قسم الكيمياء الحيوية
Biochemistry Department

جامعة الملك سعود
King Saud University
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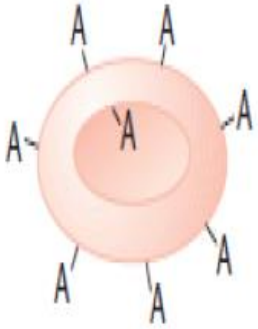
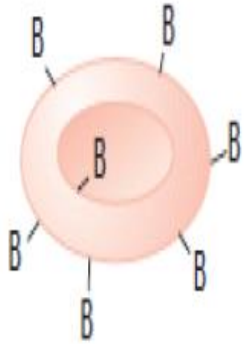
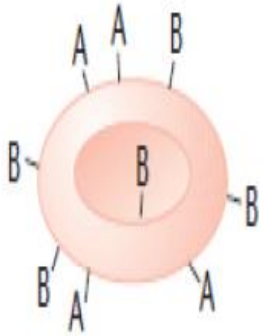
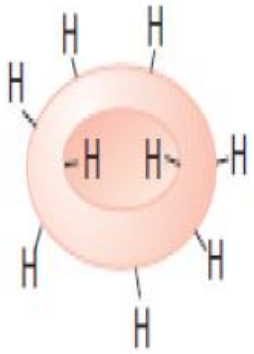
كلية العلوم

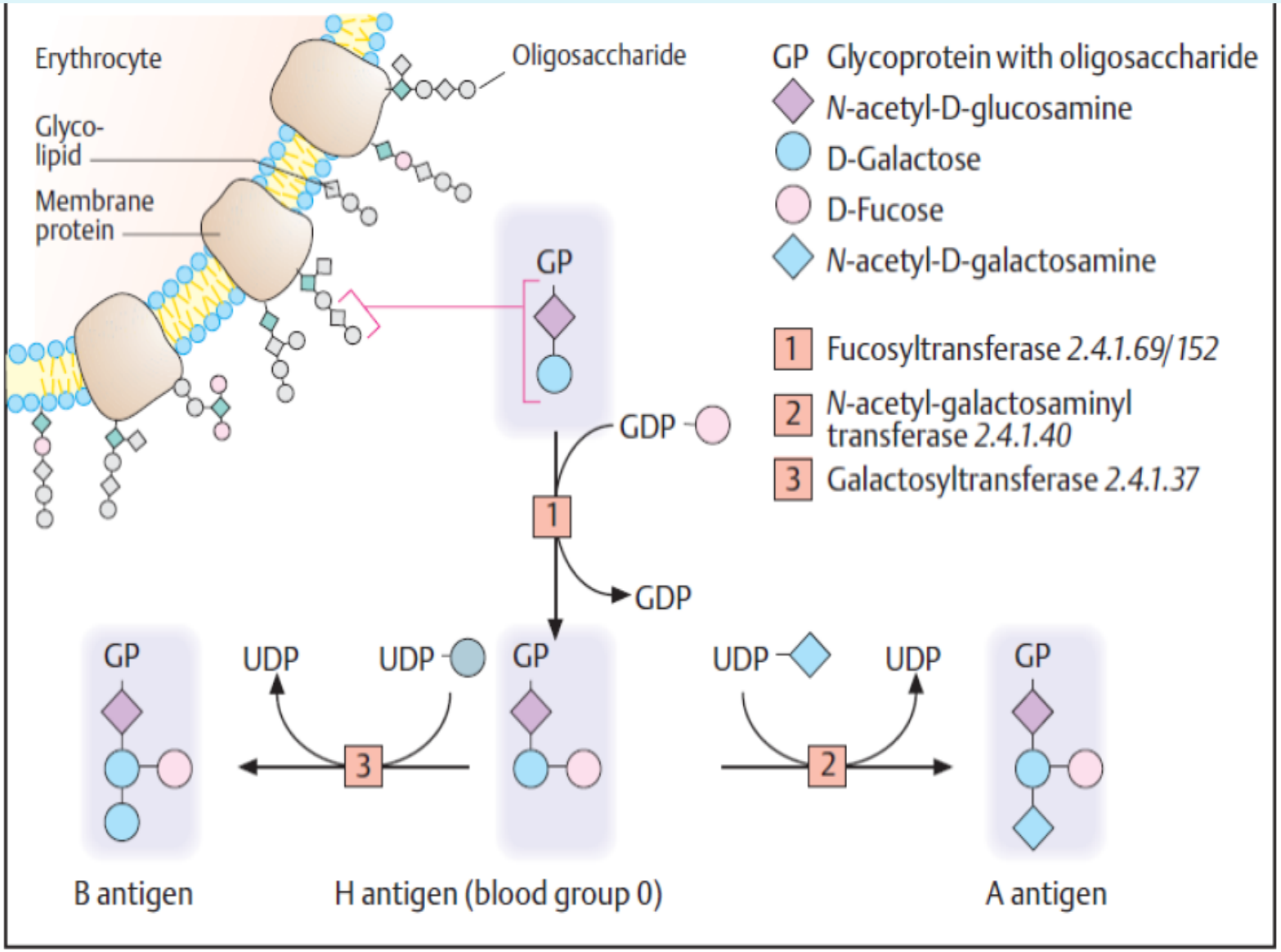
Blood Groups

Blood Groups (ABO system)

During blood transfusions, immune reactions can occur that destroy the erythrocytes transfused from the donor. These reactions result from the formation of antibodies directed to certain surface structures on the erythrocytes. Known as blood group antigens, these are proteins or oligosaccharides that can differ from individual to individual. More than 20 different blood group systems are now known. The ABO system and the Rh system are of particular clinical importance.

B. Blood groups: the ABO system

Blood group	A	B	AB	O
Genotypes	AA and AO	BB and BO	AB	OO
Antigens				
Antibodies in blood	anti-B	anti-A	—	anti-A anti-B


Erythrocyte
Oligosaccharide
Glyco-
lipid
Membrane
protein
GP
GDP
1
GDP
GP
UDP
UDP
3
GP
UDP
UDP
2
GP
B antigen
H antigen (blood group 0)
A antigen
GP Glycoprotein with oligosaccharide
N-acetyl-D-glucosamine
D-Galactose
D-Fucose
N-acetyl-D-galactosamine
1 Fucosyltransferase 2.4.1.69/152
2 N-acetyl-galactosaminyl transferase 2.4.1.40
3 Galactosyltransferase 2.4.1.37

In the ABO system, the carbohydrate parts of glycoproteins or glycolipids act as antigens. There are four blood groups (A, B, AB, and 0). In individuals with blood groups A and B, the antigens consist of tetra saccharides that only differ in their terminal sugar (galactose or N-acetylgalactosamine). Carriers of the AB blood group have both antigens (A and B). Blood group 0 arises from an oligosaccharide (the H antigen) that lacks the terminal residue of antigens A and B. The molecular causes for the differences between blood groups are mutations in the glycosyl transferases that transfer the terminal sugar to the core oligosaccharide.

- **Carriers of blood group A form antibodies against antigen B (“anti-B”), while carriers of group B form antibodies against antigen A (“anti-A”). Individuals with blood group 0 form both types, and those with blood group AB do not form any of these antibodies.**
- **If blood from blood group A is transfused into the circulation of an individual with blood group B, for example, then the anti-A present there binds to the A antigens.**

The donor erythrocytes marked in this way are recognized and destroyed by the complement system. In the test tube, agglutination of the erythrocytes can be observed when donor and recipient blood are incompatible. The recipient's serum should not contain any antibodies against the donor erythrocytes, and the donor serum should not contain any antibodies against the recipient's erythrocytes. Donor blood from blood group 0 is unproblematic, as its erythrocytes do not possess any antibodies and therefore do not react with anti- A or anti-B in the recipient's blood. Conversely, blood from the AB group can only be administered to recipients with the AB group, as these are the only ones without antibodies.

Rh system: Proteins on the surface of the erythrocytes act as antigens. These are known as “rhesus factors,” as the system was first discovered in rhesus monkeys. The rhesus D antigen occurs in 84% of all white individuals, who are therefore “Rh positive.” If an Rh-positive child is born to an Rh negative mother, fetal erythrocytes can enter The mother’s circulation during birth and lead to the formation of antibodies (IgG) against the D antigen. This initially has no acute effects on the mother or child.

Complications only arise when there is a second pregnancy with an Rh-positive child, as maternal anti-D antibodies cross the placenta to the fetus even before birth and can trigger destruction of the child's Rh-positive erythrocytes (fetal erythroblastosis).