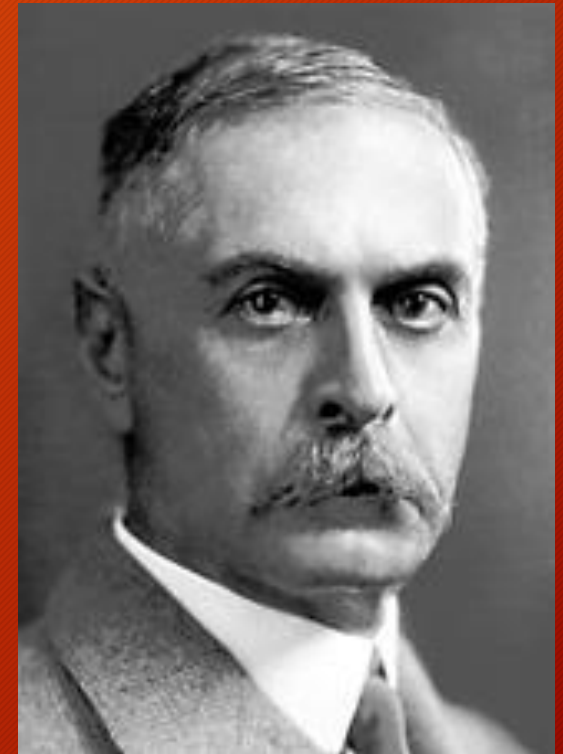


# Blood Groups

Biology 30S

# Blood Groups Discovery

- Discovered by Karl Landsteiner
- Won Nobel Prize 1930
- In 1900, Landsteiner published a paper that recognized agglutination of human blood due to the uniqueness of the individual blood.
- He later test crossed his own blood and found some caused clumping while others didn't.



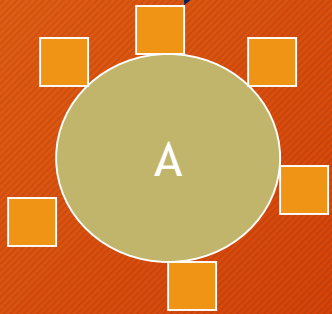
# What he found was...

- Clumping was due to an **immune response** caused by antibodies
- There were **antibodies** that were specific to some certain type of blood, which caused the clumping
- He then found out the **antigens** (A & B) on the **surface** of the red blood cells stimulated the antibody response
- He classified the 4 blood types **A, B, AB, O**

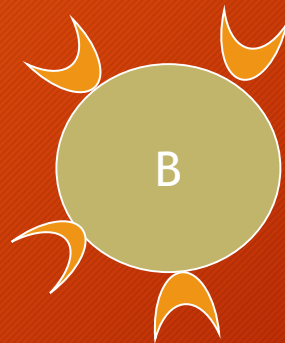
# Blood groups - Visual representation

- There are antigens on the surface of red blood cells that represented the different blood types.

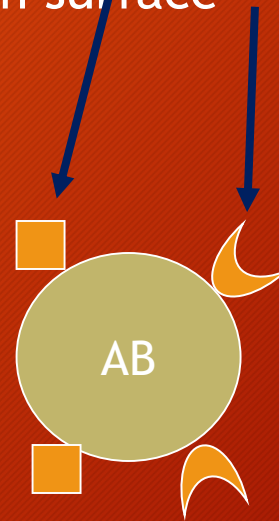
- Type A has A antigen on surface



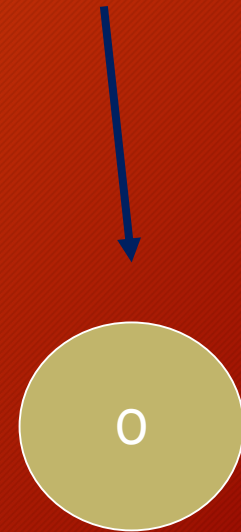
- Type B has B antigen on surface



- Type AB has both A antigen and B antigen on surface



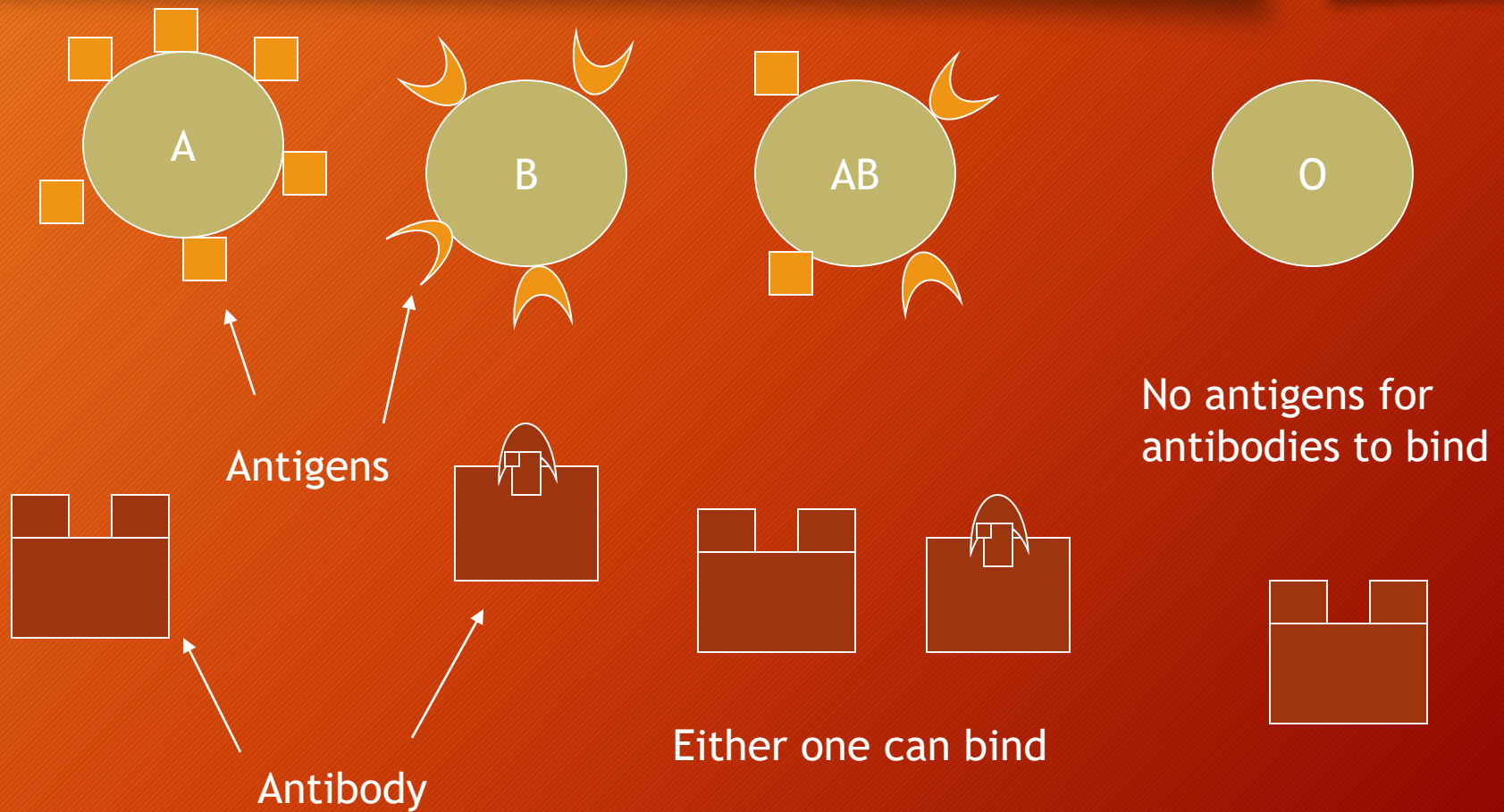
- Type O has NO antigens



# What causes clumping?

- In addition to having **antigens** on the red blood cell, there are also **antibodies** present.
- These **antibodies** are present to fight against foreign substances and are specific to the *opposite* blood type.
- **Ex.**
  - Type A blood has **Anti-B antibody**
  - Type B Blood has **Anti-A Antibody**
  - Type AB Blood has **NO Antibodies** (Since any antibody would cause clumping to its own blood)
  - Type O Blood has **BOTH Anti-A and Anti-B antibody.**

# So what he found was



# Blood types

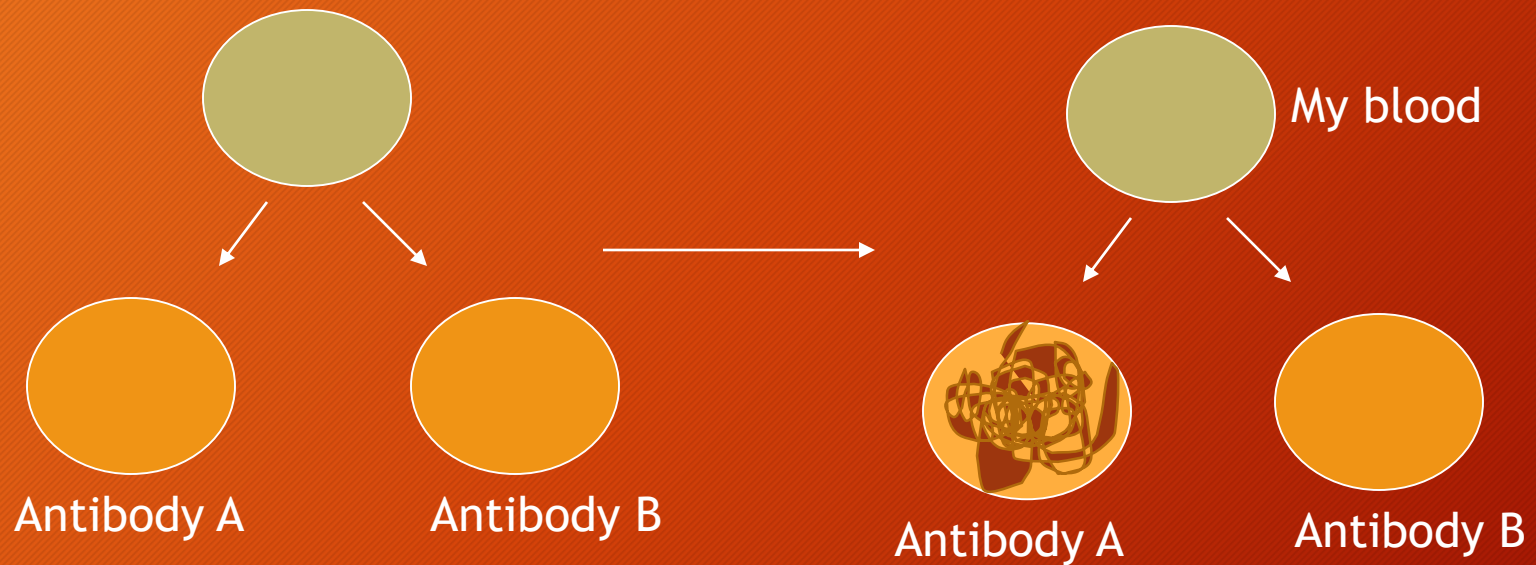
- In blood, if they bind together ...
  - If antibody A binds with antigen A (type A blood) it will... **agglutinate** or clump together.
  - If antibody B binds with antigen B (type B blood) it will...**agglutinate** or clump together
  - If antibody B binds with antigen B in AB blood it will...
    - Agglutinate or clump together

# How do you find out your blood type?

- Since there are only two antibodies that stimulate a response in our blood, we use type A and type B antibody to test our 4 combinations
- Place a drop of blood on to antibody A and see if there is a reaction.
- Place a drop of blood on to antibody B and see if there is a reaction.
- If there is a reaction in antibody A, and not in B then you know it is blood type A because there is only A antigen on the red blood cell.



# Blood Typing

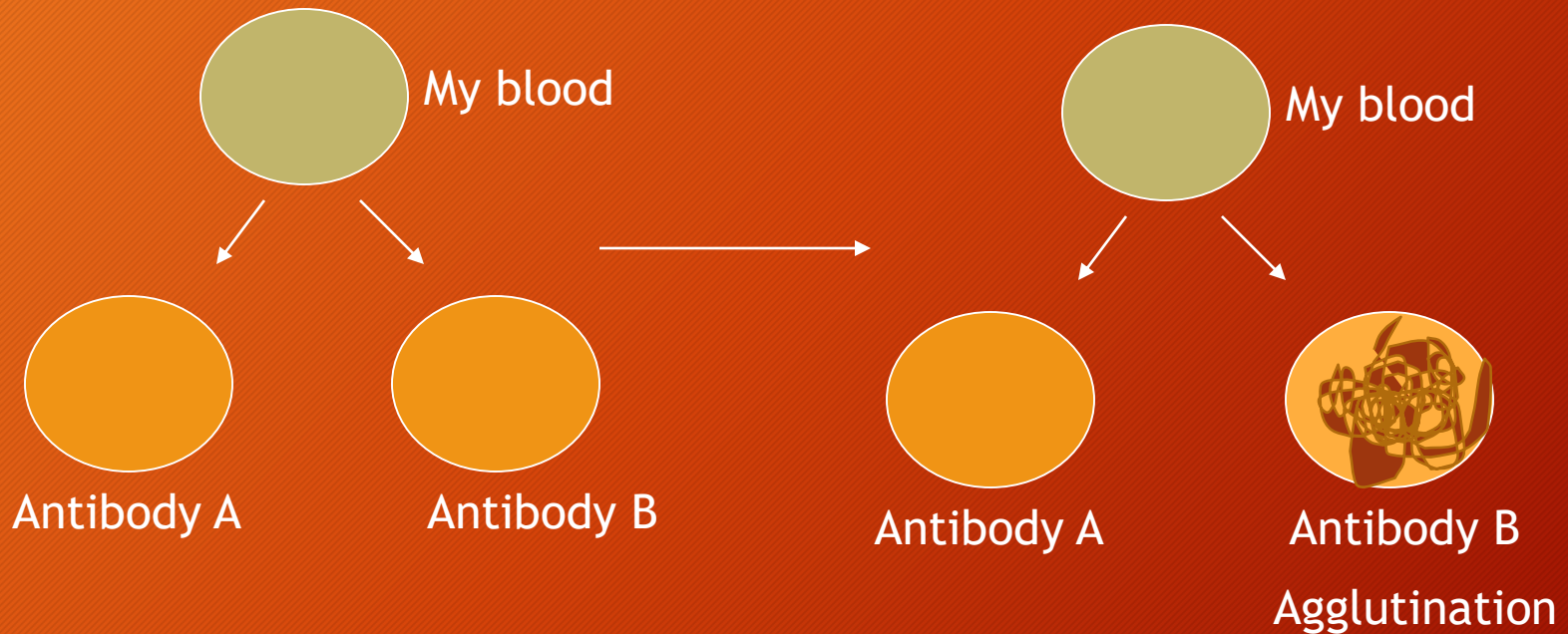


AGGLUTINATION  
TYPE A BLOOD

My blood  
Type A

# Blood Typing

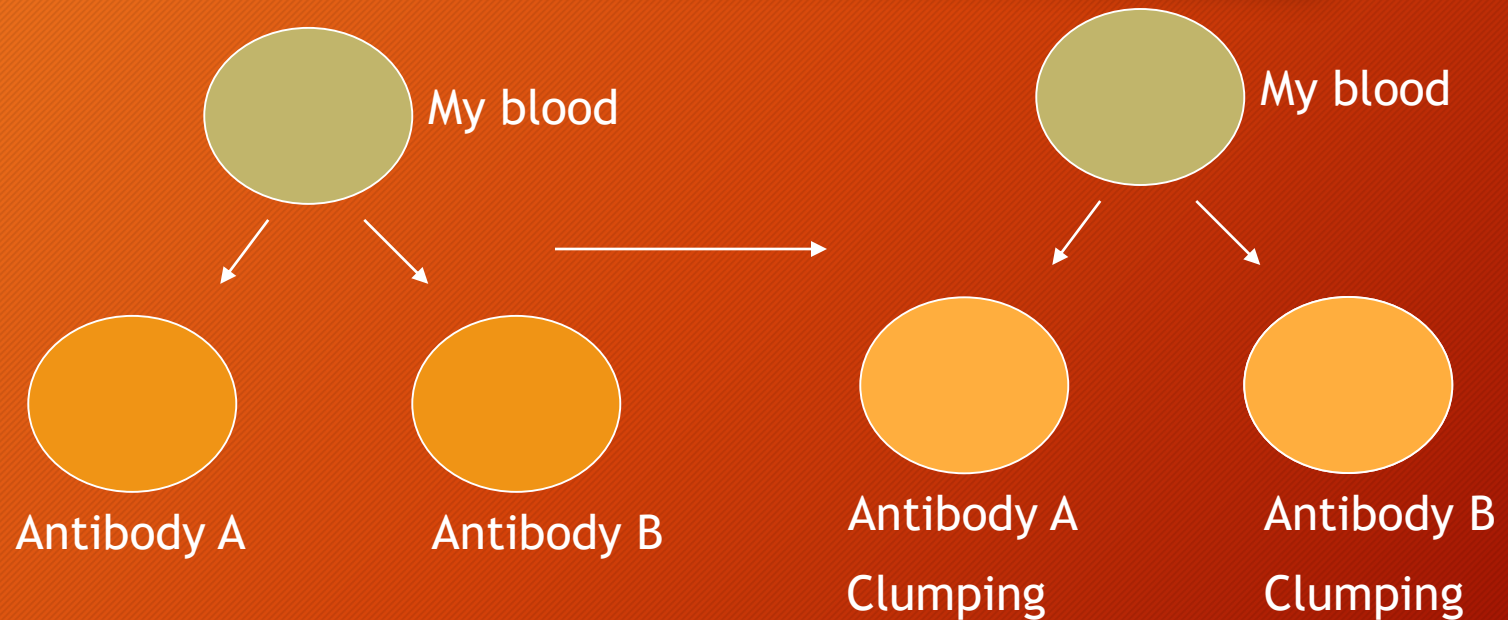
- What type is this?



Type B Blood

# Blood Typing

- What about...



Type AB

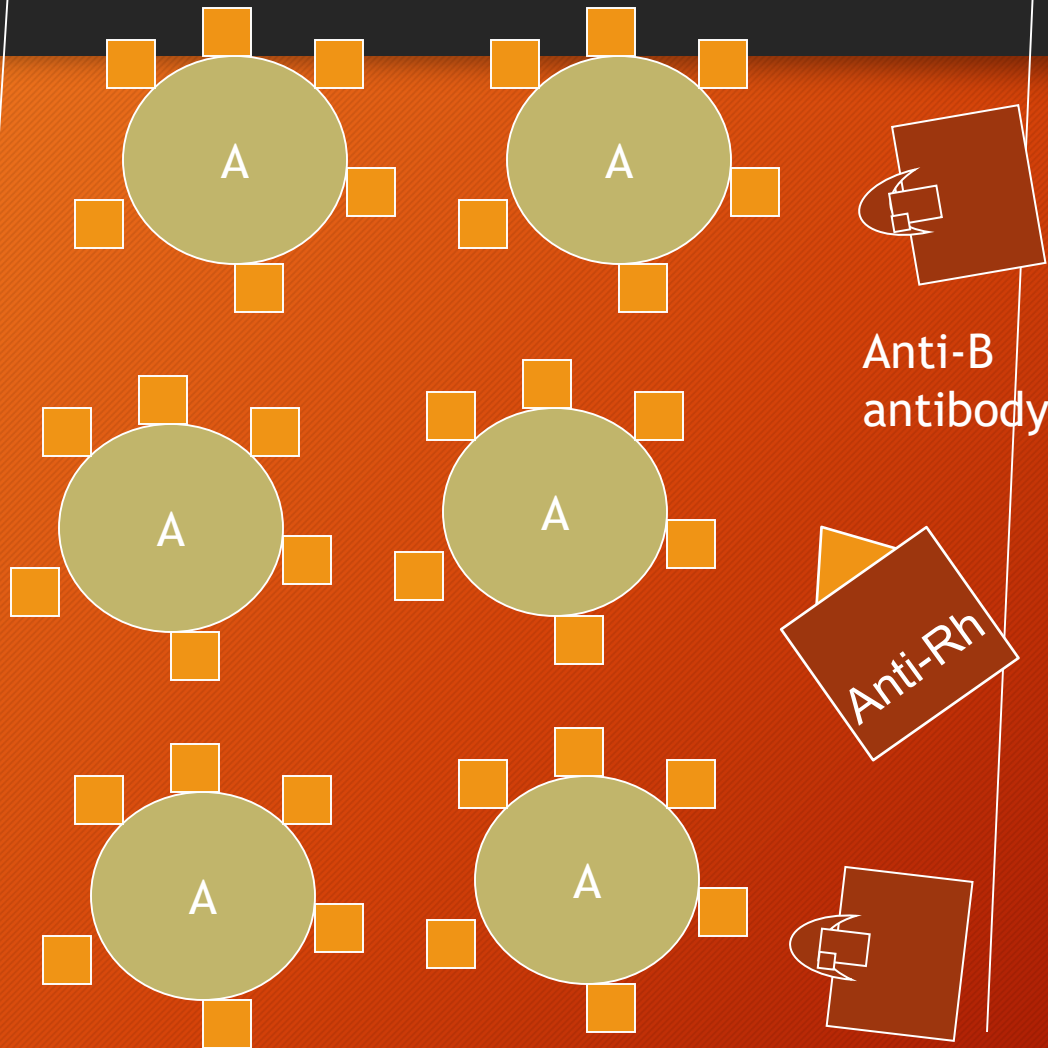
# The Rh (Rhesus) Factor

- In addition to the A and B antigens found on the red blood cells, there is another protein factor that is also found.
- The “Rh” is inherited from our parents and is independent from the A and B antigens.
- The “Rh” will give your blood type “+” if it is present, or “-” if it is not present.
- AB+ blood would have all 3 antigens (A, B, and Rh)
- Someone with Rh (+) blood **will NOT** have the Anti-Rh antibody while someone without Rh (-) **will have** the Anti-Rh antibody in its blood plasma.

# Blood transfusion

- Now we know our blood have antigens and antibodies in it how can we make transfusing blood safer?
- We know blood type A can be transfused with blood type A, but what about the others?
- Let's think...

# Blood Stream with Type A- blood



In your blood stream...

If your blood type is A-,  
you will have anti-B  
antibody and anti-Rh.

So what can be donated  
to this blood stream?

- Type A?
- Type B?
- Type AB?
- Type O?

# Blood Stream with Type A- Blood

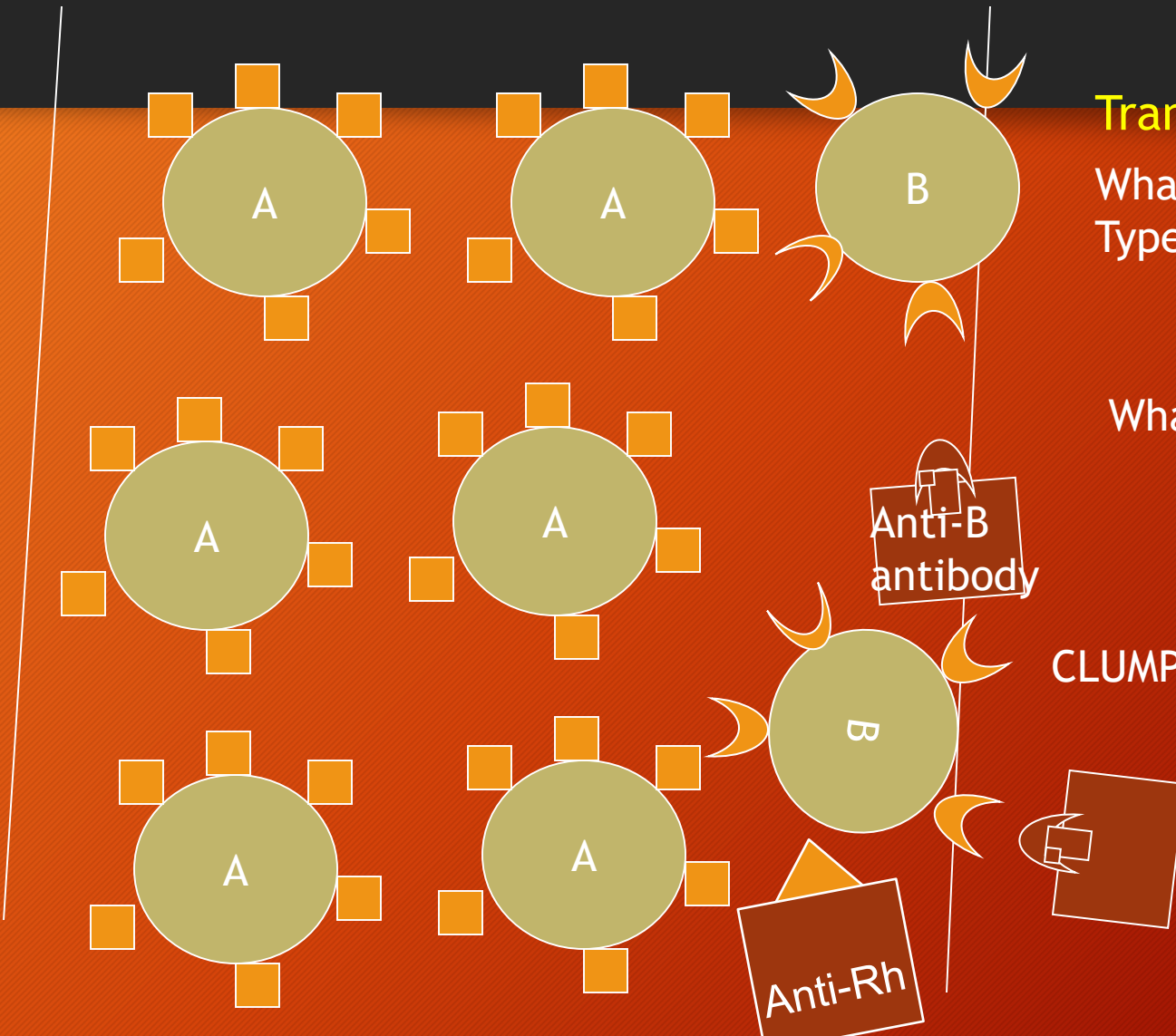
Transfuse with Type B?

What is on surface of Type B- blood?

B antigen

What is in Type A- blood?

Anti B antibody  
Anti Rh antibody



# Blood transfusion in A- blood

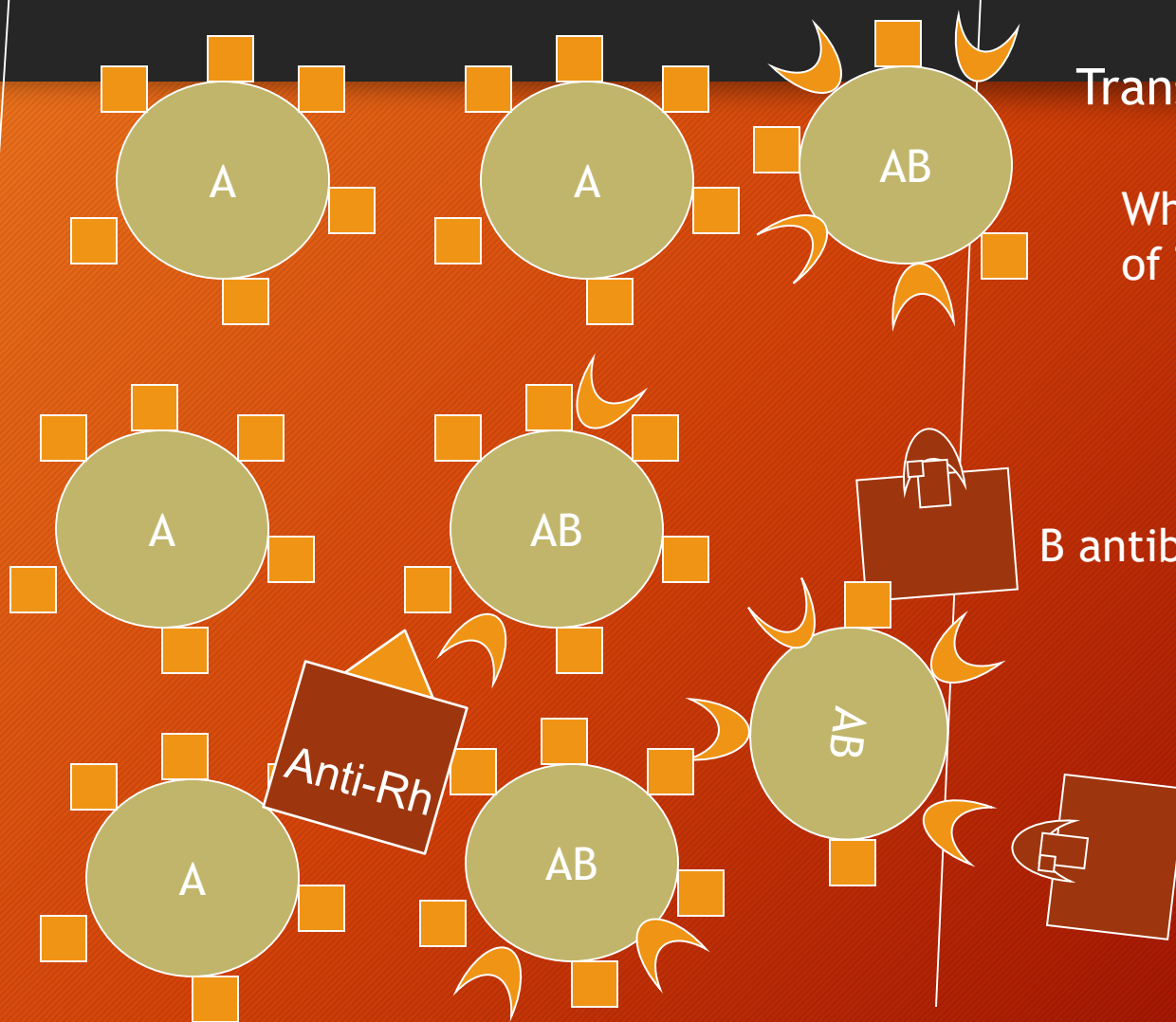
Transfuse with Type AB-?

What is on the surface of Type AB- blood?

A & B antigen

B antibody

CLUMP!





# Blood transfusion with Type 0

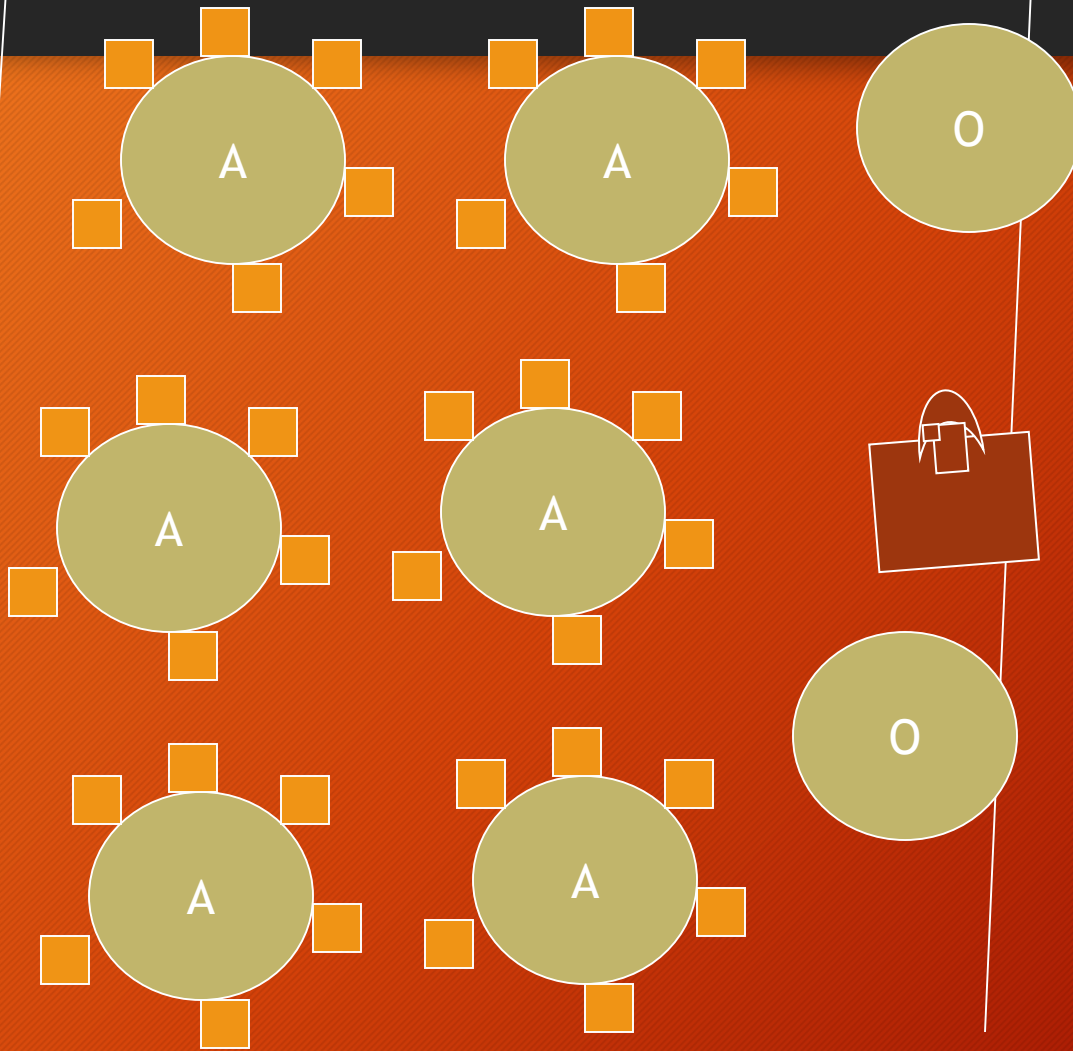
Type O?

What is on Type O- blood?

No antigens

B antibody

NO CLUMPING!



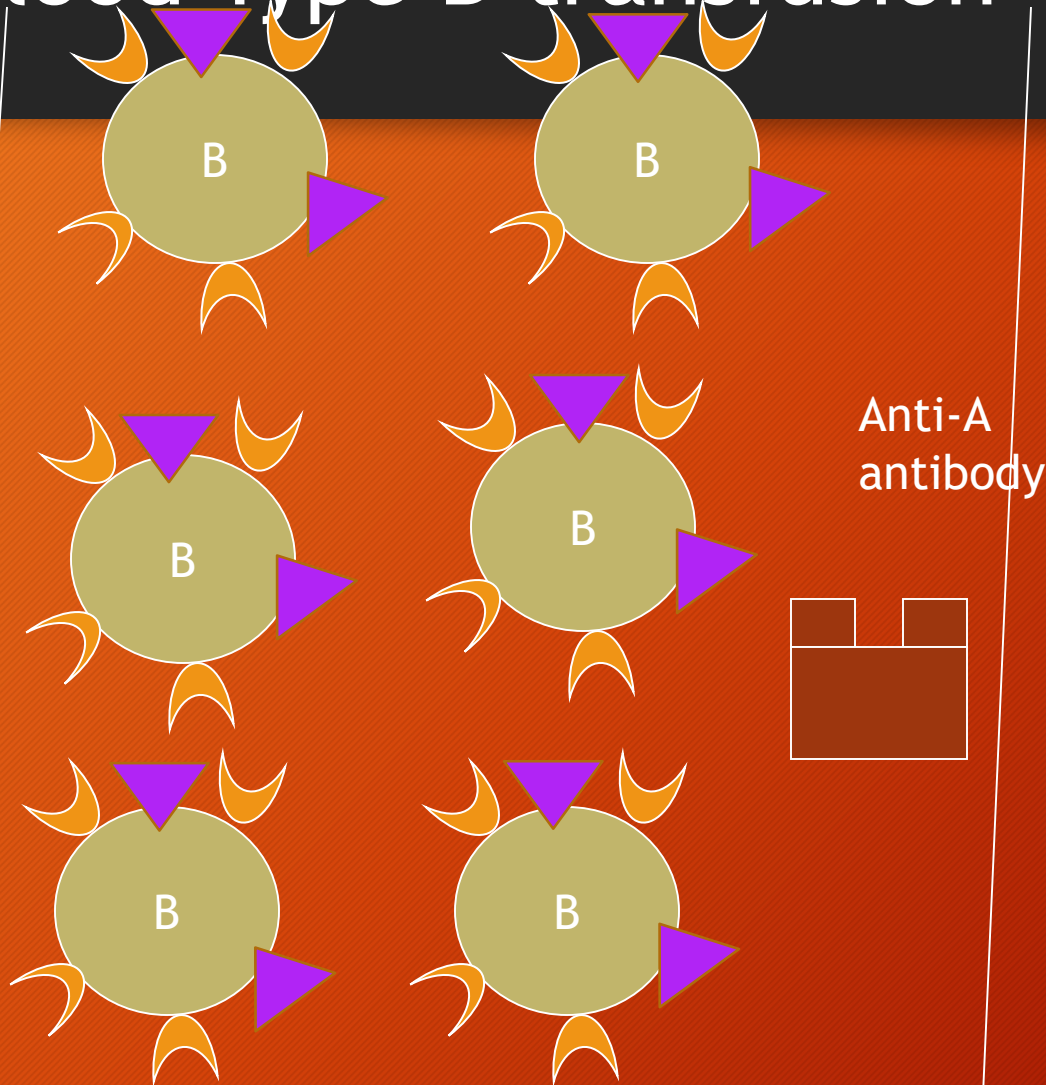
# Therefore...

- You can only donate either the same blood type to the individual or type O- blood.

# What about if your blood is...

- Type B?

# Blood Type B transfusion



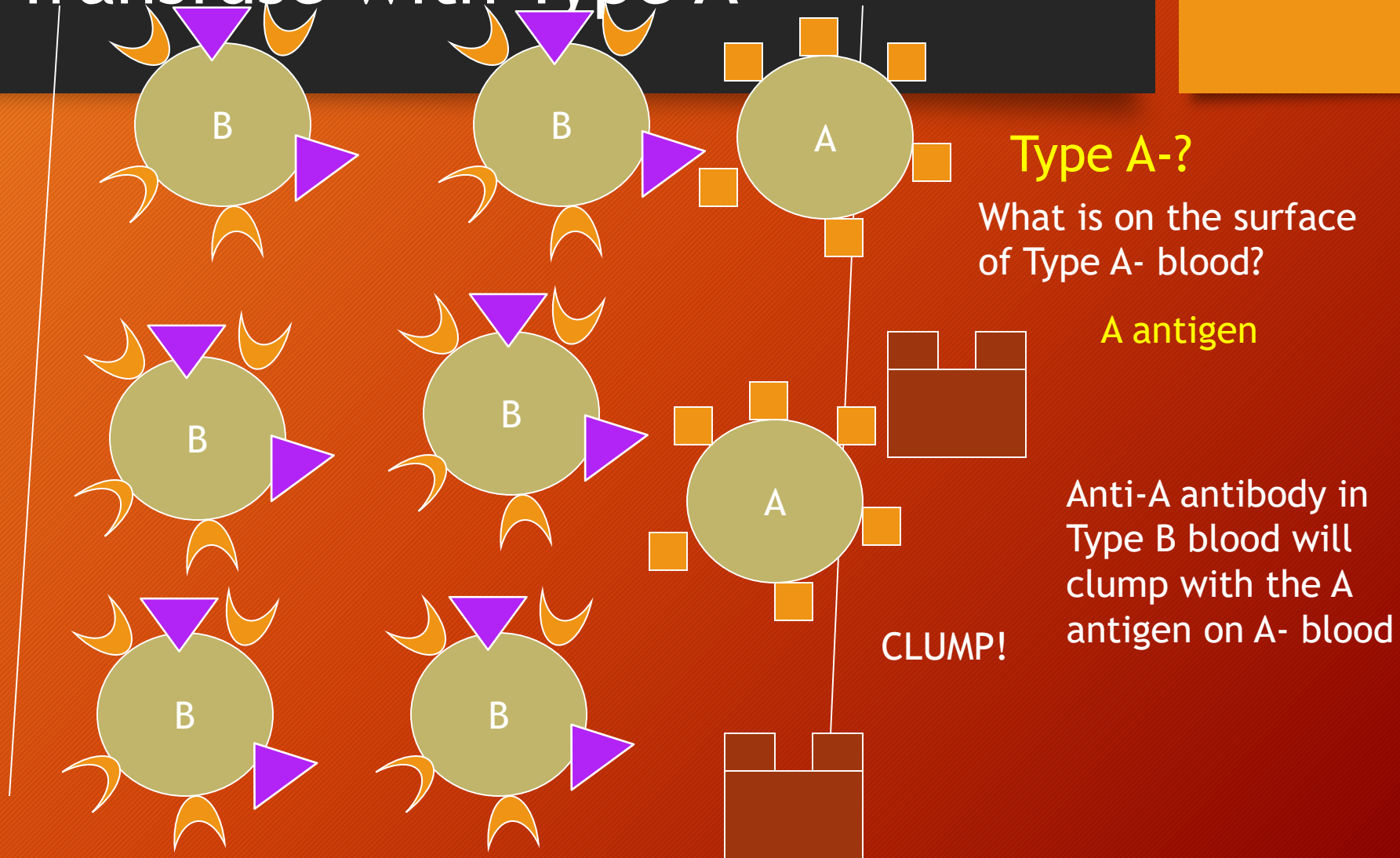
Your blood stream...

If your blood type is B+, you will have anti-A antibody.

So what can be donated to this blood stream?

- Type A+ A-?
- Type B+ B-?
- Type AB+ AB-?
- Type O+ O-?

# Transfuse with Type A-



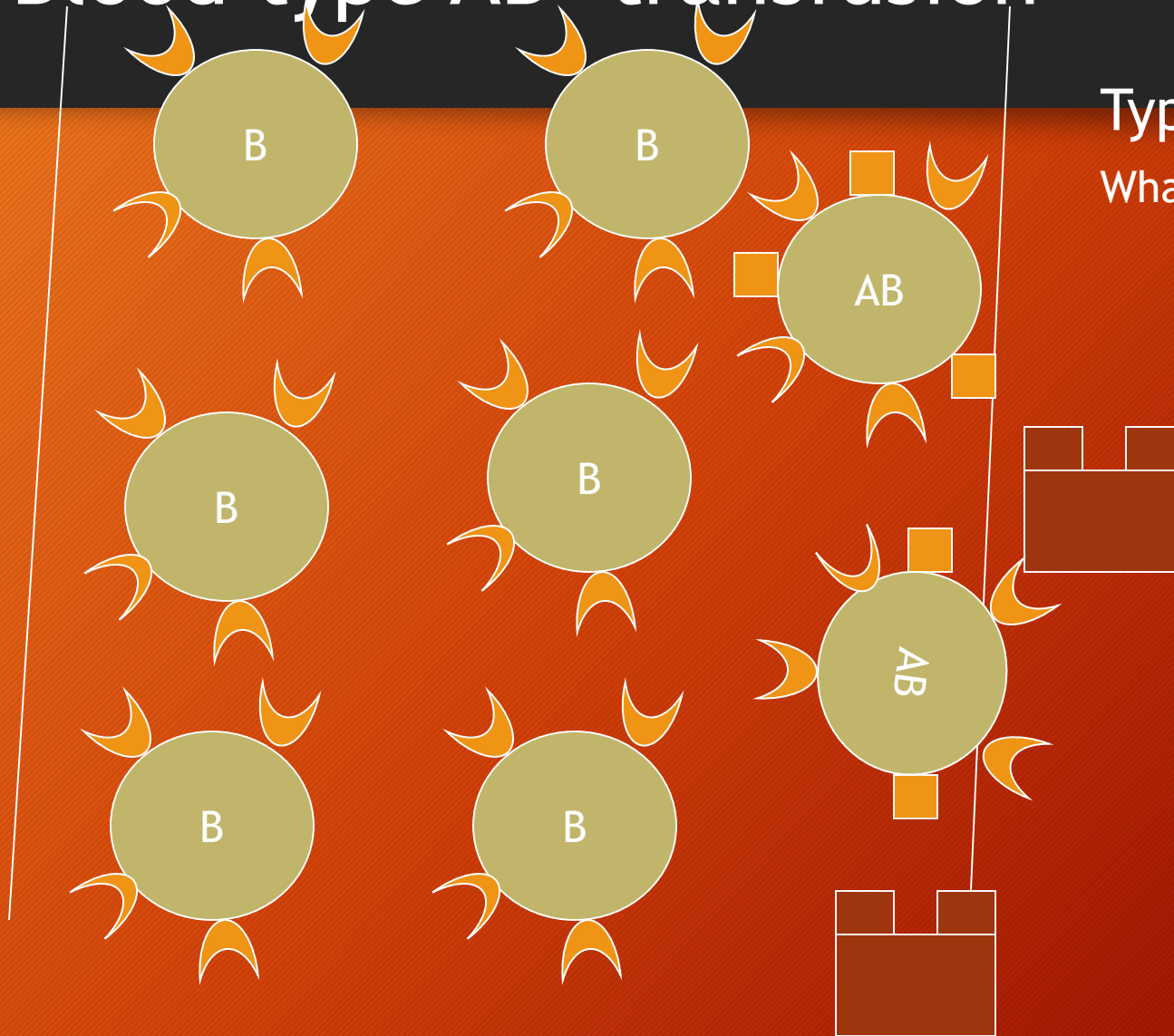
# Blood type AB- transfusion

Type AB-?

What is on Type AB- blood?

A & B antigen

CLUMP!



# Blood type O- transfusion

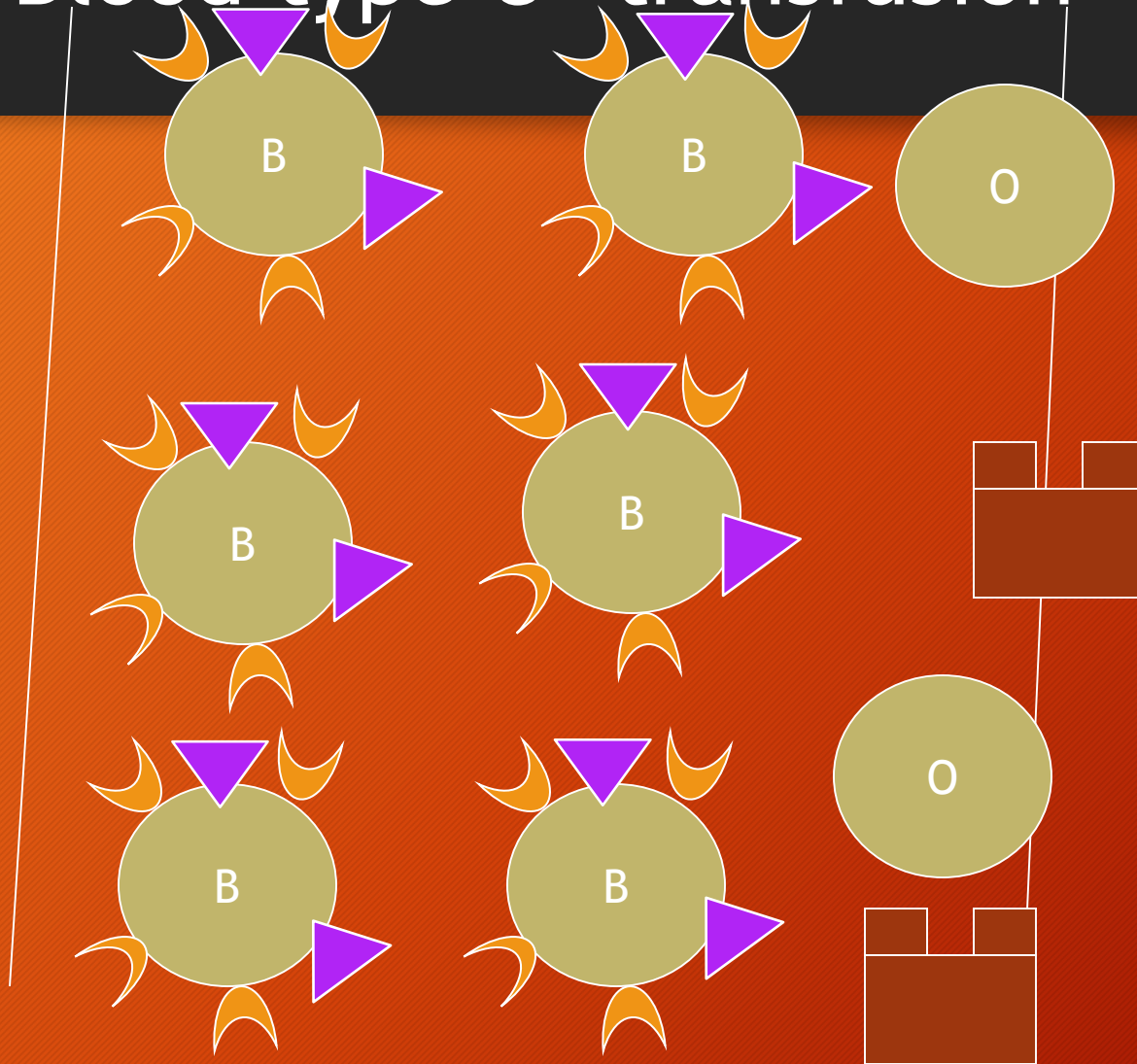
Type O-?

What is on Type O- blood?

No antigen

Anti A Antibody in type B blood

**NO CLUMPING!**



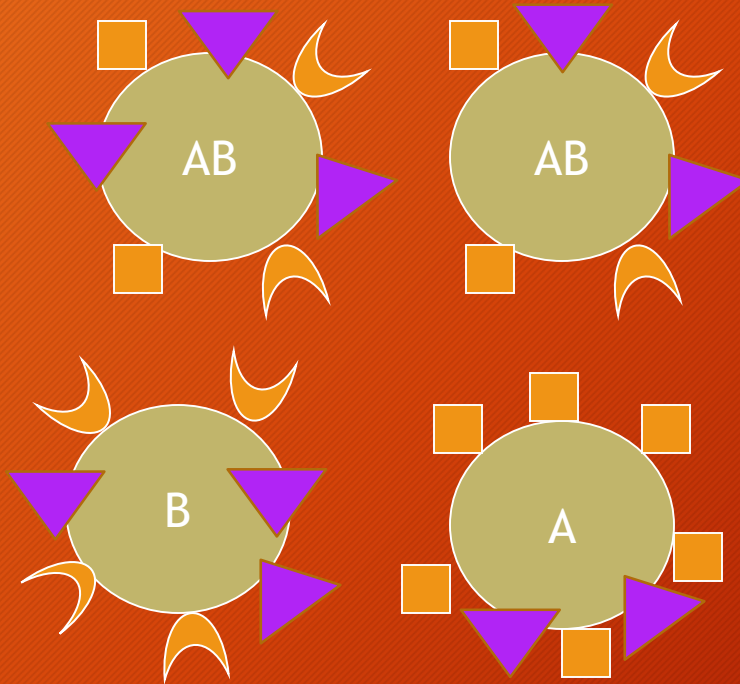
# Therefore

- You can only donate type B- and B- blood and type O- and O+ blood to type B+ blood.



# What about type AB+?

- Who can donate to type AB+?
  - What does type AB+ blood contain?
    - A & B antigen and Rh Factor, and no antibodies

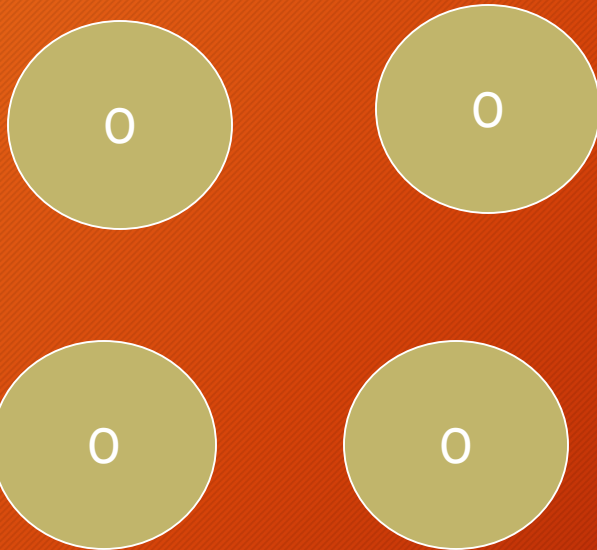


Any blood can donate to type AB+

Or known as Universal Recipient  
Because there are no antibodies to clump

# What about type O?

- Who can donate to type O-?
  - What does type O blood contain?
    - No antigens but both A & B antibodies



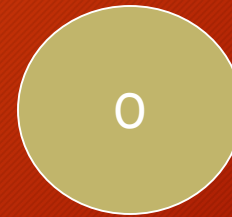
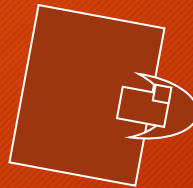
Only type O can receive type O blood because type O has Both antibodies.

It will cause clumping if any A or B or both A & B blood comes in contact with type O.

# But who can type O donate to?

Hmph...nothing  
to bind to

- Since type O- doesn't have any antigens, type O- can donate to any blood type because other blood types do not have the antibodies AGAINST type O-



# Summary

Universal Donor

## RED BLOOD CELL COMPATIBILITY TABLE

Recipient	Donor							
	O-	O+	A-	A+	B-	B+	AB-	AB+
O-	✓	✗	✗	✗	✗	✗	✗	✗
O+	✓	✓	✗	✗	✗	✗	✗	✗
A-	✓	✗	✓	✗	✗	✗	✗	✗
A+	✓	✓	✓	✓	✗	✗	✗	✗
B-	✓	✗	✗	✗	✓	✗	✗	✗
B+	✓	✓	✗	✗	✓	✓	✗	✗
AB-	✓	✗	✓	✗	✓	✗	✓	✗
AB+	✓	✓	✓	✓	✓	✓	✓	✓

Universal Recipient

*It takes **all** types.*

<b>TYPE</b>	<b>YOU CAN GIVE BLOOD TO</b>	<b>YOU CAN RECEIVE BLOOD FROM</b>
<b>A+</b>	<b>A+, AB+</b>	<b>A+, A-, O+, O-</b>
<b>O+</b>	<b>O+, A+, B+, AB+</b>	<b>O+, O-</b>
<b>B+</b>	<b>B+, AB+</b>	<b>B+, B-, O+, O-</b>
<b>AB+</b>	<b>AB+</b>	<b>EVERYONE</b>
<b>A-</b>	<b>A+, A-, AB+, AB-</b>	<b>A-, O-</b>
<b>O-</b>	<b>EVERYONE</b>	<b>O-</b>
<b>B-</b>	<b>B+, B-, AB+, AB-</b>	<b>B-, O-</b>
<b>AB-</b>	<b>AB+, AB-</b>	<b>AB-, A-, B-, O-</b>

# Blood type percentages in Canada

Source: Canadian Blood services

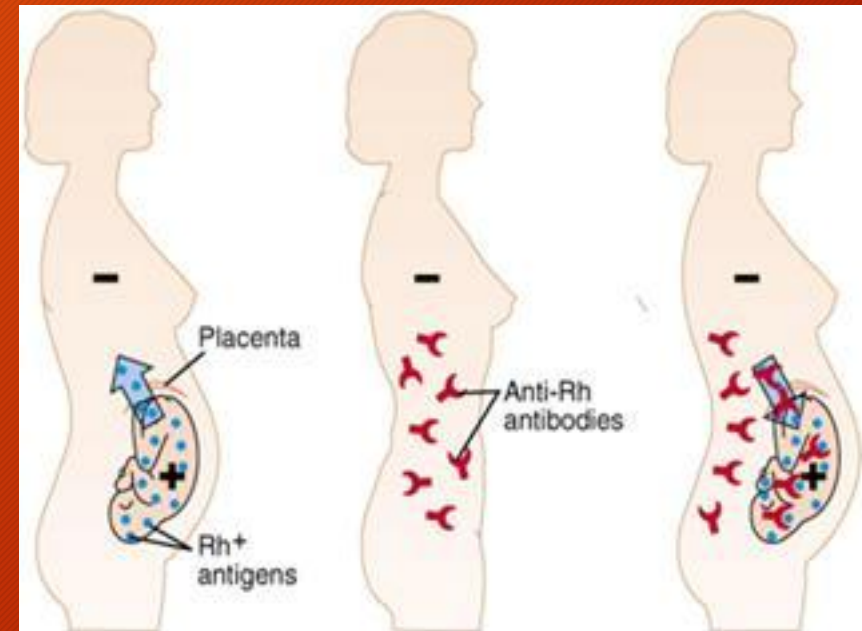
	Total	Break down from each blood type
A+	42%	36%
A-		6%
B+	9%	7.6%
B-		1.4%
AB+	3%	2.5%
AB-		0.5%
O+	46%	39%
O-		7%

Universal Recipient

Universal Donor

# Rh Factor - Hemolytic Disease of Newborn

- Occurs during pregnancies
- If Mother is Rh- and child is Rh+ (got it from the father), the blood from the child could cross the placenta and transfuse into mother.
- The foreign blood of the child with Rh+ antigen will cause the mother to make antibodies against the antigen.



- Doesn't affect the current baby, because the mother does not have the antibodies *yet*.
- But in later pregnancies, the new developed antibodies could cross the blood lining and get into the baby's blood stream.
- Causing swelling and anemia by attacking the baby's red blood cells



An Rh<sup>+</sup> man and an Rh<sup>-</sup> woman could have an Rh<sup>+</sup> baby.



First pregnancy: At birth some of the Rh<sup>+</sup> blood of the fetus may enter the mother's circulation.

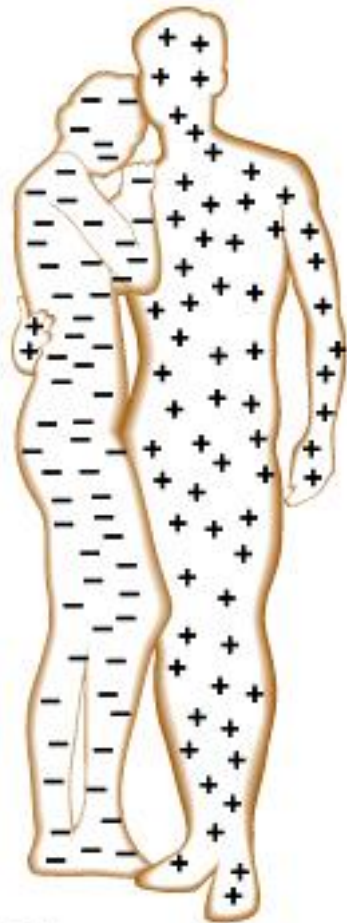


After delivery: The mother forms anti-Rh antibodies over the next few months.



Second pregnancy with an Rh<sup>+</sup> fetus: Anti-Rh antibodies may pass into the fetus's blood, causing its blood cells to burst.





**Rh-negative woman and Rh-positive man conceive a child**



**Rh-negative woman with Rh-positive fetus**



**Cells from Rh-positive fetus enter woman's bloodstream**



**Woman becomes sensitized—antibodies (◆) form to fight Rh-positive blood cells**



**In the next Rh-positive pregnancy, maternal antibodies attack fetal red blood cells**

Rh-positive father

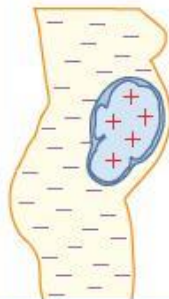


Rh-negative mother



during pregnancy

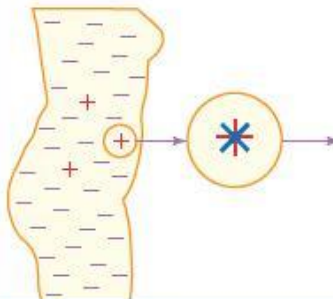
Rh-negative mother with Rh-positive baby



at delivery

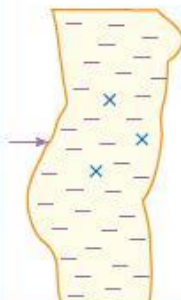
Rh-positive baby's blood cells enter mother's bloodstream

invading Rh-positive blood cells cause the production of Rh antibodies



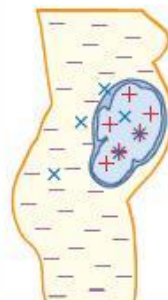
months later

Rh antibodies remain in mother's bloodstream



later pregnancy

the Rh antibodies attack the baby's blood cells, causing Rh disease

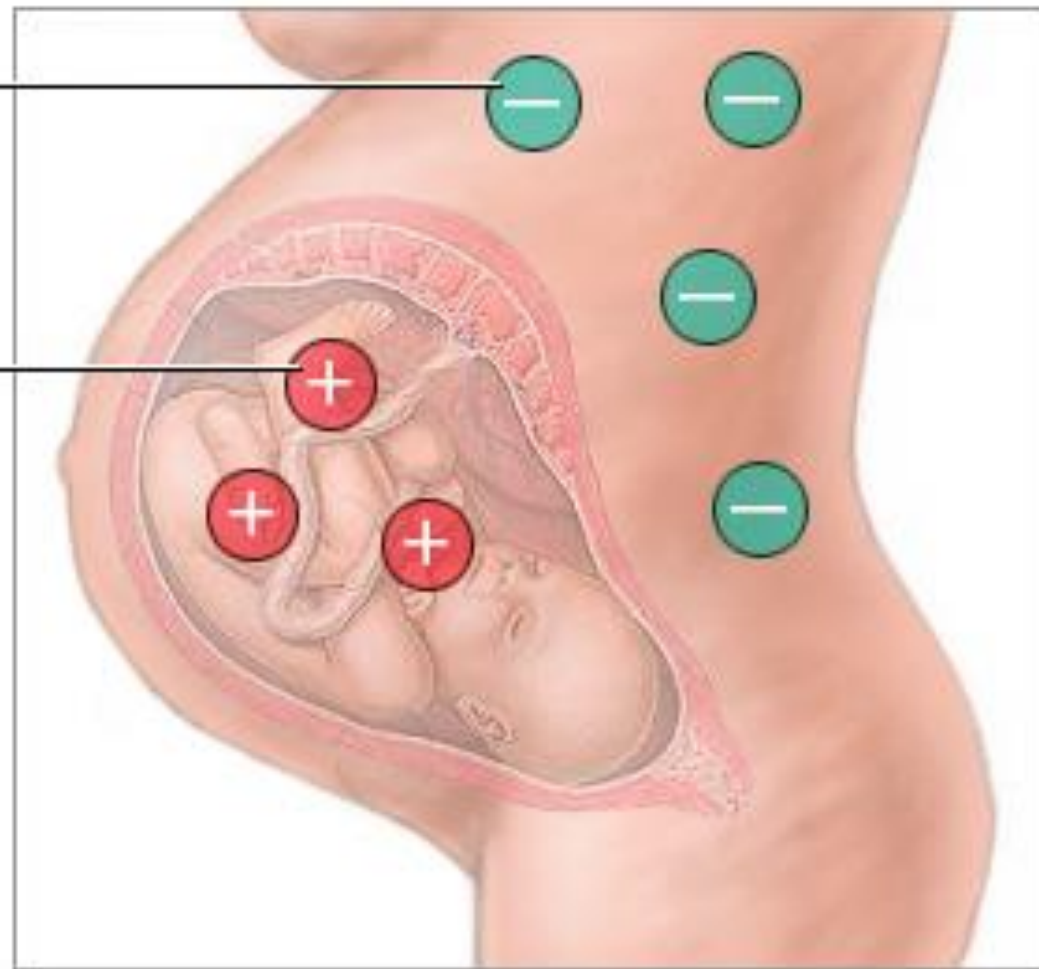


# Treatment to Rh problem

- Inject mother with Rh immunoglobulin (antibody) at 28 weeks gestation and within 72 hours of delivery.
- Prevents antibodies from being formed in the mother.

Rh negative  
blood cell

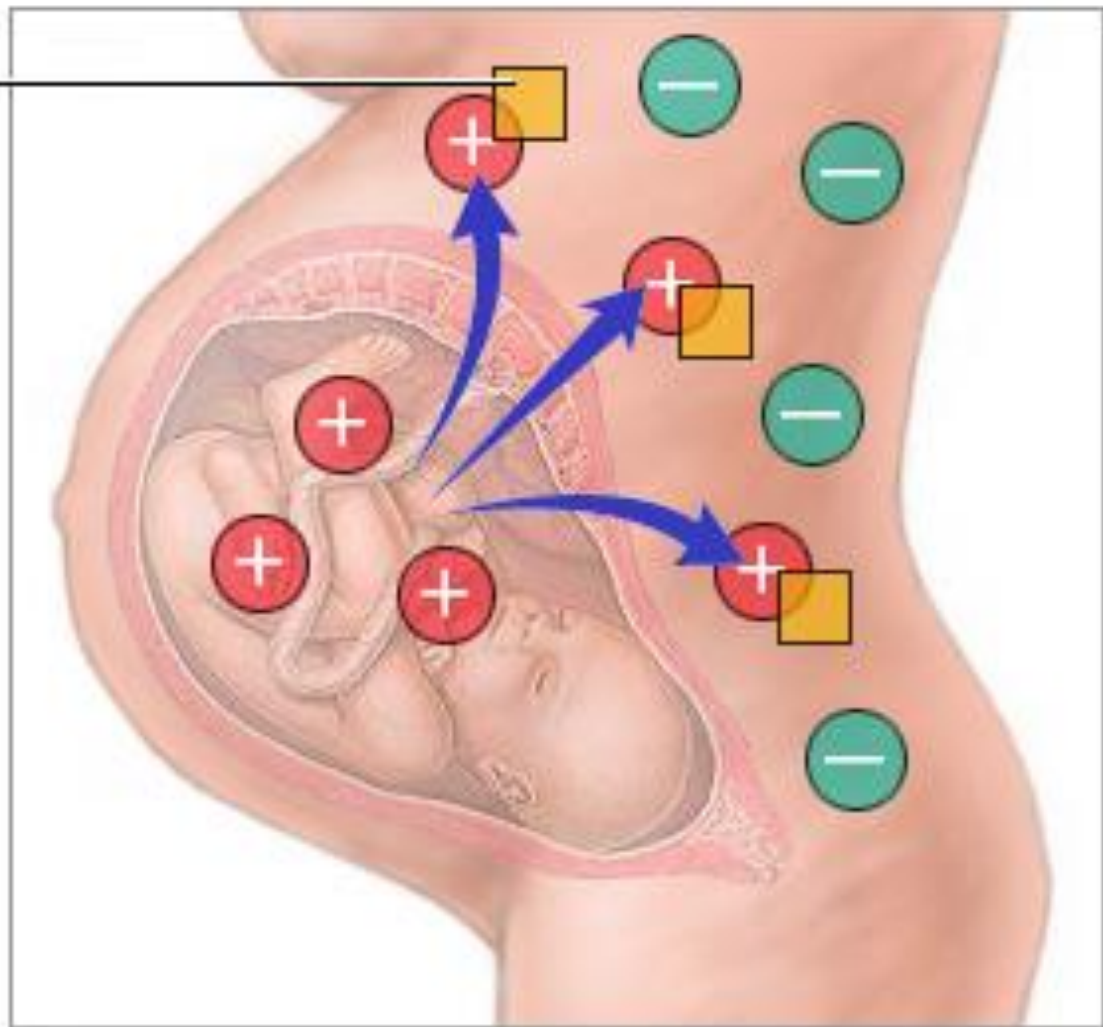
Rh positive  
blood cell



ADAM.

Mother is Rh- and child is Rh+

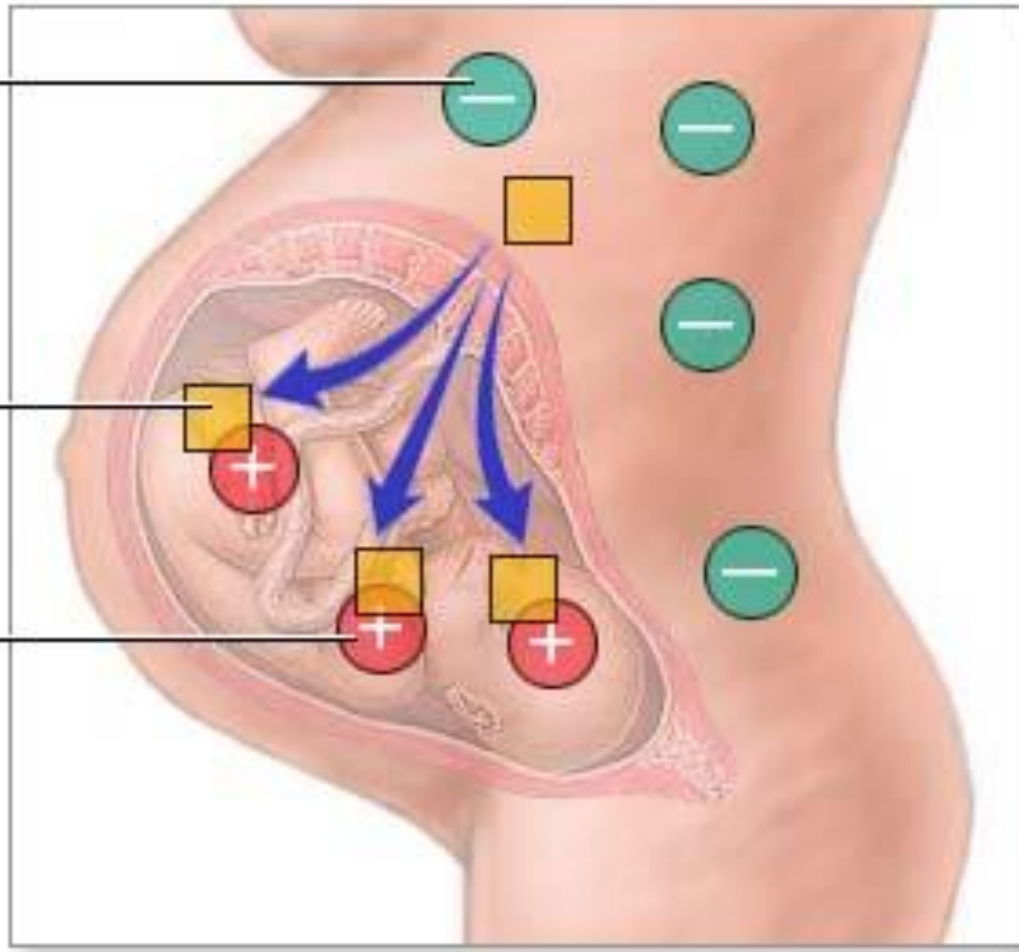
Antibody



Rh negative  
blood cell

Antibody

Rh positive  
blood cell



nancy

# Questions

- 1. Your blood typing test shows clumping in your anti-A serum but not anti-B, what blood type do you have?
- 2. Your blood typing test shows clumping in both your anti-A and anti-B serum, what blood type do you have?
- 3. Your blood typing test did not show any clumping in both anti-A and anti-B serum, what blood type do you have?
- 4. You want to donate blood to your brother who has type B blood, what blood type do you have to be to donate blood to him?
- 5. You want to donate blood to your sister who has type AB blood, what blood type do you have to be?
- 6. What are antigens and antibodies in blood clumping sense?
- 7. You have type O blood, who can you donate your blood to?
- 8. What kind of antibodies do you have in type AB blood, type O blood and type A blood?
- 9. What kind of antigens are found on the surface of type A, B, AB, and O red blood cells?
- 10. You did a blood transfusion on a patient, and his blood clumped. You found out he has type B blood, what could have been the blood types that caused this clumping?

# Answers

- 1. O-
- 2. B- or O-
- 3. A- or O-
- 4. All
- 5. A B AB O negatives
- 6. A +/-
- 7. A- B - AB- O-
- 8. O-
- 9. B+/- O+/-
- 10. A+/- O+/-