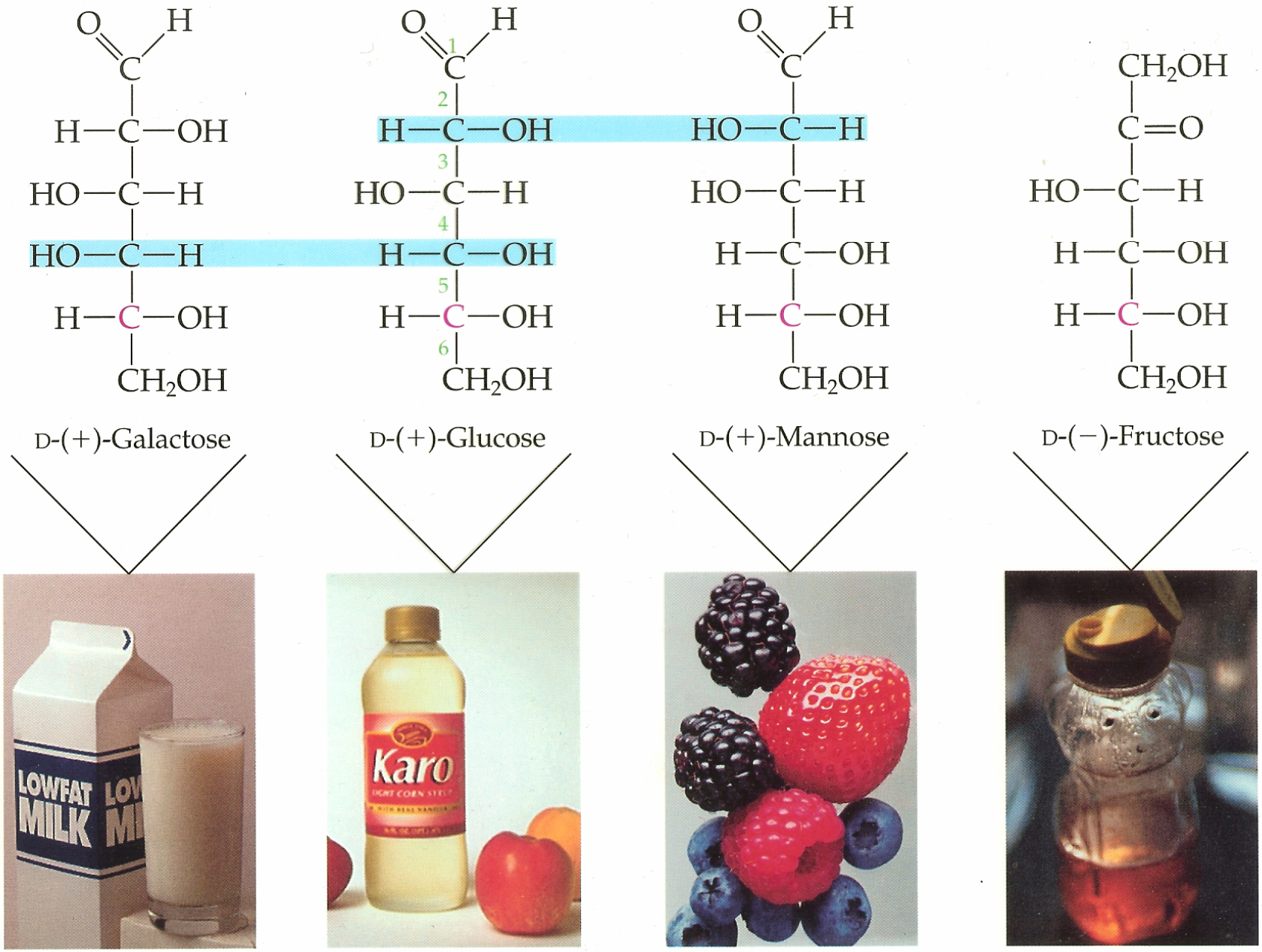
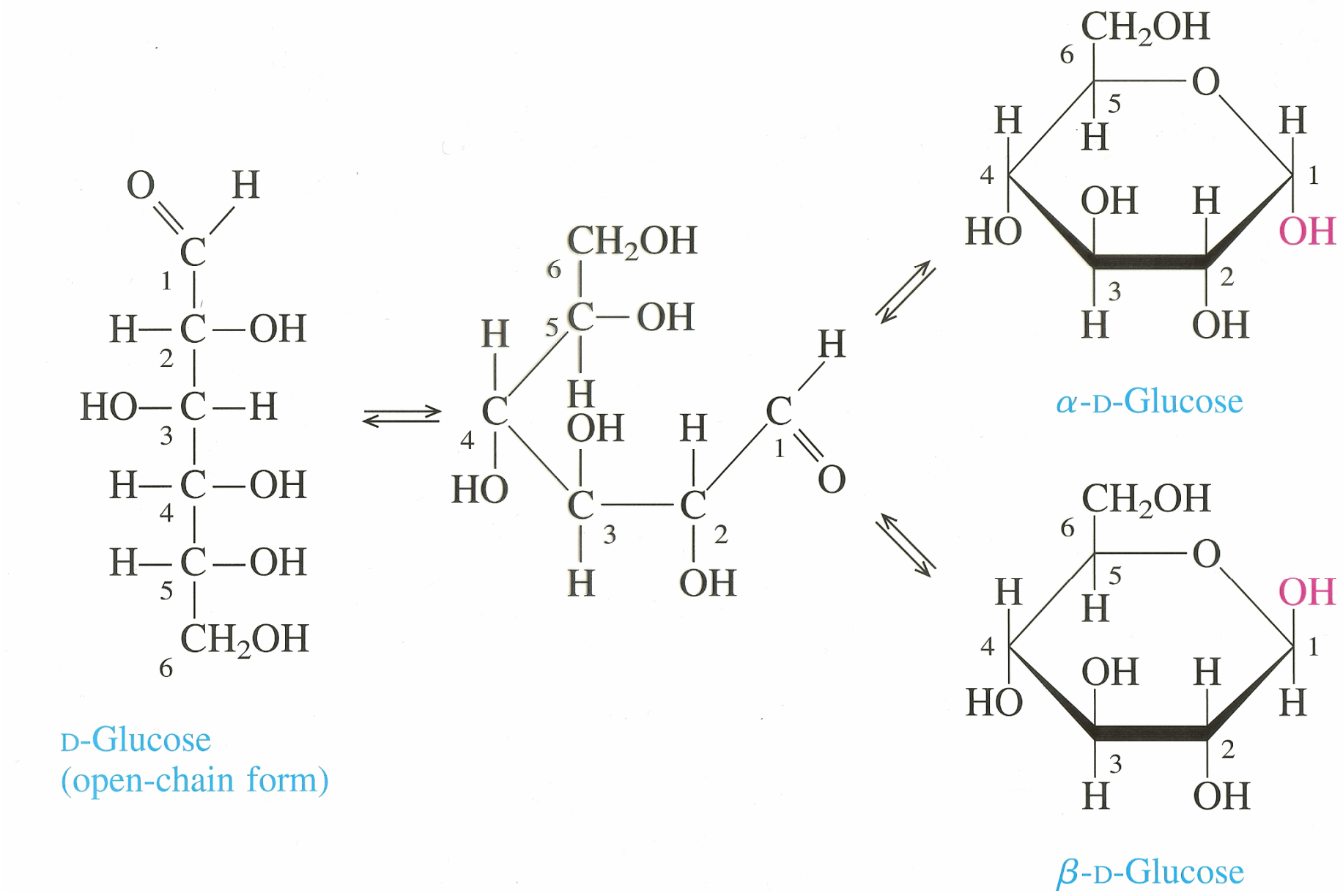
Carbohydrates

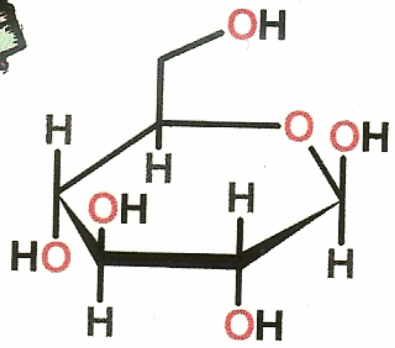
Structures of Four Important Hexoses



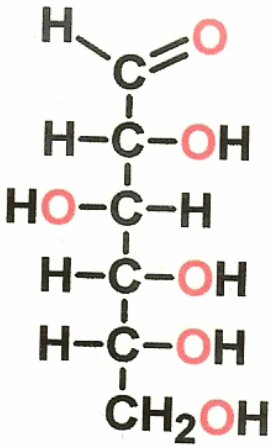
Mutarotation of Glucose



Sugar (Glucose) Conformations

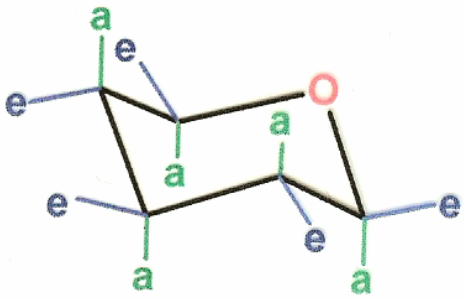


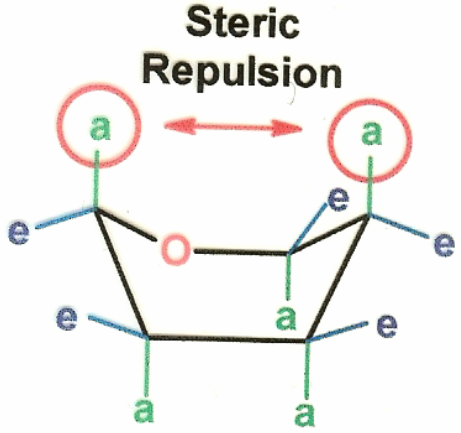
β-D-glucopyranose



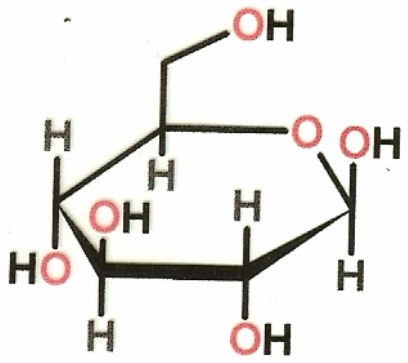
D-Glucose (aldohexose)

-But cyclic form is NOT flat!!
-Tetrahedral carbons, bent oxygen

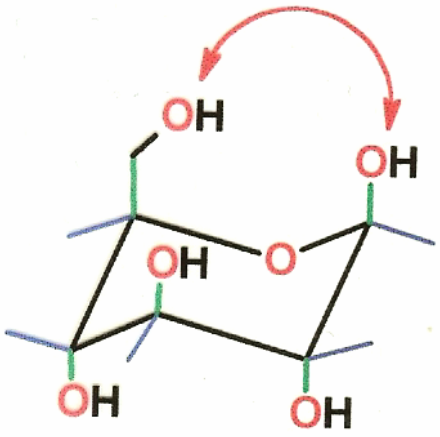




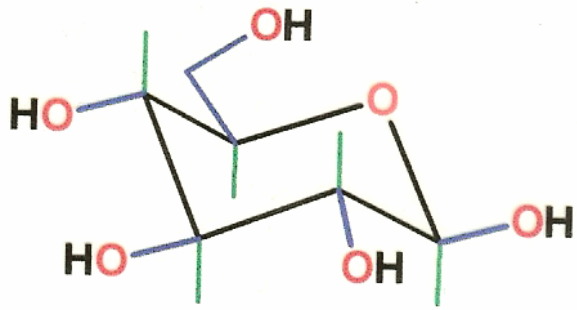
Chair conformation is predominate.



β-D-glucopyranose



More steric repulsion

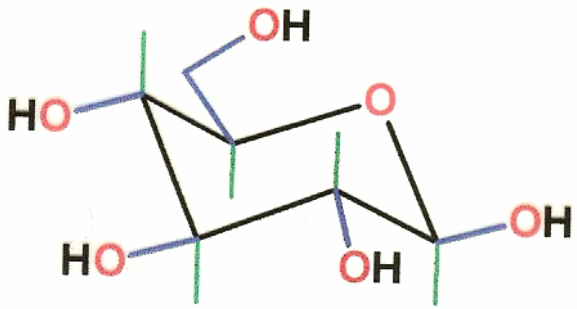


less steric repulsion

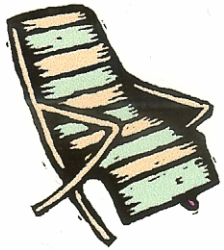
Two Possible Chair forms

(1) all substitutents (OH/CH2OH) equatorial (**Most Stable!!**)

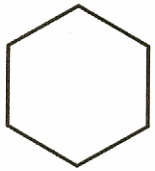
(2) all substituents (OH/CH2OH) axial (**Less Stable**)



Most stable conformation of Glucose



Cyclohexane Conformations

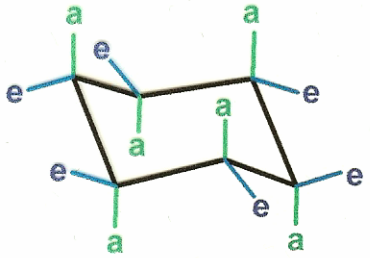


-Not really flat
-Tetrahedral Carbons

Cyclohexane

Chair Conformation

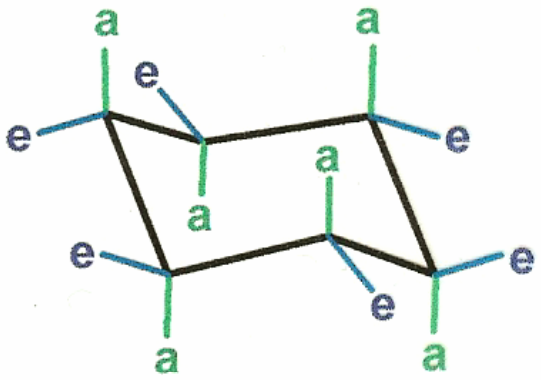
Boat Conformation



axial positions → Perpendicular to Ring Plane

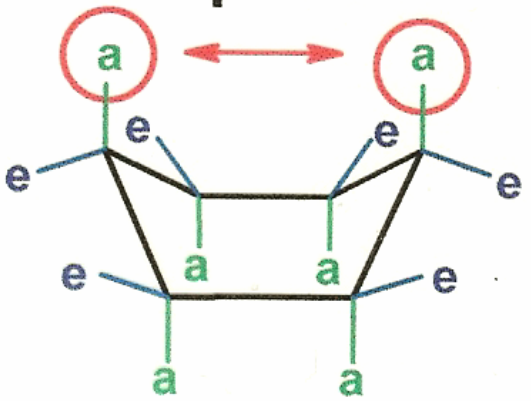
equatorial positions → ~ in Ring Plane

Chair Conformation is predominate form.



Less Steric Repulsion

High Steric Repulsion

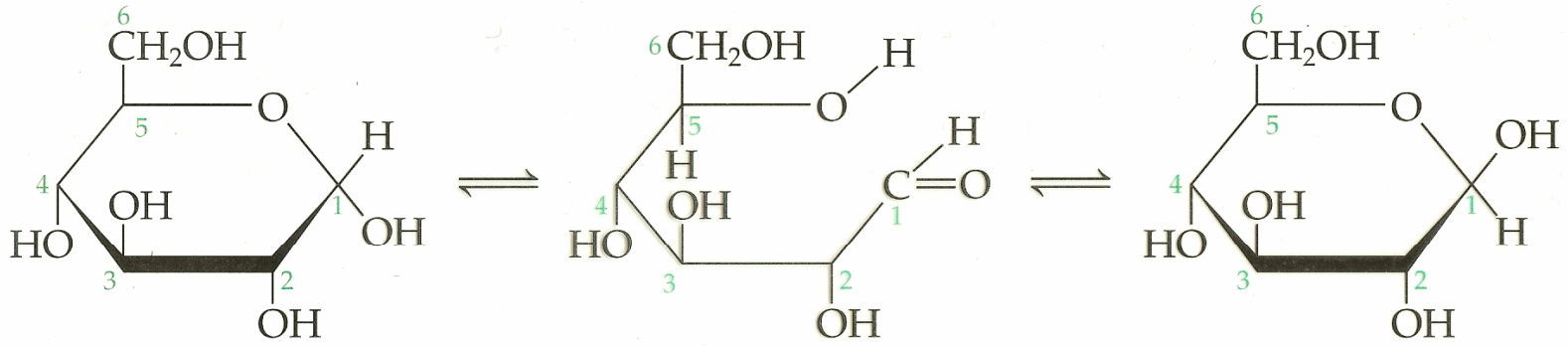


Level of steric repulsion between groups determines stability.

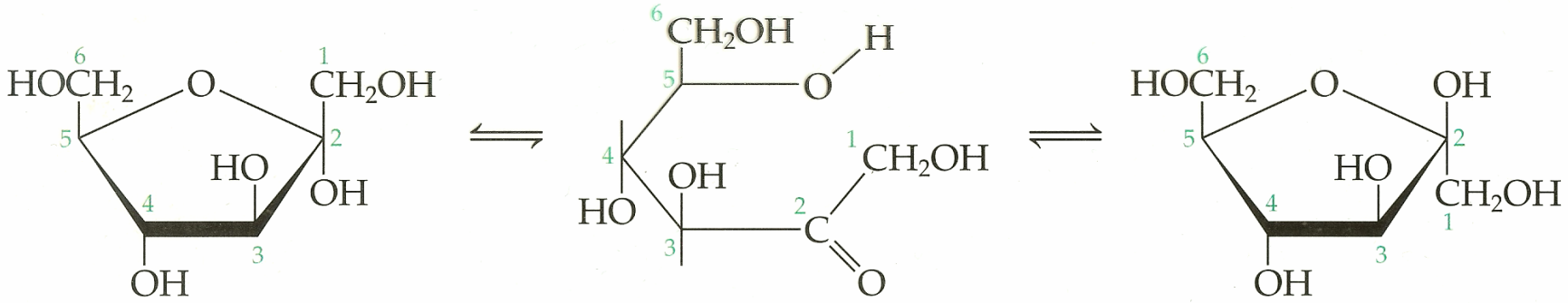
- High steric repulsion ⟶ low stability
- Low steric repulsion ⟶ high stability

T-65
Figure 19.4, p. 513

Mutarotation of Glucose and Fructose



(a) α-D-(+)-Glucose ⇌ D-(+)-Glucose ⇌ β-D-(+)-Glucose

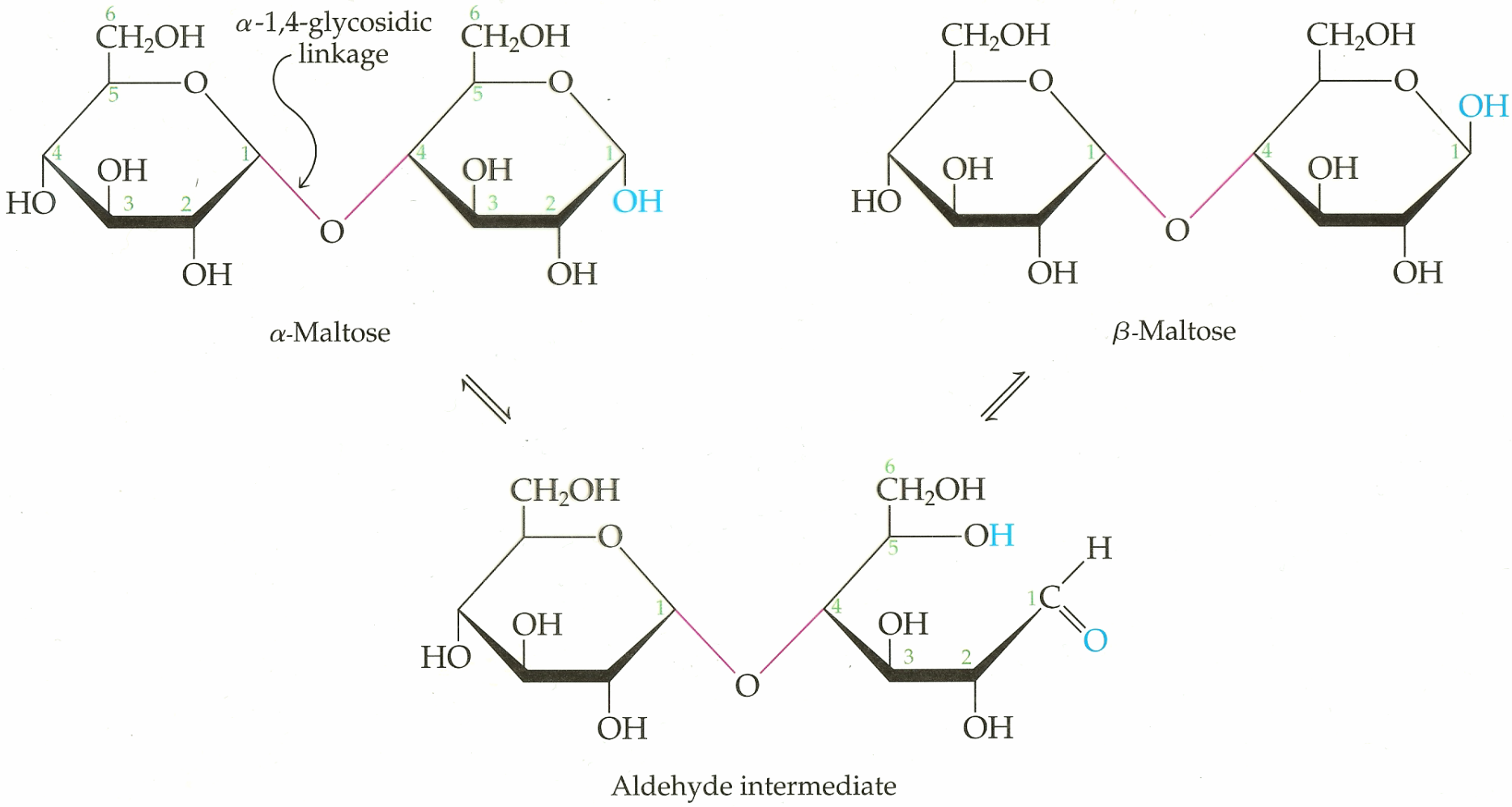


(b) α-D-(−)-Fructose ⇌ D-(−)-Fructose ⇌ β-D-(−)-Fructose

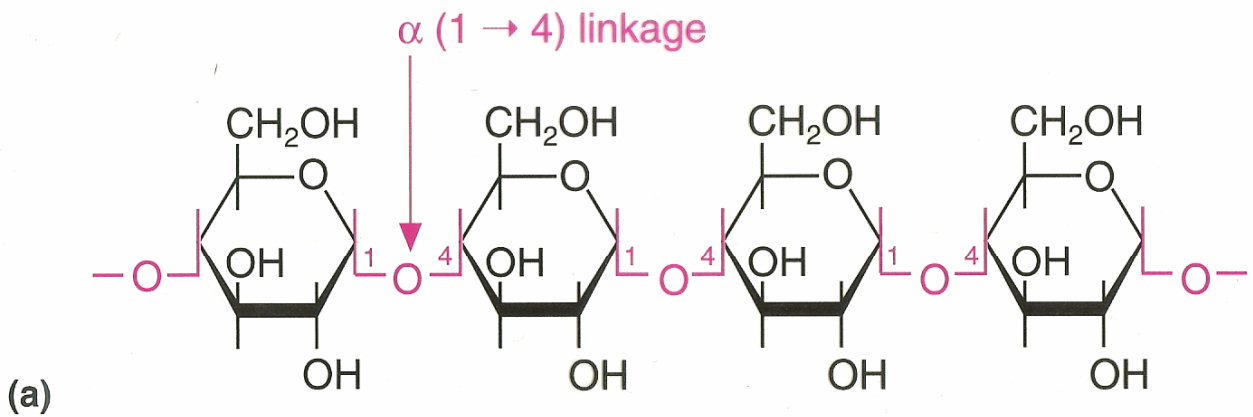
Mutarotation of Maltose

T-66
Figure 19.6, p. 516

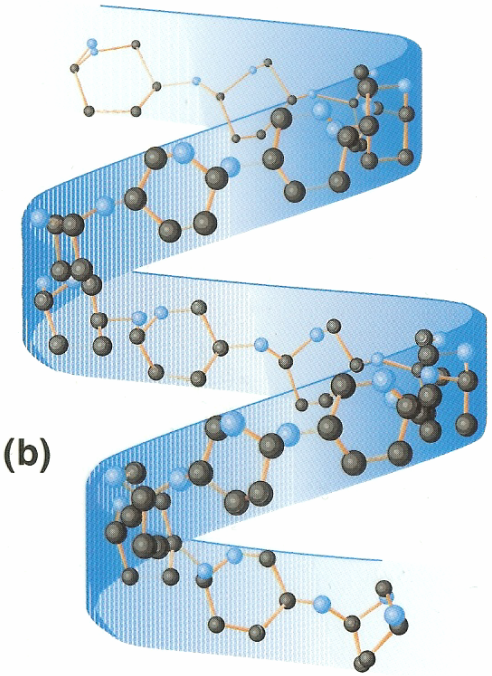
Equilibrium Mixture of Maltose Isomers



Amylose

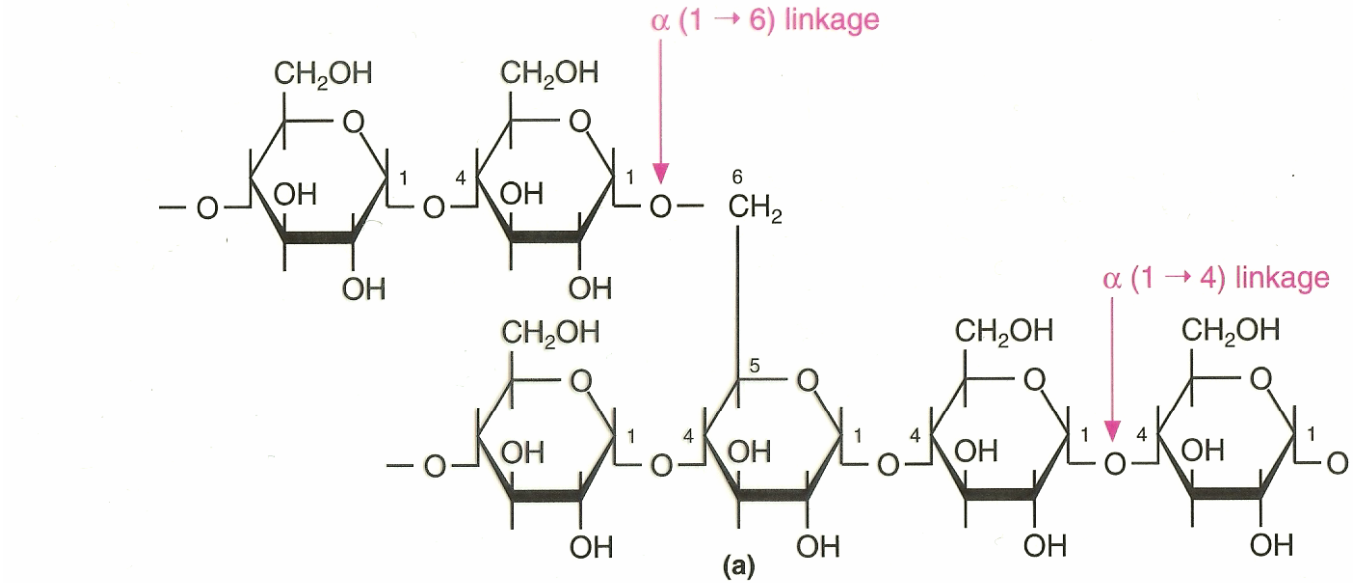


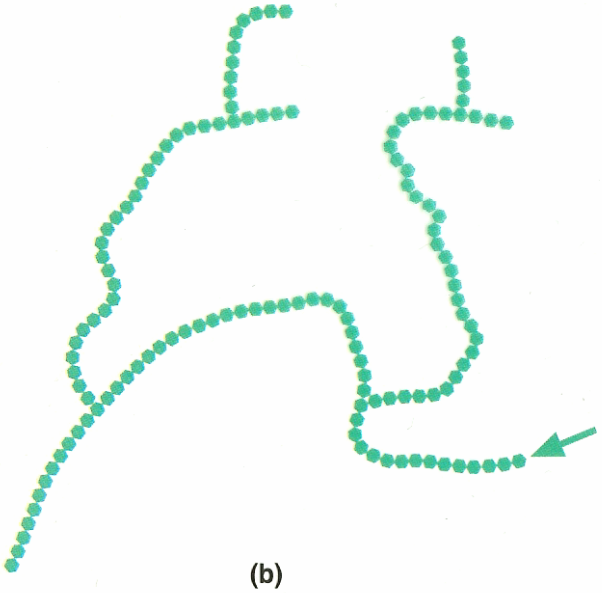
(a)

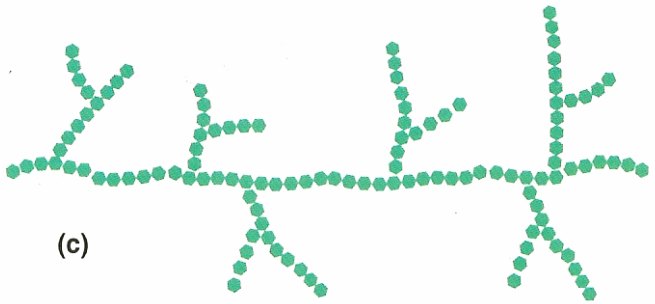


(b)

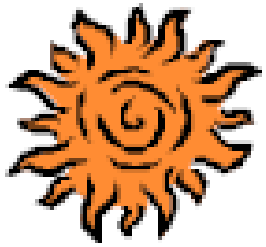
Amylopectin

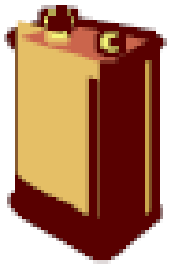


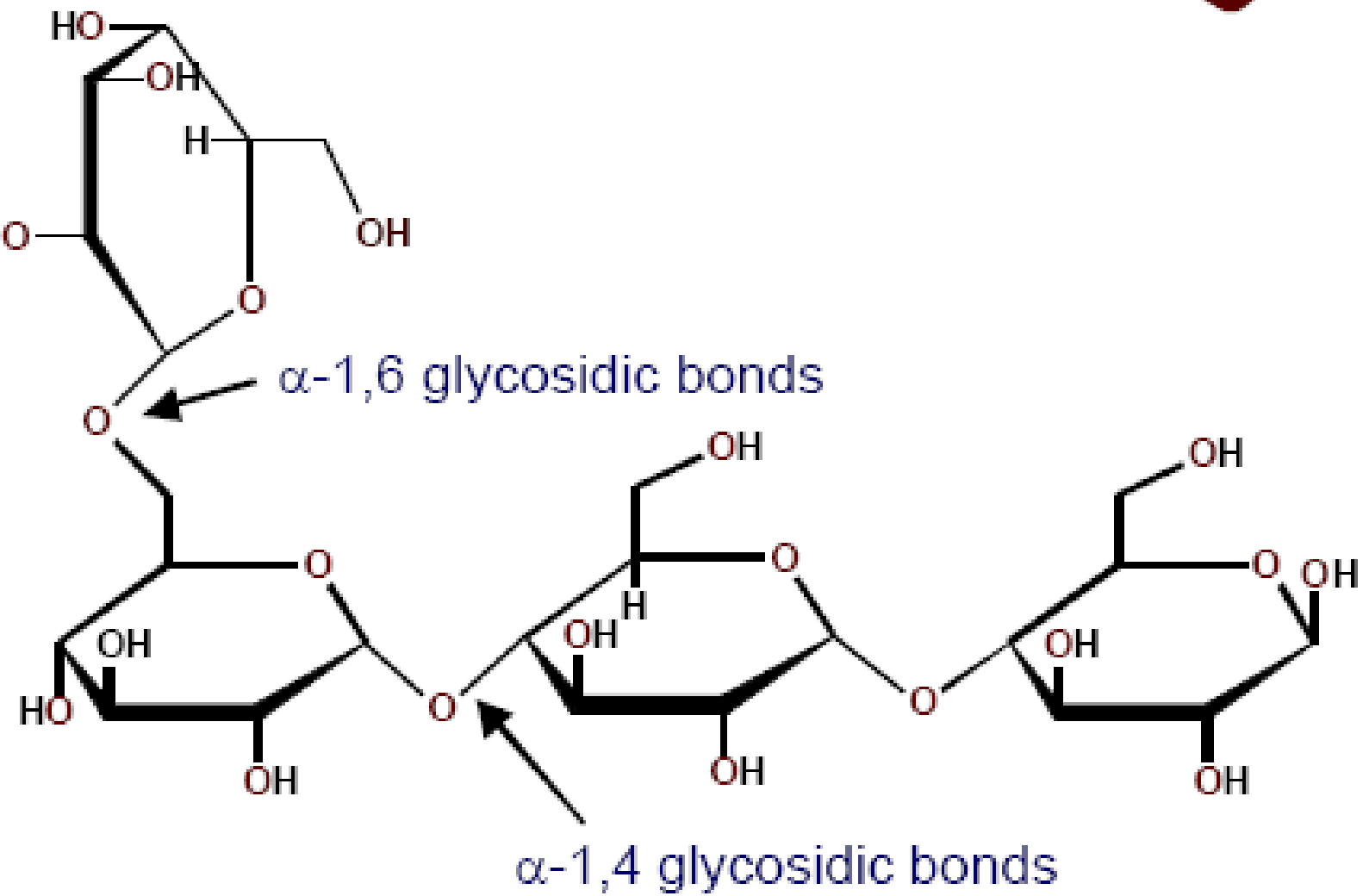




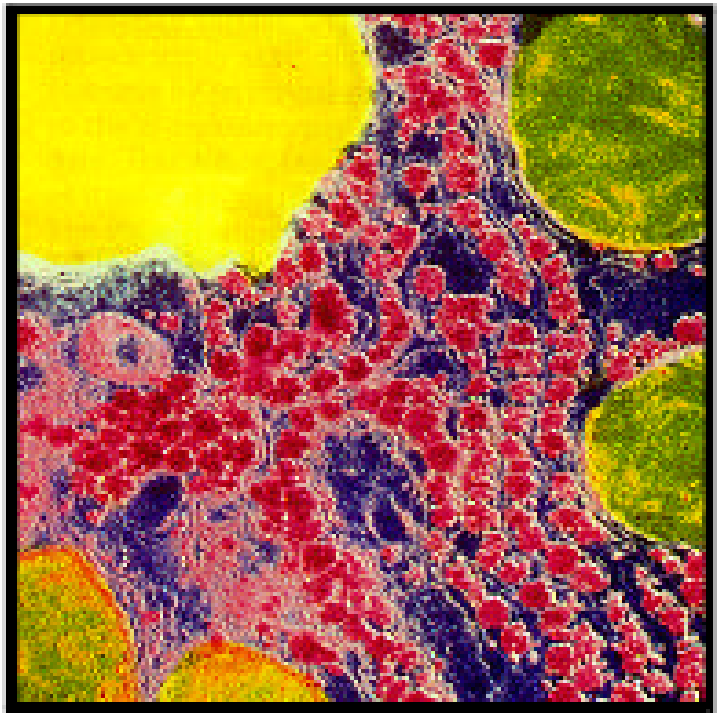
Glycogen

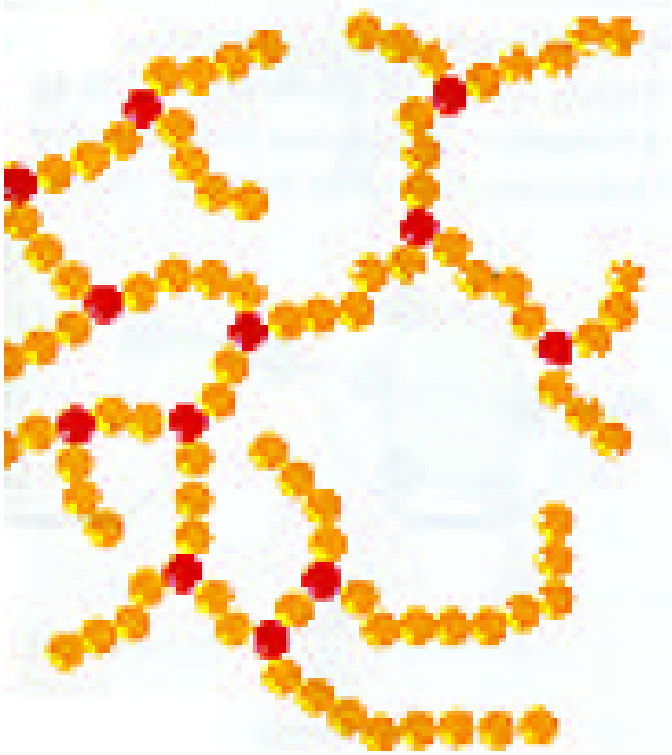





HO
OH
H
HO
OH
O
α-1,6 glycosidic bonds
O
O
OH
HO
OH
O
OH
H
OH
O
OH
O
OH
O
OH
OH
α-1,4 glycosidic bonds

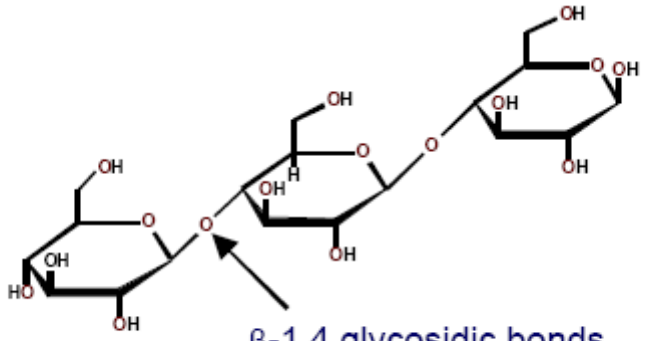
Glycogen forms long chains with many short branches.





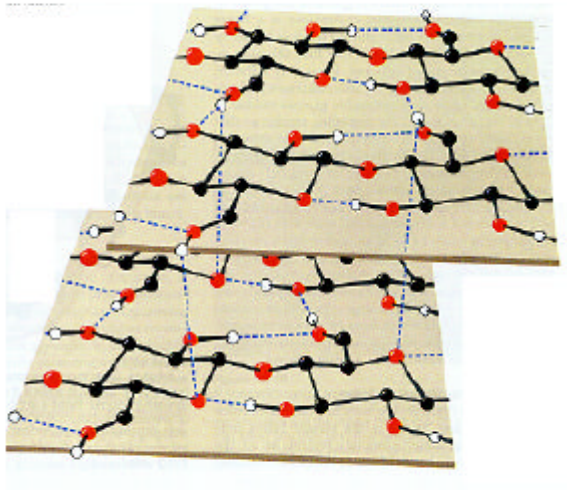
Pictures reproduced from Biochemistry, Voet/Voet

Cellulose



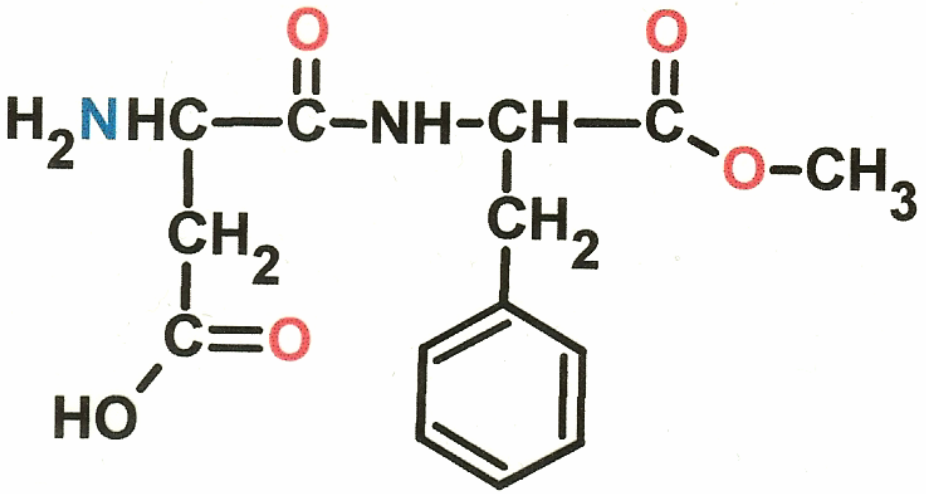
β-1,4 glycosidic bonds

Cellulose forms sheets because of extensive H-bonding between sugars.



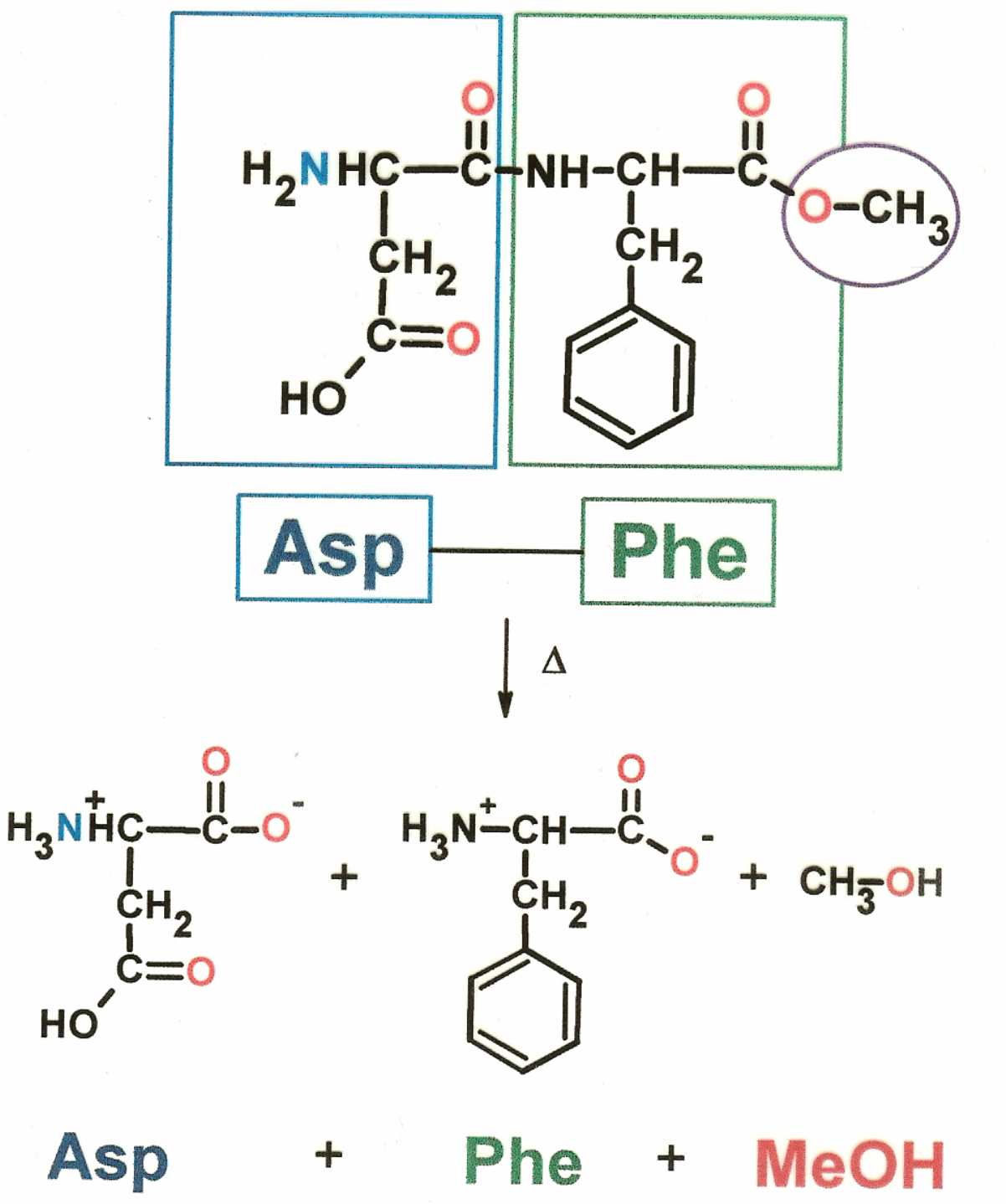
Pictures reproduced from Biochemistry, Voet/Voet

Aspartame

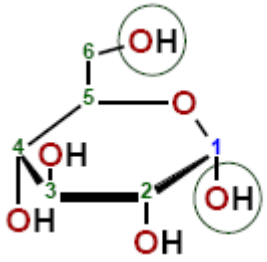


Composed of 2 amino acids
- Aspartic Acid (Asp)
- Phenylalanine (Phe)

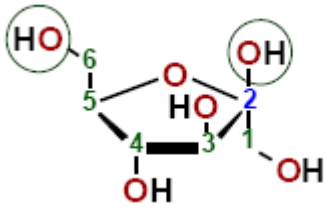
Asp tastes flat
Phe tastes bitter
But combined...
- 160X sweeter than sucrose


Asp
Phe
Δ
+
+
Asp + Phe + MeOH

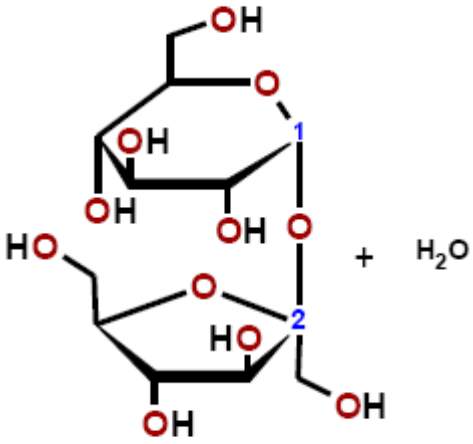
Sucrose



α-D-glucopyranose



β-D-fructofuranose



Sucrose

+ H_2O

α-1, β-2 glycosidic bond

glucose fructose

Non-reducing sugar

"head" to "head"

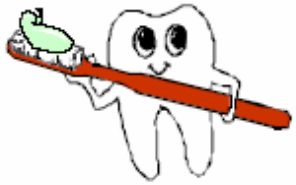
Sodium Fluoride

Used in tooth pastes to strengthen enamel and prevent decay

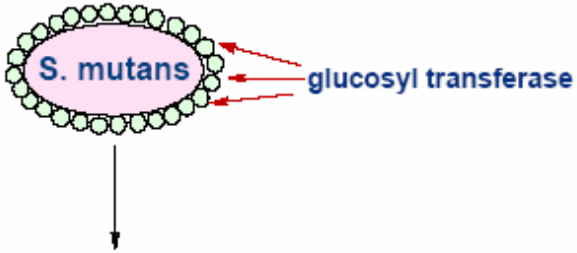
Used in blood collection tubes to preserve blood glucose and prevent ethanol production

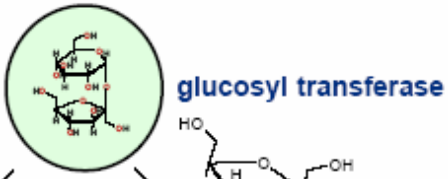
$$Na^{+} + F^{-} \longrightarrow NaF$$

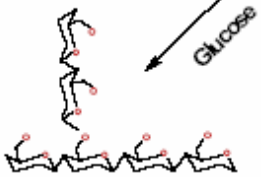
Tooth Decay



Streptococcus mutans cause of dental caries.
Uses sucrose (table sugar).







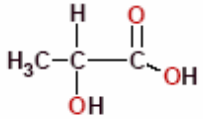
Dextran

Forms Plaque
- Adheres bacteria to tooth
- Insoluble to water

Glucose

Fructose

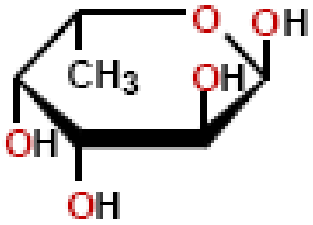
metabolism



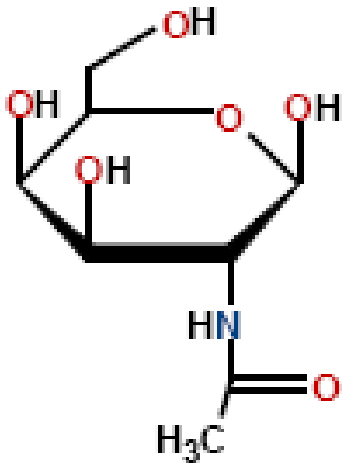
Lactic Acid

Degrades Ca^{2+} in tooth enamel

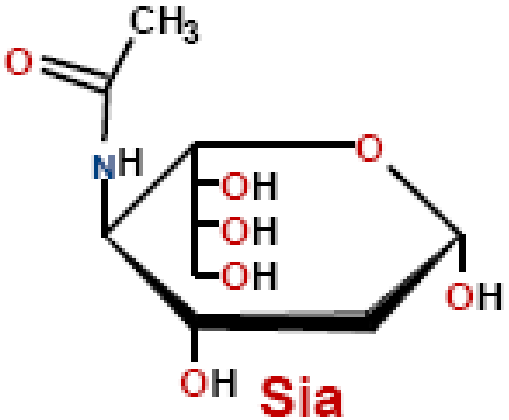
Blood Types



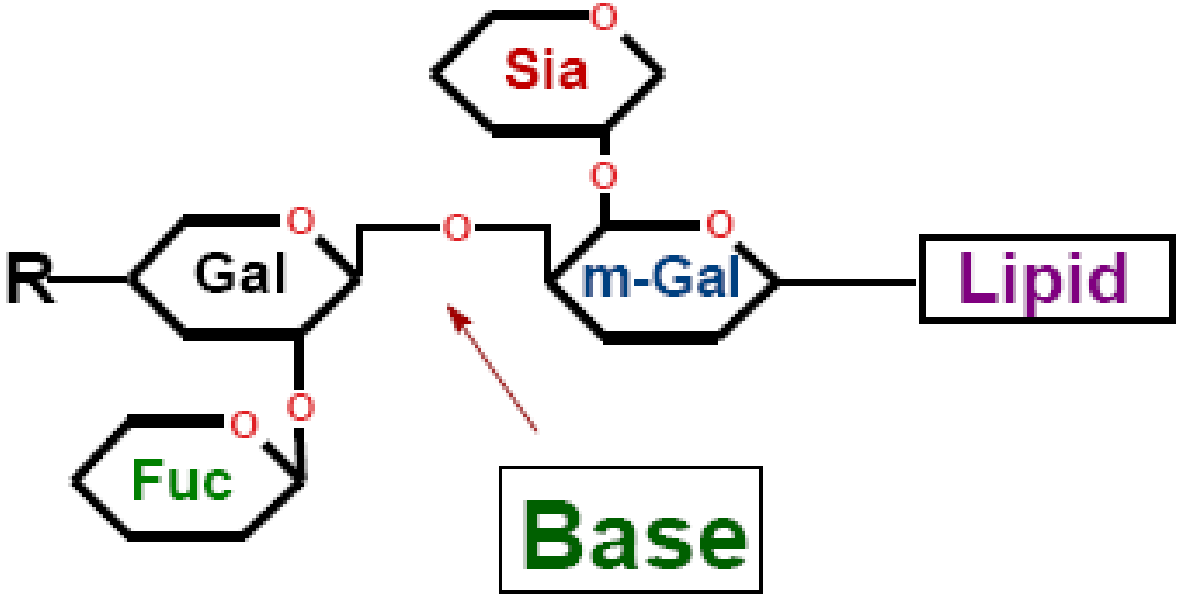
Fuc
α-L-Fucose

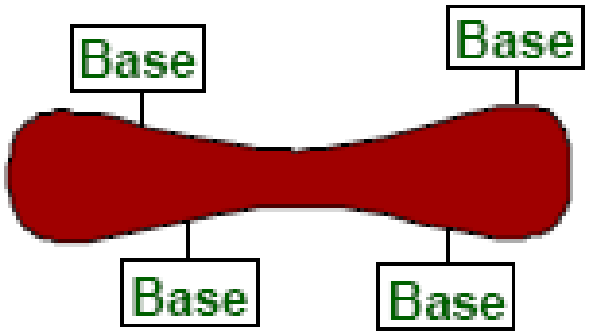


m-Gal
β-D-N-Acetylgalactosamine

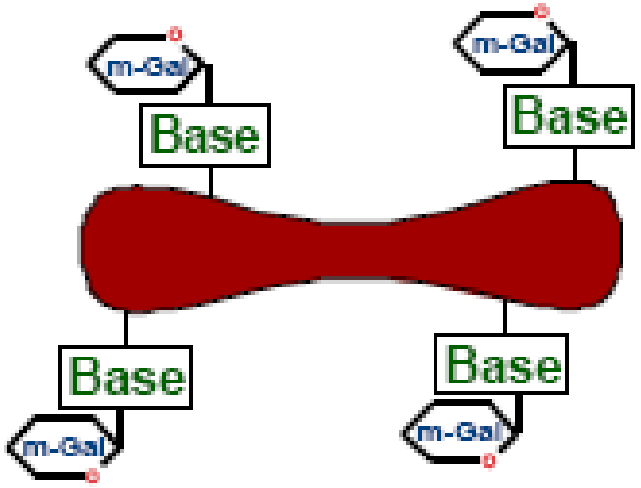


Sia
N-Acetylneuraminic acid

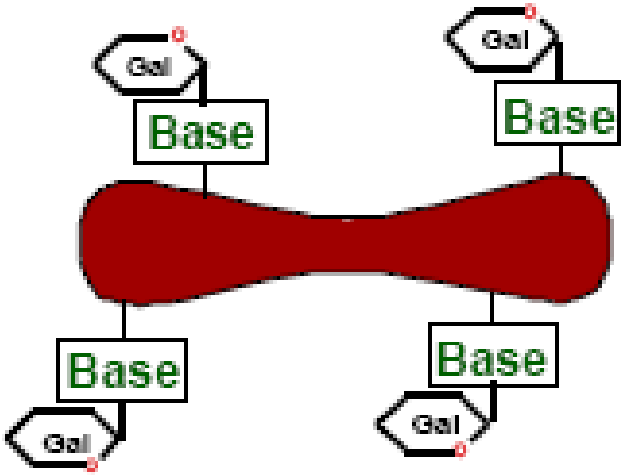




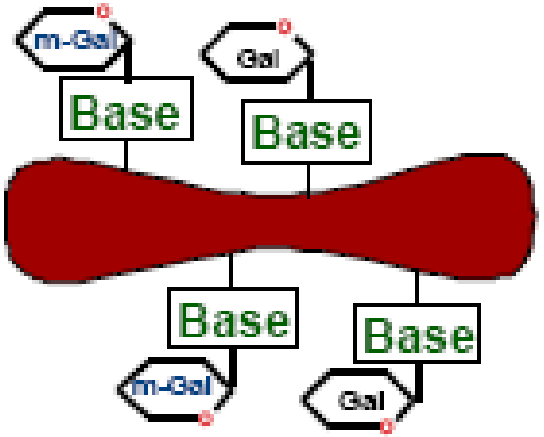
Type O blood cell



Type A blood cell



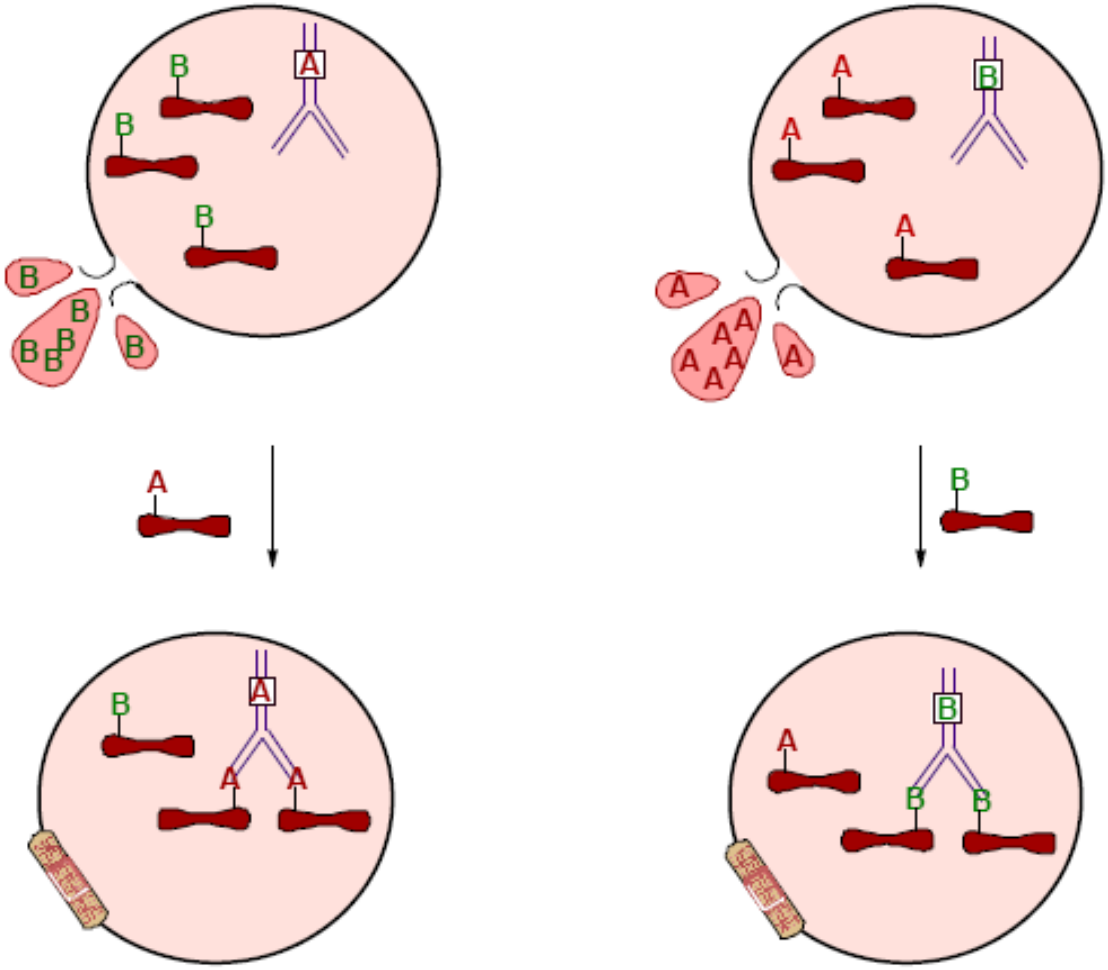
Type B blood cell



Type AB blood cell

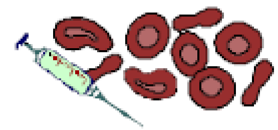
Blood Types

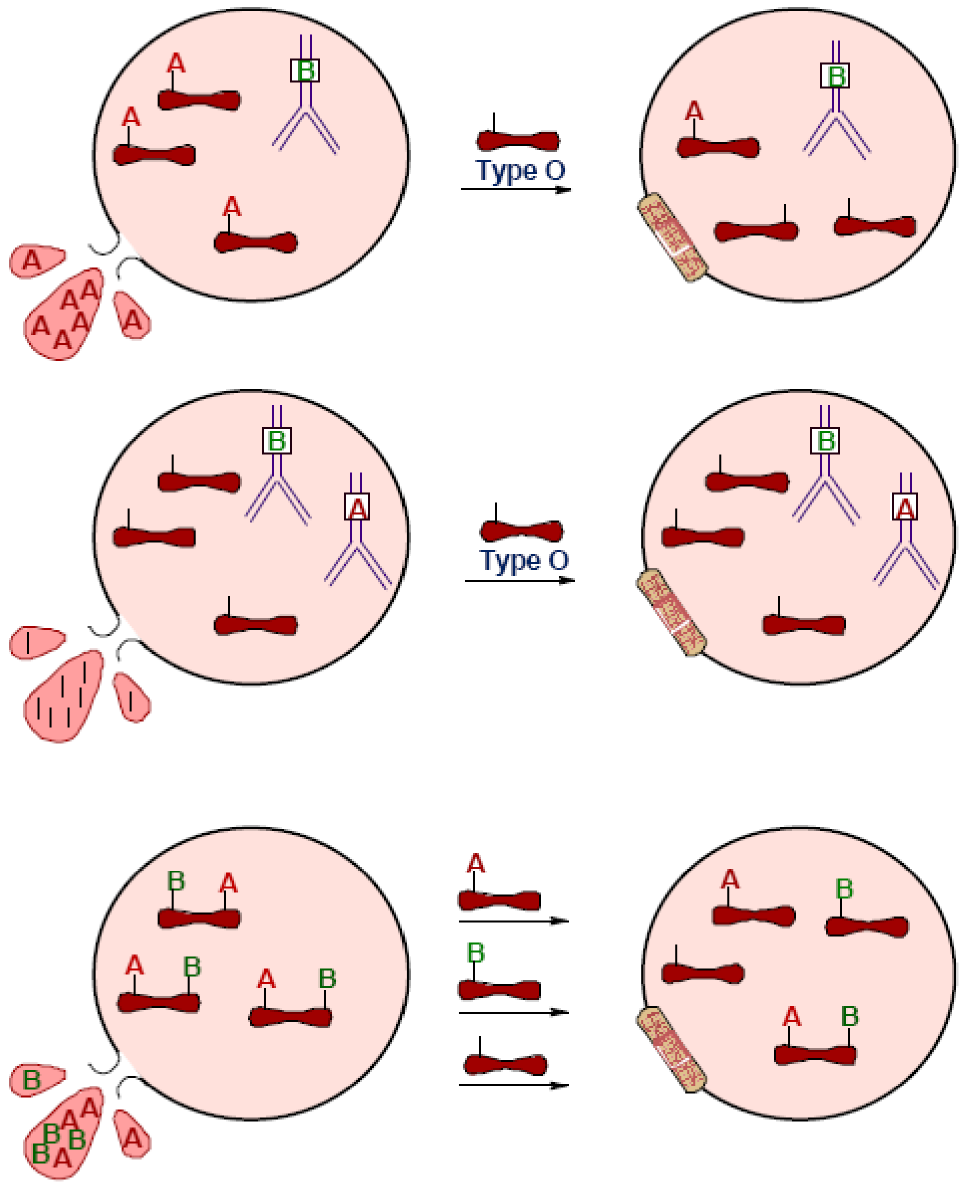
Need same type of blood because have antibodies to other R group.
-A cant get B blood and B cant get A blood



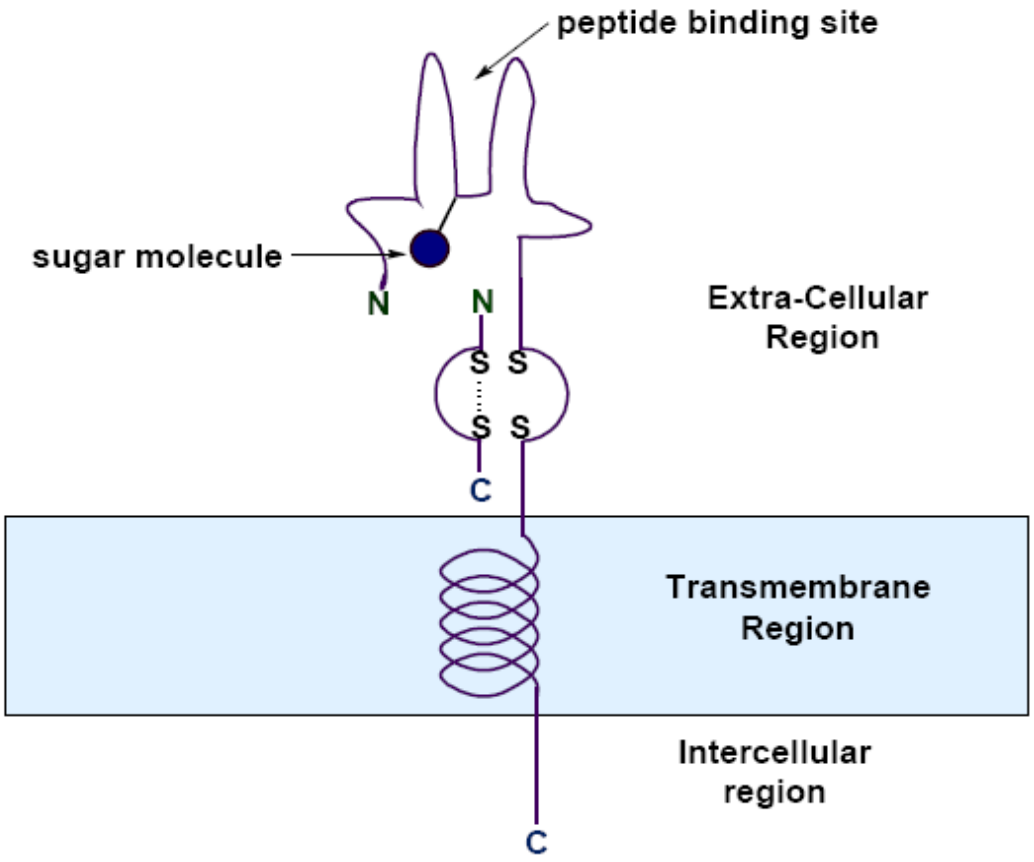
Antibodies bind to non-native RBC ultimately causing lysis.

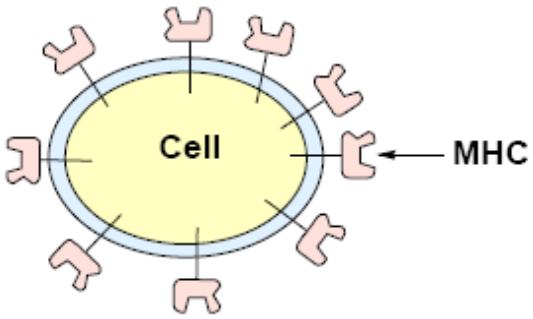
Blood Types





Major Histocompatibility Complex (MHC)



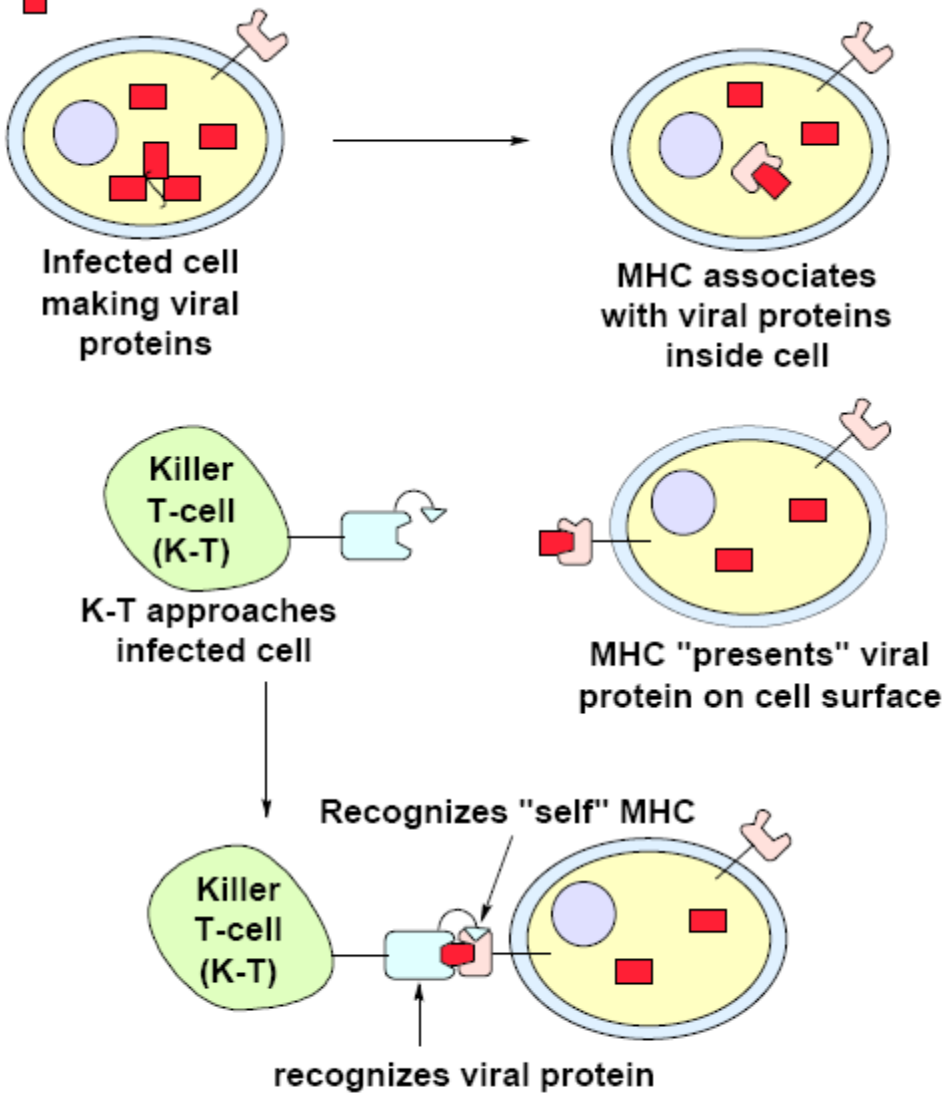


All nucleated cells have class IMHC on their surface

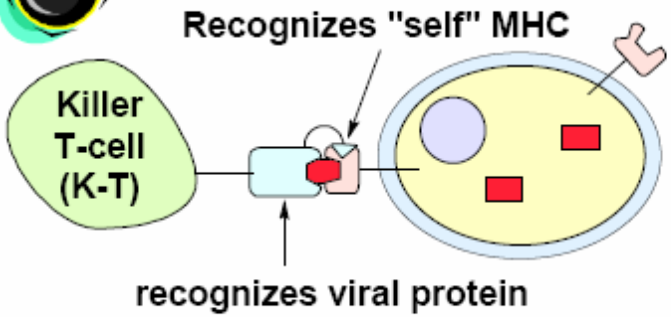
Roles of MHC

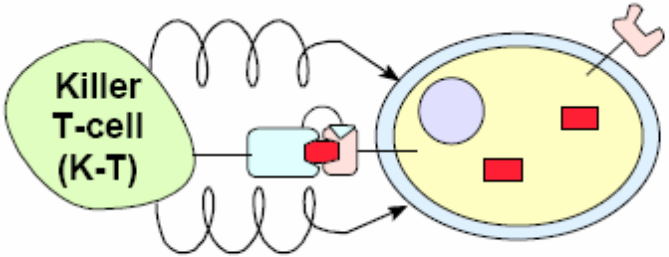
When cell infected by virus, viral proteins are produced inside

virus viral protein

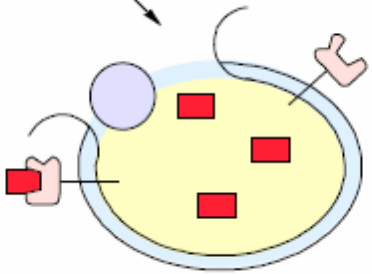


MHC Roles (cont.)





K-T then sends out chemical "bombs" that lyse virus infected cell!



Cell destroyed

So MHC:

(1) presents viral antigens to K-T cells

(2) provides self recognition

(3) Reason that transplants are rejected.

(4) Tissue Typing involves similarity between donor and recipient MHC.