

TEXTBOOK OF
BIOCHEMISTRY

For Medical Students

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For Medical Students

Sixth Edition

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Textbook of Biochemistry for Medical Students

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*With humility and reverence,
this book is dedicated
at the lotus feet of the Holy Mother*

Sri Mata Amritanandamayi Devi

"Today's world needs people who express goodness in their words and deeds. If such noble role models set the example for their fellow beings, the darkness prevailing in today's society will be dispelled, and the light of peace and non-violence will once again illumine this earth. Let us work together towards this goal." —Mata Amritanandamayi Devi

Preface to the Sixth Edition

We are glad to present the sixth edition of the *Textbook of Biochemistry for Medical Students*. With this sixth edition, the textbook is entering the 16th year of existence. With humility, we may state that the medical community of India has warmly received the previous editions of this book. Many medical colleges and universities in India have accepted it as one of the standard textbooks. We are happy to note that this book has also reached in the hands of medical students of neighboring countries of Nepal, Pakistan, Bangladesh, Sri Lanka, etc. and also to distant countries in Africa and Europe. Apart from the medical community, this book has also become popular to other biology group of students in India. In retrospect, it gives immense satisfaction to note that this book served the students and faculty for the past one and half decades.

At this time, a revision of the textbook has become absolutely necessary for two reasons. Firstly, the Medical Council of India has revised the syllabus for biochemistry, especially enhancing the topics on Clinical Biochemistry. Accordingly, we have made elaborate changes in the order of chapters, old chapters on clinical chemistry have been extensively updated and clinically relevant points were further added. Secondly, rapid progress has been made in the area of molecular biology during past few years, and these advances are to be reflected in this book also. The major change in this sixth edition is that advanced knowledge has been added in almost all pages, a few sentences were added here and there in almost all pages; sometimes, a few pages are newly incorporated; while it became necessary to include a few new chapters also.

From the first edition onwards, our policy was to provide not only basic essentials but also some of the advanced knowledge. About 30% contents of the previous editions were not required for a student aiming for a minimum pass. A lot of students have appreciated this approach, as it helped them to pass the PG entrance examinations at a later stage. However, this asset has paved the way for a general criticism that the extra details are a burden to the average students. Especially when read for the first time, the student may find it difficult to sort out the essential minimum from the desirable bulk. So, in the fifth edition, we have promised that we shall make two different books, one for MBBS and another one for postgraduate courses in Biochemistry. Thus, the content has been reduced substantially in the last edition. But, due to various reasons, most of which beyond the control of the authors, the postgraduate book could not be published. This led to the criticism that the content is sub-optimal. Many PG students were enquiring about the advanced book. The advanced students felt that they were neglected. This 6th edition is a compromise. Advanced topics are given in small prints. In essence, this book has three components; rather this book is composed of three books. The bold printed areas will be useful for the students at the time of revision just before the examinations; regular printed pages are meant for an average first year MBBS student (must-know areas) and the fine printed paragraphs are targeted to the advanced students preparing for the PG entrance (desirable to know areas). The readability has been markedly improved by increasing the font size in the regular areas.

Essay and short notes questions, problem solving exercises, viva voce, quick look, multiple choice questions (MCQs) are given as a separate book, but free of cost. These questions are compiled from the question papers of various universities during the last decade. These questions will be ideal for students for last-minute preparation for examinations.

A textbook will mature only by successive revisions. In the preface for the first edition, we expressed our desire to revise the textbook every 3 years. We were fortunate to keep that promise. This book has undergone metamorphosis during each edition. Chemical structures with computer technology were introduced in the second edition. Color printing has been launched in the third edition. The fourth edition came out with multicolor printing. In the fifth edition, the facts were presented in small paragraphs and that too with numbers, so as to aid memorization. In this sixth edition, figures are drastically increased; there are now about 1,100 figures, 230 tables and 200 boxes (perhaps we could call it as Illustrated Textbook of Biochemistry), altogether making the book more student-friendly. The quality of paper is also improved during successive editions.

We were pleasantly surprised to receive many letters giving constructive criticisms and positive suggestions to improve the textbook. These responses were from all parts of the country (we got a few such letters from African students also). Such contributors include Heads of Departments, very senior professors, middle level teachers and mostly postgraduate students. We have tried to incorporate most of those suggestions, within the constraints of page

limitations. In a way, this book thus became multi-authored, and truly national in character. This is to place on record, our deep gratitude for all those “pen-friends” who have helped us to improve this book. The first author desires more interaction with faculty and students who are using this textbook. All are welcome to communicate at his e-mail address <dmvasudevan@yahoo.co.in>

The first author is in the process of retirement from active service, and would like to reduce the burden in due course. A successful textbook is something like a growing institution; individuals may come and go, but the institution will march ahead. Therefore, we felt the need to induce younger blood into the editorial board. Thus, a third author has been added in this sixth edition, so that the torch can be handed over smoothly at an appropriate time later on.

In this connection, I would like to introduce the young author, Dr Kannan Vaidyanathan. He has teaching experience of 15 years. He took MD in Biochemistry from Kerala, and done extensive research at the Indian Institute of Science, Bengaluru, Karnataka. He has also visited many advanced laboratories world over, and presented papers in different international conferences. He has many publications to his credit. He is now Clinical Associate Professor, Department of Biochemistry, and Head, Metabolic Disorders Laboratory, Amrita Institute of Medical Sciences, Kochi, Kerala.

The help and assistance rendered by our students in preparing this book are enormous; the reviews collected by Dr Sukhes Mukherjee is specially acknowledged. The official website of Nobel Academy has been used for pictures and biographies of Nobel laureates. Web pictures, without copyright protection, were also used in some figures. The remarkable success of the book was due to the active support of the publishers. This is to record our appreciation for the co-operation extended by Shri Jitendar P Vij, and his associates.

We hope that this sixth edition will be friendlier to the students and be more attractive to the teachers. Now this is in your hands to judge.

“End of all knowledge must be building up of character.”—*Gandhiji*

**DM Vasudevan
Sreekumari S
Kannan Vaidyanathan**

Preface to the First Edition

There are many textbooks of biochemistry written by Western and Indian authors. Then what is the need for yet another textbook? Putting this question to ourselves, we have waited for many years before embarking on this project. Most western textbooks do not emphasise nutrition and such other topics which are very vital to an Indian student. While Indian authors do cover these portions, they sometimes neglect the expanding fields such as molecular biology and immunochemistry. Thus during our experience of more than 25 years in teaching, the students have been seen compelled to depend on different textbooks during their study of biochemistry. We have tried to keep a balance between the basic essentials and the advanced knowledge.

This book is mainly based on the MBBS curriculum. However, some advanced portions have also been given in almost all chapters. These areas will be very beneficial to the readers preparing for their postgraduate entrance examinations.

Chapters on diabetes, cancer and AIDS are included in this book. During their clinical years, the students are going to see such cases quite more often, hence knowledge of applied biochemistry of these diseases will be very helpful. The authors, themselves medical graduates, have tried to emphasise medical applications of the theoretical knowledge in biochemistry in almost all the chapters.

A few questions have been given at the end of most of the chapters. These are not comprehensive to cover all the topics, but have been included only to give emphasis to certain points which may otherwise be left unnoticed by some students.

We are indebted to many persons in compiling this textbook. We are highly obliged to Dr ANP Ummerkutty, Vice-Chancellor, University of Calicut, for his kind gesture of providing an introduction. Dr M Krishnan Nair, Research Director, Veterinary College, Trichur, has provided his unpublished electron micrographs for this book. Dr MV Muraleedharan, Professor of Medicine, and Dr TS Hariharan, Professor of Pharmacology, Medical College, Trichur, have gone through the contents of this book. Their valuable suggestions on the applied aspects of biochemistry have been incorporated. Two of our respected teachers in biochemistry, Prof R Raghunandana Rao and Prof GYN Iyer (both retired) have encouraged this venture. Prof PNK Menon, Dr S Gopinathan Nair, Assistant Professor, Dr Shyam Sundar, Dr PS Vasudevan and Mr K Ramesh Kumar, postgraduate students of this department, have helped in collecting the literature and compiling the materials. Mr. Joby Abraham, student of this college has contributed the sketch for some of the figures. Prof CPK Tharakan, retired professor of English, has taken great pains to go through the entire text and correct the usage of English. The secretarial work has been excellently performed by Mrs Lizy Joseph. Many of our innumerable graduate and postgraduate students have indirectly contributed by compelling us to read more widely and thoroughly.

“A lamp that does not glow itself cannot light another lamp” — *Tagore*

Our expectation is to bring out new editions every 3 years. Suggestions to improve the contents are welcome from the teachers.

November 1994

DM Vasudevan
Sreekumari S

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