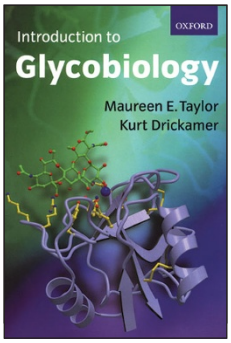
Totally Sweet



Introduction to Glycobiology

by Maureen E. Taylor and Kurt Drickamer

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Reviewed by Daniel N. Hebert

The biological trinity of '-omes' is comprised of the well-publicized genome and proteome, in addition to the overshadowed glycome. The glycome represents the entire population of sugar chains within the cell including carbohydrates covalently attached to both proteins and lipids. While the complexity of the glycome is one of the obstacles that ensures it will not be completed anytime soon, another is the relatively small number of scientists that are trained and engaged in glycobiology research when compared to its more popular brethren. *Introduction to Glycobiology* by Maureen Taylor and Kurt Drickamer serves to help fill this void by providing an introductory text for the study of glycobiology.

A search of the PubMed database using the key words genome or proteome discovers thousands of references. In contrast, a similar query for glycome or glycomics currently uncovers fewer than ten. This is due, in part, to the relative novelty of the term glycome, but it is also a statement to the difficulties encountered in the acquisition of information on carbohydrates. Currently, there is no method available to amplify cellular glycans. Glycans are not encoded from a single template (where would we be today without PCR?). Carbohydrate structures are the result of a large number of gene products that are involved in the transport, assembly, transfer and trimming of sugar residues. This provides many points for regulation, creating tremendous heterogeneity and complexity. However, the importance of sugars is emphasized by their key roles in protein sorting, cell–cell communication, cell adhesion and immune recognition, to name a few.

Introduction to Glycobiology was originally developed from an upper level undergraduate course in glycobiology that the authors have taught at Oxford University. However, the text seems best suited for graduate studies (at least in the system employed in the United States). Overall it provides a comprehensive introduction to everything related to carbohydrates, focusing largely on mammalian systems including carbohydrate compositions, structures, biosynthesis and functions, along with descriptions of the tools and procedures that are employed in their study. The book opens with the compulsory background in sugar chemistry, including nomenclature and structural description of monosaccharides, that is built upon in the chapters that follow. While this is the very topic that likely intimidates students from further pursuits, the authors knowingly transcend rapidly into the roles of *N*- and *O*-linked glycosylation, inserting connections with diseases where appropriate. This balance between structure, function and significance is well maintained throughout.

The protein-centric approach taken in the *O*-linked glycosylation chapter was very effective; as the authors themselves state on page 58, "much of this chapter is devoted to a discussion of [mucins and proteolgycans] and how glycosylations endow them with physical properties appropriate for important biological functions that they perform." The heavily *O*-linked glycosylated mucins are present at the hydrated surfaces of digestive, genital and respiratory tracts to help trap moisture. The large modifications associated with proteoglycans provide strength to the extracellular matrix that helps give cartilage its resilience. In addition, proteoglycans play an important role in development by providing networks attached to the plasma membrane, creating tracks that support signaling and cell–cell communication.

I found the chapter on the effects of glycosylation on protein structure and function to be well organized and insightful. Its concept deviated from the usual encyclopedic segregation of topics by their carbohydrate classification. One should not be surprised that these bulky attachments can actually affect the structure and activities of some proteins. Examples were also provided where glycans help to stabilize a protein by masking sites susceptible to proteolysis.

Also of special note is the section on plants, bacteria and viruses that describes how many pathogens use lectins or carbohydrate binding proteins to invade our cells and co-opt established cellular pathways. It provides explanations as to how plant toxins such as ricin, which has become known to lay people through our unfortunate times, can kill cells and more. Human diseases that are associated with defective glycosylation are also referred to throughout the book to engage the practically minded student. In addition, the penultimate chapter provides further examples of the relationship of glycosylation with human diseases, from cancer to blood clotting, which effectively ties together many of the concepts and carbohydrate categories covered previously.

It appears certain that in order for a large advance to be achieved in understanding the glycome, new technologies will be needed, as was (or is) the case for both its older siblings. However, one should keep in mind that the very qualities that make carbohydrates difficult to study, are the same properties that the cell has exploited to utilize them as protein and lipid tags, and tethers. Their heterogeneity provides specificity and their flexible, bifurcated and hydrophilic structures make them ideal for recruiting proteins and initiating protein–protein and cell–cell contacts in the crowded biological environment that we are just beginning to understand. ■

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