Biotechnology

Textbook for Class XI

11150

विद्यया ऽमृतमश्नुते

एन सी ई आर टी
NCERT

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Foreword

Biotechnology is comparatively a newer discipline as compared to Biology, Chemistry or Microbiology. It has emerged as a new subject to be taught in schools and colleges in the last two–three decades. As the name indicates, Biotechnology fundamentally deals with the application of laws and principles that govern and control the processes and phenomenon in living organisms.

Considering the fact that Biotechnology has a potential to provide solutions to many of the diverse problems that our society is facing right from protection and conservation of environment to treatment of diseases; production of alcoholic beverages to many humulin pharmaceutical products (one such example is monoclonal antibodies used for the treatment and diagnosis of diabetes); development of drought and disease resistant crop varieties in agriculture to genetically modified crops; understanding genetic bases of many of the phenomena happening in organisms to deciphering the whole genome and such others. All these have created new vistas and wider opportunities with tremendous potential.

This emerging area has not only helped in providing solutions to many problems and answers to a number of queries related to fundamentals of the processes and phenomena of living organisms, but, it has also opened the gate of interdisciplinary collaborations in newer areas. Today's Biotechnology or even Biology for that matter cannot be completely understood without the understanding of Physics and Chemistry. Similarly, generations of enormous data and its interpretation has opened up opportunities in yet another area called Bioinformatics, which largely depends on computer based applications, softwares and algorithms. This has a potential of even providing tailor made diagnosis and treatment of diseases and prediction of a person's possible suffering of diseases in future.

However, considering the fact that the present course is an entry level one, this book mainly focuses on understanding the fundamental concepts. Focus has also been given on problem solving skills by providing opportunities for hands-on activities and experiments in laboratories on one hand, and working on bioinformatics databases on the other.

Last but not the least, as an organisation committed to systemic reforms and continuous improvement in the quality of its teaching-learning products, NCERT has always welcomed comments and suggestions which enables us to improve the quality of materials. Valuable comments and suggestions on the book will also help NCERT to improve the content of the textbook.

New Delhi
November 2018

Director
National Council of Educational
Research and Training

Preface

Quite recently, in the last two-three decades specialised disciplines like Biotechnology, Computer Science, Information Practices, etc., have emerged as priority areas in school education and these have been introduced at the higher secondary stage. This stage is challenging because of the transition from general to discipline-based curriculum. The higher secondary stage is also a connecting link between school education and higher and technical education. Therefore, syllabus at this stage needs to have appropriate rigour and depth while remaining mindful of the comprehension level of the learners. Further, the textbook need not be heavily loaded with content.

Biotechnology, as the name suggests, is an applied discipline which has potential to impact various facets. On one hand it has provided solutions to many health and medicine related problems, while on the other it has provided opportunities to explore newer areas like genomics, transcriptomics, proteomics, etc. These areas have implications to improve the quality of life besides solving many problems on various fronts like treatment of diseases, environmental protection and conservation, and understanding the process of evolution of life on earth, etc.

As an applied area related to molecular biology and biotechnology, Bioinformatics has also become a popular discipline due to generation of enormous amount of data in the area of genome biology. Needless to mention that about 15 years back we have seen the publication of draft human genome as an outcome of globally collaborated project called, 'Human Genome Project'.

Students take up Biotechnology with an aim of pursuing a career in molecular biology, molecular medicine, genome biology and various production industries related to biotechnology and molecular biology. Therefore, the course content of the subject must address all areas in which the subject has an implication. At the same time, it is also to be considered that the course must also make a foundation for higher and technical education. An attempt has been made in this direction to ensure that there is a balance between appropriateness and prospective need.

The course for Class XI has been divided into five units with 12 chapters. Unit I provides an introduction to the subject — its background and application in various areas. Unit II, has four chapters with details to understanding of cells, its bio-molecules including enzyme and cellular processes. Three chapters of Unit III will be helpful in developing the understanding of fundamentals of genetics, genetic material, mechanisms and processes related to DNA and RNA, and certain abnormalities in human beings especially related to chromosomal and genetic mechanisms. Unit IV, has three chapters, on quantitative biology, bioinformatics and programming in biology with application. The last unit of the book acquaints learners in the understanding of various tools and techniques used in the area of Biotechnology. An attempt has been made that the book provides a lucid reading to students and teachers so that it can effectively transact the concepts mentioned.

I take this opportunity to place on record appreciation for U. N. Dwivedi, *Professor* Department of Biochemistry and Pro-Vice Chancellor of University of Lucknow, for leading the activities in the book as well as for his guidance and motivation to the development team. Thanks are due to the authors and reviewers for their valuable contribution.

Comments and suggestions towards the improvement of this book are welcome.

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THE CONSTITUTION OF INDIA

PREAMBLE

WE, THE PEOPLE OF INDIA, having solemnly resolved to constitute India into a [1]**[SOVEREIGN SOCIALIST SECULAR DEMOCRATIC REPUBLIC]** and to secure to all its citizens :

JUSTICE, social, economic and political;

LIBERTY of thought, expression, belief, faith and worship;

EQUALITY of status and of opportunity; and to promote among them all

FRATERNITY assuring the dignity of the individual and the [2][unity and integrity of the Nation];

IN OUR CONSTITUENT ASSEMBLY this twenty-sixth day of November, 1949 do **HEREBY ADOPT, ENACT AND GIVE TO OURSELVES THIS CONSTITUTION.**

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1. Subs. by the Constitution (Forty-second Amendment) Act, 1976, Sec.2, for "Sovereign Democratic Republic" (w.e.f. 3.1.1977)
2. Subs. by the Constitution (Forty-second Amendment) Act, 1976, Sec.2, for "Unity of the Nation" (w.e.f. 3.1.1977)