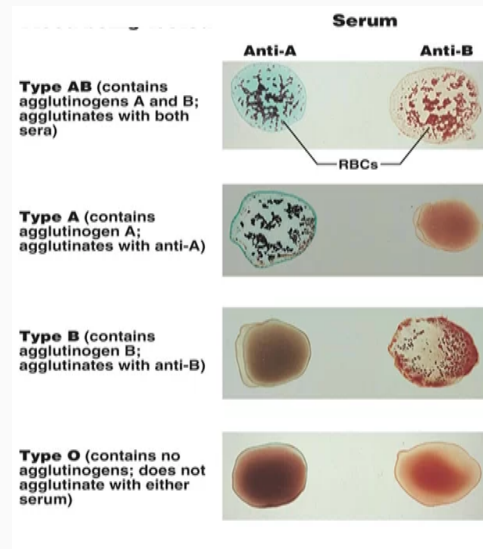
Anti-A

Anti-B



5. Interpret Results

Reaction with Anti-A	Reaction with Anti-B	Reaction with Anti-D	Blood Type
Clumping	No clumping	$\pm$	Type A (Rh+ if Anti-D clumps; Rh- if not)
No clumping	Clumping	$\pm$	Type B (Rh+ or Rh-)
Clumping	Clumping	$\pm$	Type AB (Rh+ or Rh-)
No clumping	No clumping	$\pm$	Type O (Rh+ or Rh-)



Presenting blood type evidence in court



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1. Collection and Chain of Custody

- Show that the blood sample (crime scene, victim, suspect, or child in paternity case) was properly collected, preserved, and documented.
- Chain of custody logs must prove the sample was not tampered with.

2. Laboratory Methodology

An expert witness (forensic serologist or medical technologist) explains the blood typing procedure:

- Forward typing (testing RBCs with anti-A, anti-B, anti-D).
- Reverse typing (testing plasma with known A and B cells).
- Results are presented with photos, lab sheets, or agglutination slides.

3. Interpretation of Results

The expert explains what the blood type means in the case:

Exclusionary:

Paternity: If a child's blood type is impossible from alleged father's genotype, paternity is excluded.

Suspect: If suspect and crime scene blood do not share the same type, it does not prove innocence, but excludes the suspect from possible involvement and creates reasonable doubt.

3. Interpretation of Results

Supportive:

Paternity: If a child's blood type is possible from alleged father's genotype, his paternity is not excluded but does not mean that he is the father.

Suspect: If suspect and crime scene blood do not share the same type, it does not prove innocence, but may exclude the suspect from possible involvement and creates reasonable doubt.

Summary on the evidentiary value of blood types

In court, blood type evidence is presented through expert testimony, lab results, population data, and careful explanation of its limits.

It is strongest for exclusion (ruling someone out), and supportive but not conclusive for inclusion.

How to Test the Validity of Blood Type Evidence



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1. Collection and Chain of Custody

The defense (or court) will first ask:

- Who collected the sample?
- How was it collected?
- How was the sample stored upon collection?
- To whom was the sample given? Do you have evidence (e.g., logbook) to support this? (Ask to bring next hearing.)
- From the one who received the sample from the laboratory, how was it endorsed to the one in charge of testing the sample?
- Was the blood type analysis done on the same day? If not, when was it done? Who actually analyzed the sample?

2. Expertise of “Expert” Witness

Questions that may be asked to the person who actually conducted the blood type analysis; otherwise, any other person’s testimony would be considered as hearsay.

You can request the court to issue a subpoena duces tecum and ad testificandum for that person.

2. Expertise of “Expert” Witness

Personal and Academic Background

- Please state your name for the record.
- What is your current profession and position?
- Where did you obtain your college degree?
- What was your field of specialization?
- Do you hold any postgraduate degrees, diplomas, or certifications related to forensic science or medical technology?
- Have you undergone specialized training in serology, or forensic blood typing?

2. Expertise of “Expert” Witness

Professional Experience

- Are you a member of any professional organizations related to forensic science or laboratory medicine?
- How long have you been practicing as a forensic serologist or medical technologist?
- Have you previously been designated as an expert witness in court proceedings?
- Approximately how many blood sample analyses have you conducted in your career?

2. Laboratory procedure & methodology

- What specific laboratory tests did you perform on the blood samples in this case?
- Can you describe in detail how you conducted the ABO blood typing procedure?
- When performing ABO typing, what are the differences between forward typing and reverse typing, and did you conduct both methods in this case?
- What reagents did you use in your testing, such as anti-A, anti-B, or anti-D serums?
- What laboratory equipment and materials were necessary for the analysis, such as slides, test tubes, centrifuges, or automated analyzers?

2. Laboratory procedure & methodology

- How do these reagents and equipment function in detecting the presence or absence of blood group antigens?
- Did you prepare control samples alongside the case samples to ensure the accuracy of your testing? Do you have documents to prove this?
- What type of controls were used — positive, negative, or both — and how did these confirm that your results were reliable?
- Did you repeat the tests or perform duplicate runs to validate your findings? Do you have documents to prove this?
- Based on these procedures, how confident are you in the accuracy and reliability of your laboratory results?

2. Laboratory procedure & methodology:

Results of Analysis

- After completing your laboratory testing, what was the determined ABO blood type of the blood sample recovered from the crime scene?
- Did you also conduct Rh typing on the crime scene sample? If so, what was the Rh factor result?
- Were you able to determine whether the blood sample from the crime scene came from a secretor or non-secretor, and if so, what was the finding? (This is for instances when non-blood samples were used to determine the ABO type, e.g., saliva, semen)
- Moving now to the reference sample: what was the determined ABO blood type of the blood collected from the suspect [or victim]?
- What was the corresponding Rh factor of the suspect's [or victim's] blood?

2. Laboratory procedure & methodology:

Results of Analysis

- How do the blood typing results of the crime scene sample compare with the reference sample from the suspect [or victim]?
- Would you say that the results are consistent or inconsistent with one another?
- If they are consistent, what does that signify in forensic terms?
- If they are inconsistent, what does that signify in forensic terms?
- Can these results, by themselves, conclusively establish identity, or do they serve only to include or exclude an individual as a possible contributor of the blood sample?

2. Laboratory procedure & methodology:

Results of Analysis and Interpretation

- How do the blood typing results of the crime scene sample compare with the reference sample from the suspect [or victim]?
- Would you say that the results are consistent or inconsistent with one another?
- If they are consistent, what does that signify in forensic terms?
- If they are inconsistent, what does that signify in forensic terms?
- Can these results, by themselves, conclusively establish identity, or do they serve only to include or exclude an individual as a possible contributor of the blood sample?

Summary

- To test the validity of blood type evidence, courts scrutinize the chain of custody, lab methods, reproducibility, expert testimony, population statistics, and legal standards.
- The strongest use is for **exclusion**; inclusion must be carefully qualified with its limits.
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