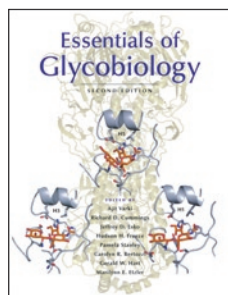


The expanding world of glycobiochemistry



Essentials of Glycobiology, 2nd edition

Edited by Ajit Varki, Richard D Cummings, Jeffrey D Esko, Hudson H Freeze, Pamela Stanley, Carolyn R Bertozzi, Gerald W Hart & Marilynn E Etzler

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Reviewed by Nicola L B Pohl

Glycobiology includes the study of the structures, biosynthesis and evolution of carbohydrates and the molecules (such as proteins) that recognize them. The field has developed a unique identity from its parent disciplines—molecular and cellular biology—because the study of carbohydrates has lagged behind that of nucleic acids and proteins. This is due in part to the lack of tools to probe this class of biomolecules, although recent progress is beginning to correct this deficiency. Given the rapid pace of research in glycobiochemistry, the second edition of *Essentials of Glycobiology*, published early this year, is more than welcome. This new edition is doubly welcome as it continues the experiment of publishing the full book simultaneously in print and online—easily accessible by a title search on the US National Institutes of Health website. This book, although written as a textbook for a graduate-level course in glycobiochemistry, serves as a great introduction to this exciting area for the general reader with an undergraduate background in organic chemistry and biology.

The book relies on a group of editors and experts for its exposition and fortunately still coheres nicely as a complete work. With a basic background in carbohydrates, or glycans, the reader can also easily read each individual chapter on its own. The study questions for each chapter at the end of the book make a perfect starting point for informal or group meeting-based discussions of particular topics. For the reader relatively new to the field, the book establishes the basics of glycobiochemistry in the first seven chapters. Especially interesting is the first chapter, which provides a historical overview of the field with a three-page table of important discoveries in the history of glycobiochemistry from 1876 (the discovery of glycosphingolipids and sphingosines by J. Thudichum) to 1987 (the development of high-performance anion-exchange chromatography to separate oligosaccharides using pulsed amperometric detection by Y.C. Lee). Another two-page table in this introductory chapter lists the

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“universal” principles of glycobiochemistry—the book’s must-read executive summary for every biologist. Within nine pages the reader can glean a sense of the importance of glycobiochemistry and where the field stands today. The remaining introductory chapters describe the basic chemical details of carbohydrates for the many readers whose undergraduate organic chemistry classes never reached that chapter in their textbook, as well as the cellular organization of glycosylation, the source of sugars and their transporters, an overview of glycosyltransferases and glycosidases, the biological roles of glycans, and a genome-wide view of the many sequences that appear to code for proteins that make, break and bind carbohydrates. Since the first edition was published in 1999, hundreds of complete genomes have been published; from these genomes, we know that about 5% of genes are involved in carbohydrate degradation, synthesis or recognition. These genome sequences have significantly accelerated knowledge of the biosynthetic pathways of glycans. However, the biological functions of many glycans remain to be assigned.

After a good grounding in the history and basics of glycobiochemistry, the book proceeds in the next eleven chapters to discuss the structure and biosynthesis of primarily mammalian glycans and then outlines some of the evolutionary diversity of carbohydrates across several groups of life. Whereas the original 1999 edition largely focused on mammalian glycobiochemistry, the revised and expanded second edition starts to provide a flavor of the incredible diversity of carbohydrate-mediated interactions across the full spectrum of life. Hosts and their pathogens appear to be in an evolutionary dance that diversifies surface carbohydrate structures in ways that we are only beginning to understand. In addition, the ubiquity of protein glycosylation is evident in that even archaeal proteins have now been discovered to be glycosylated. Clearly, these chapters will be expanded even more in future editions as more is learned.

The next section of this text is ten chapters devoted to glycan-binding proteins—their structures, their biological significance and, in part their use in medicine and biotechnology. After these discussions, the importance of carbohydrates in physiology and disease in vertebrates is reviewed in nine chapters. Carbohydrate-mediated infections of plants are not discussed; however, the basics of parasitic, bacterial and viral infections of animals are reviewed, along with the genetic disorders, cancers and some acquired human diseases such as autoimmune disorders that are mediated by sugars. The roles of glycans as signaling molecules and in development and glycoprotein quality control are also discussed. The book ends with a section on methods and applications of glycans—a discussion that the curious reader may want to begin with in order to get a sense for how some of the data in the earlier chapters were acquired and to what practical use they can be put.

The field is changing rapidly, so the reader is advised to seek out more recent reviews for the most up-to-date information of specific topics. However, this well-written text is a perfect entry point for an overview of this fascinating area of biology. For a broad audience interested in the myriad functions of glycans, particularly in vertebrate biology, this new edition of *Essentials of Glycobiology* is indeed essential. Best of all, the online version is only a few mouse clicks away!

COMPETING INTERESTS STATEMENT

The author declares competing financial interests: details accompany the full-text HTML version of the paper at <http://www.nature.com/naturechemicalbiology/>.