

# Carbohydrates Lecture II Highlights

1. Linking together of more than one sugar residues creates higher order saccharides. These include disaccharides (two sugars), trisaccharides (three sugars), oligosaccharides (several sugars), and polysaccharides (many sugars).
2. Most of the linkages in higher order saccharides involve glycosidic bonds.
3. Disaccharides include sucrose (glucose + fructose), lactose (glucose + galactose), and maltose (two glucoses). Linkages of these are shown in the figures in the notes.
4. Sucrose is a non-reducing sugar (has no free anomeric hydroxyl), whereas lactose is a reducing sugar (has a single free anomeric hydroxyl). The sucrose figure in your book shows a confusing structure. [HERE](#) is a better one. You are responsible for the structure of sucrose and the linkages for the disaccharides I described in class.
5. Oligosaccharides are components of glycoproteins.
6. The most common polysaccharides include glycogen (energy storage in animals), cellulose (structural integrity in plants), starch (energy storage in plants), chitin (exoskeleton of insects).
7. Polysaccharides can be homopolymers (contain only one sugar residue) or heteropolymers (contain more than one sugar residue). Homopolymers include glycogen (glucose in alpha 1-4 linkages plus extensive alpha 1-6 branches), cellulose (glucose in beta 1-4 linkages), amylose (glucose in alpha 1-4 linkages), amylopectin (glucose in alpha 1-4 linkages plus some alpha 1-6 branches), and chitin (N-acetyl-D-glucosamine in beta 1-4 linkages).
8. Glycogen is an animal energy storage polysaccharide, amylopectin and amylose combine to form starch, which is a plant energy storage polysaccharide, cellulose is a plant structural polysaccharide, and chitin is a component of insect exoskeletons.
9. The enzyme cellulase is required to digest the beta 1-4 bonds of cellulose. Most animals do not contain cellulase. Ruminants and ungulates contain the bacterium that makes that enzyme.
10. Glycosaminoglycans are polysaccharides that contain either N-acetylgalactosamine or N-acetylglucosamine as one of their monomeric units. They are polyanionic and have interesting chemical properties, as a result. Examples include chondroitin sulfates and keratan sulfates of connective tissue, dermatan sulfates, heparin, hyaluronic acid, and others.
11. Proteoglycans are complexes of proteins and glycosaminoglycans that form feathery structures.
12. Glycoproteins consist of a protein linked to an oligosaccharide, usually via an 'N' or an 'O' linkage. N linkages occur through asparagine of the protein. O linkages occur across serine or

threonine of the protein.

13. Oligosaccharides on proteins (glycoproteins) and lipids (glycolipids) have functions in cellular identity and can be recognized and bound by immunoglobulins.

14. Oligosaccharides on the surface of cells help give them their identity. For example, A,B, and O blood group antigens give rise to the various blood types and these arise from carbohydrates on their cell surfaces.

15. Transplanted organs suffer rejection when the new organ has a different oligosaccharide pattern than the organ the recipient originally had. This encourages the immune system to attack it as foreign.

16. All N-linked glycoproteins have the same core of five carbohydrate residues.

17. N-linked glycoproteins have glycosylation (addition of carbohydrate residues) occurring in the endoplasmic reticulum and Golgi complex of the cell. O-linked glycoproteins have glycosylation occurring only in the Golgi complex.

18. Movement of modified proteins from the endoplasmic reticulum to the Golgi complex allows for additional carbohydrate modifications to occur, followed by targeting to 1) the cell membrane, 2) release from the cell, or 3) the lysosome.

19. Two terms I overlooked mentioning in the lecture that you should be aware of are Haworth structures and Fischer projections. Haworth structures refer to the ring forms of sugars. The straight chain forms are referred to as a Fischer projections.

20. Oligosaccharides destined to be linked to proteins to make glycoproteins are "built" on dolichol phosphate on the outer portion of the endoplasmic reticulum and then this "flips" to the inside for attachment.