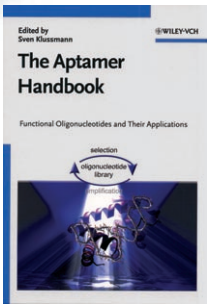
The Aptamer Handbook



Functional Oligonucleotides and their Applications. Edited by *Sven Klussmann*. Wiley-VCH, Weinheim 2006. 493 pp., hardcover € 149.00.—ISBN 3-527-31059-2

Nucleic acid aptamers exhibit the ability to recognize specific molecular targets and form stable complexes. The first aptamers were obtained by in vitro selection, amplification, and evolution (the "SELEX" process) 16 years ago. The initial targets for these experiments were small organic dye molecules and proteins. Although the task of identifying typically rare "winning" sequences from a library containing 10^{14}–10^{15} individual sequences is daunting, the appeal of being able to generate high-affinity selective aptamers for a diverse range of targets has led to applications in virtually all areas of biotechnology and biomedical research. In these areas, aptamers are filling many of the roles traditionally reserved for protein antibodies. Given the rapid growth in this field, the time is right for a book that covers aptamer research and development in great breadth as well as depth. *The Aptamer Handbook*, edited by Dr. Sven Klussman, fulfills this need wonderfully.

The book is divided into four sections: 1) History and Theoretical Background, 2) In Vitro Selection of Target-Binding Oligonucleotides, 3) In Vitro Selection of Short, Catalytically Active Oligonucleotides, and 4) Applications and Outlook. The first section will be very useful to beginners, by providing historical context for the book. However, this section achieves much more than just bringing the novice up to speed. As well as introducing the reader to molecular evolution from a qualitative empirical perspective, it also describes mathematical and computational approaches to understanding how, from an initially highly randomized pool containing trillions of unique RNA or DNA molecules (which still only sparsely covers sequence space), it is possible to select and evolve to obtain highly enriched populations of aptamers or catalysts. Important concepts that are introduced include informational complexity and fitness landscapes. Even seasoned experts in the field will be impressed by the facility with which the authors connect history, theory, and experiment in these three chapters.

The second section of the book provides an excellent overview of the range of targets against which aptamers have been selected, including a rapidly growing catalogue of small molecules, proteins, and other nucleic acids. The section concludes with a chapter describing nature's aptamers, namely riboswitches, which are found in transcribed RNA, and regulate gene expression at the translational or transcriptional level through binding of small molecules.

The brief third section presents two chapters that describe ribozymes and deoxyribozymes, which are RNA or DNA oligonucleotides that catalyze various chemical reactions. Previous review articles in this field have discussed nucleic acid catalysts in comparison with protein enzymes. However, the ribozyme chapter takes an interesting alternative approach by discussing the topic from the perspective of using ribozymes as tools for organic chemistry. The deoxyribozyme chapter follows a more traditional organization, with considerable emphasis placed on the "10–23" and "8–17" RNA-cleaving DNAzymes.

The fourth and final section of the book describes an exciting range of applications for aptamers in imaging, diagnostics, basic research, and therapeutic agents. Readers familiar with the use of antibodies in these areas will readily recognize the similarities between aptamers and antibodies. A thorough chapter by Cload and coauthors addresses practical considerations in the development and function of therapeutic aptamers. An entire chapter is devoted to the development of the first aptamer-based therapeutic agent, Macugen. Although this aptamer is also described in an earlier chapter on protein-binding aptamers, there is very little overlap of material. The section closes with an epilogue by Dr. Larry Gold, one of the inventors of the SELEX process.

The book suffers from a couple of unfortunate omissions. The first is the lack of a practical description of the SELEX method withvarious selection formats. While the traditional in vitro selection process is mentioned several times, alternative methods such as "photoSELEX" or capillary electrophoresis receive little or no attention. A comparison of different methods and protocols seems warranted, especially in a publication that refers to itself as a "handbook". The other deficiency is the failure to mention Internet resources that would be useful to the practicing scientist in this field. For example, the Aptamer Database (http://aptamer.icmb.utexas.edu/index.php) hosted by the Ellington Laboratory at the University of Texas provides a searchable interface that allows researchers to quickly determine whether a target of interest already has aptamers, to obtain information about the properties of those aptamers, and to follow links to the primary literature.

Overall, this is an outstanding book and it will deservedly become the resource of choice for the growing legion of researchers in the aptamer field. Clear illustrations, extensive reference lists for each chapter, and a detailed index supplement the excellent writing. Students and faculty members at all levels will benefit from reading selected chapters in isolation, or from methodically reading the entire book. While perhaps too specialized to serve as a primary textbook for a course, it will be a likely reference source for graduate level courses in bioorganic chemistry, sensors, or biotechnology.

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