

Study Guide – Lehninger Principles 5th Edition

Chapter Seven

By Frank Deis

Homework: 2*, 10, 15, 28, 29a. **7.1 Mono- and Di-saccharides.** Know the sugars with “boxed” names on page 237, plus D-Allose. Learn the terms in the online handout “Carbohydrate Naming Rules.” Understand how sugars cyclize in solution (e.g. Fig 7-6) and be able to convert from Fischer to Haworth projections. Understand nomenclature for sugar alcohols (“ribitol”) and acids (“gluconic”). Look at D-Sorbose on p. 237. Can you see that L-Sorbitol is the same as D-Glucitol? Disaccharides – know Maltose, Lactose, Sucrose, and Cellobiose (not in book).

7.2 Polysaccharides Know structures of amylose, amylopectin, glycogen, cellulose, and “dextran.” Understand that chitin is essentially a modified form of cellulose. The coiled structure of amylose (Fig 7-20) accounts for its affinity for iodine. The flat structure of cellulose helps make it relatively strong and insoluble. We will omit heteropolysaccharides.

7.3 Glycoconjugates. Probably the most familiar glycoconjugates are the ABO blood group substances (shown in Chapter 10, Fig 10-15 p. 355). Cells generally have sugars “decorating” the outside surface, whether eukaryotic or prokaryotic. Glycoproteins can be O-linked (sugars attached to Ser or Thr) or N-linked (sugars attached to Asn). Glycolipids include gangliosides, in which sugars are connected covalently to sphingosine. Bacterial lipopolysaccharides will provoke a strong immune response even if injected without living bacteria. Because we are not covering heteropolysaccharides we will not describe hyaluronate or proteoglycan. But multicellular organisms rely on an extracellular matrix (ECM). In plants this is cellulose, in animals proteoglycan. Transmembrane proteins such as integrins link the cytoskeleton (largely actin) to the ECM (Fig. 7-28).

7.4 Carbohydrate Information. Because of the many ways oligosaccharides can be put together their structures can be bewilderingly complex. Lectins are proteins which are highly specific for certain oligosaccharides, and together they make for a “sugar code.” One of the first examples known was protein targeting, i.e. proteins made in a eukaryotic cell are given a “zip code” for the correct compartment. Mannose-6-P codes for the lysosome. The text doesn’t discuss it but Neu5Ac (p. 259) is human-specific. In bicycle racing one way of cheating involves taking Erythropoietin (EPO, Fig 12-8) to stimulate red blood cell production. EPO made by non-human cells has Glycolyl HO-CH₂-COO- instead of acetyl. Older methods thus made detectable EPO. New methods are using cultured human cells which produce a hormone exactly like what’s inside everyone. Influenza viruses (like H5N1) are named after the type of Hemagglutinin (“H”) which binds Neu5Ac, and Neuraminidase, (“N”) which removes it, that they contain.

7.5 Working with Carbohydrates. Methods used for analyzing proteins, such as MALDI-MS and tandem MS, are helpful in analyzing oligosaccharide structure but not diagnostic. What you get is a molecular weight, and a given set of sugar residues can be linked together many different ways. Methylation (with methyl iodide) can reveal which positions are unoccupied. As the book states, finding the correct structure remains a formidable task.