

Study Questions for Essentials of Glycobiology

- * Participate when called upon.
- * Answer questions as carefully and clearly as possible.
- * Address the whole class so that everyone can hear their answers.
- * Be as succinct as possible in the interest of maximizing classroom time and effectiveness.

Lecture	Topic	Guide Questions
1	Course Overview History of Glycobiology, Primer on Glycans Lectins, and Biological Functions	<ol style="list-style-type: none"> 1. Why are studies of the biology of glycans ("glycobiology") not fully integrated into conventional molecular and cellular biology? 2. Why has evolution repeatedly selected for glycans to be the dominant molecules on all cell surfaces? 3. Why are extracellular and nuclear/cytosolic glycans so different from one another? 4. What are the different ways in which glycans can mediate or modulate biological functions?
2	Cellular organization and transferase structure	<ol style="list-style-type: none"> 1. Subcellular localization of glycosylation. Why is N-linked glycosylation more likely to play an intrinsic role than O-linked glycosylation in protein folding (unrelated to quality control covered in the next lecture). 2. Glycosyltransferase specificity. Glycans carry information that mediate many biological processes. How does the specificity of glycosyltransferases play a role in translating the information carried by the genome to glycans synthesized by a cell. 3. Glycosyltransferase specificity. Glycans carry information that mediate many biological processes. How does expression of glycosyltransferase genes play a role in translating the information carried by the genome to glycans synthesized by a cell.
3	Lectins and principles of glycan recognition	<ol style="list-style-type: none"> 1. Most glycan-protein interactions are low affinity, but high avidity is achieved by clustering receptors and ligands. What are the advantages and disadvantages of achieving high affinity interactions in this way? 2. How does the density of carbohydrate ligands affect binding of a GBP? Is this relevant in vivo? 3. What are the similarities and differences in binding of N-glycans, O-glycans, GSL, and GAGs to GBPs. 4. Would you predict the existence of GBPs that bind to the tips of GAG chains? What would be the advantages and disadvantages of this binding mode?
4	Assembly of precursors	<ol style="list-style-type: none"> 1. What is meant by "essential" monosaccharides? 2. Mammalian plasma contains glucose (~5 mM) and mannose, which is present at 50-100uM, but no other monosaccharides. Where does mannose come from? How is it metabolized? 3. Some cells have extremely low activity of enzymes needed to generate activated monosaccharides. We know that knock out of genes encoding these enzymes in a mouse is lethal, so how do deficient cells survive without the biosynthetic enzymes? 4. How are nucleotide sugar transporters distributed in the Golgi? Does this distribution influence glycosylation? What are the advantages of transporters that transfer multiple substrates?
5	N-glycans and Quality Control	<ol style="list-style-type: none"> 1. What steps in N-glycosylation would be good candidates for regulating N-glycan content and composition? 2. What are the functions of the various subunits of the oligosaccharyltransferase? 3. Consider the topology of N-glycosylation and provide possible explanations for its complexity. 4. Why is N-linked glycosylation more likely to play a role than O-linked glycosylation in protein folding?

Lecture	Topic	Guide Questions
		5. How is the ER stress response (ERAD) coordinated with N-glycan synthesis? 6. Compare the processing of N-glycans in the ER and Golgi with degradative pathways for N-glycans in lysosomes and in the cytoplasm. 7. How might diseases of protein misfolding be treated therapeutically?
6	O-glycans and C-type lectins	
7	Glycosphingolipids and GPI anchors	
8	Proteoglycans, hyaluronan and binding proteins	
9	Glycans and signaling	
10	Nuclear and cytoplasmic glycosylation, O-GlcNAc	
11	Sialic acids and I-type lectins	
12	Galectins	
13	Lysosomal degradation and P-type lectins	
14	Plants and L-type lectins	
15	R-type lectins	
16	Genomics & evolution	
17	Glycan Synthesis, and Glycomics	
	Memorial Day – No Class	
18	Microbial Cell Walls and Colonization	
19	Microbial infection	
20	Glycans in development	
21	Genetic disorders and acquired diseases	
22	Inhibitors and pharmaceutical design	