

# Biology

Textbook for Class XI



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एन सी ई आर टी  
NCERT

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## **F**OREWORD

The National Curriculum Framework (NCF) 2005, recommends that children's life at school must be linked to their life outside the school. This principle marks a departure from the legacy of bookish learning which continues to shape our system and causes a gap between the school, home and community. The syllabi and textbooks developed on the basis of NCF signify an attempt to implement this basic idea. They also attempt to discourage rote learning and the maintenance of sharp boundaries between different subject areas. We hope these measures will take us significantly further in the direction of a child-centred system of education outlined in the National Policy on Education (1986).

The success of this effort depends on the steps that school principals and teachers will take to encourage children to reflect on their own learning and to pursue imaginative activities and questions. We must recognise that, given space, time and freedom, children generate new knowledge by engaging with the information passed on to them by adults. Treating the prescribed textbook as the sole basis of examination is one of the key reasons why other resources and sites of learning are ignored. Inculcating creativity and initiative is possible if we perceive and treat children as participants in learning, not as receivers of a fixed body of knowledge.

These aims imply considerable change in school routines and mode of functioning. Flexibility in the daily time-table is as necessary as rigour in implementing the annual calendar so that the required number of teaching days are actually devoted to teaching. The methods used for teaching and evaluation will also determine how effective this textbook proves for making children's life at school a happy experience, rather than a source of stress or boredom. Syllabus designers have tried to address the problem of curricular burden by restructuring and reorienting knowledge at different stages with greater consideration for child psychology and the time available for teaching. The textbook attempts to enhance this endeavour by giving higher priority and space to opportunities for contemplation and wondering, discussion in small groups, and activities requiring hands-on experience.

The National Council of Educational Research and Training (NCERT) appreciates the hard work done by the textbook development committee responsible for this book. We wish to thank the Chairperson of the advisory group in science and mathematics, Professor J.V. Narlikar and the Chief Advisor for this book, Professor K. Muralidhar, Department of Zoology, University of Delhi, Delhi for guiding the work of this committee.



Several teachers contributed to the development of this textbook. We are grateful to their principals for making this possible. We are indebted to the institutions and organisations which have generously permitted us to draw upon their resources, material and personnel. We are especially grateful to the members of the National Monitoring Committee, appointed by the Department of Secondary and Higher Education, Ministry of Human Resource Development under the Chairpersonship of Professor Mrinal Miri and Professor G.P. Deshpande, for their valuable time and contribution.

As an organisation committed to systemic reform and continuous improvement in the quality of its products, NCERT welcomes comments and suggestions which will enable us to undertake further revision and refinement.

New Delhi  
20 December 2005

*Director*  
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## **A NOTE FOR THE TEACHERS AND STUDENTS**

Biology is the science of life. It is the story of life on earth. It is the science of life forms and living processes. Biological systems, often appear to challenge physical laws that govern the behaviour of matter and energy in our world. Historically, biological knowledge was ancillary to knowledge of human body and its function. The latter as we know, is the basis of medical practice. However, parts of biological knowledge developed independent of human application. Fundamental questions about origin of life, the origin and growth of biodiversity, the evolution of flora and fauna of different habitats, etc., caught the imagination of biologists.

The very description of living organisms, be it from morphological perspective, physiological perspective, taxonomical perspective, etc., engaged scientists to such an extent that for sheer convenience, if not for anything else, the subject matter got artificially divided into the sub-disciplines of botany and zoology and later into even microbiology. Meanwhile, physical sciences made heavy inroads into biology, and established biochemistry and biophysics as new sub-disciplines of biology. Mendel's work and its rediscovery in the early twentieth century led to the promotion of study of genetics. The discovery of the double-helical structure of DNA and the deciphering of three dimensional structures of many macromolecules led to the establishment of and phenomenal growth in the dominating area of molecular biology. In a sense, functional disciplines laying emphasis on mechanisms underlying living processes, received more attention, support, intellectual and social recognition. Biology, unfortunately, got divided into classical and modern biology. To the majority of practising biologists, pursuit of biological research became more empirical rather than a curiosity and hypothesis driven intellectual exercise as is the case with theoretical physics, experimental physics, structural chemistry and material science. Fortunately and quietly, general unifying principles of biology were also being discovered, rediscovered and emphasised. The work of Mayr, Dobzhansky, Haldane, Perutz, Khorana, Morgan, Darlington, Fisher and many others brought respect and seriousness to both classical and molecular biological disciplines. Ecology and Systems biology got established as unifying biological disciplines. Every area of biology began developing interface with not only other areas of biology but also other disciplines of science and mathematics. Pretty soon, the boundaries became porous. They are now on the verge of disappearing altogether. Progress in human biology, biomedical sciences, especially the structure, functioning and evolution of human brain brought in respect, awe and philosophical insights to biology. Biology even stepped out of laboratories, museums and natural parks and raised social, economic and cultural issues capturing the imagination of general public and hence political attention. Educationists did not lag behind and realised that biology should be taught as an interdisciplinary and integrating science at all stages of educational training especially at school and undergraduate levels. A new synthesis of all areas of basic and applied areas of biology is the need of the hour. Biology has come of age. It has an independent set of concepts which are universal just like physics and chemistry and mathematics.

The present volume is the first time presentation of the integrated biology for the school level children. One of the lacunae in biology teaching and study is the absence of integration



with other disciplinary knowledge of physics, chemistry etc. Further many processes in plants, animals and microbes are similar when looked from physico-chemical perspective. Cell biology has brought out the unifying common cellular level activities underlying apparently diverse phenomena across plants, animals and microbes. Similarly, molecular science (e.g. biochemistry or molecular biology) has revealed the similar molecular mechanisms in all these apparently diverse organisms like plants, animals and microbes. Phenomena like respiration, metabolism, energy utilisation, growth, reproduction and development can be discussed in a unifying manner rather than as separate unrelated processes in plants and animals. An attempt has been made to unify such diverse disciplines in the book. The integration achieved however, is partial and not complete. Hopefully along with changes in the teaching and learning context, to be brought out in the next few years, the next edition of this book will reveal more integration of botany, zoology and microbiology and truly reflect the true nature of biology – the future science of man by man and for man.

This new textbook of Biology for class XI is a completely rewritten book in view of the syllabus revision and restructuring. It is also in accordance with the spirit of the National Curriculum Framework (2005) guidelines. The subject matter is presented under twenty-two chapters which are grouped under five thematic units. Each unit has a brief write up preceding the unit highlighting the essence of the chapters to follow under that unit. Each unit also has a biographical sketch of a prominent scientist in that area. Each chapter has, on the first page, a detailed table of contents giving sub-headings within the chapter. Decimal system using arabic numerals has been employed to indicate these sub-headings. At the end of each chapter a brief summary is provided. This brings to the notice of the student, what she/he is supposed to have learnt by studying the chapter. A set of questions is also provided at the conclusion of each chapter. These questions are essentially to enable the student to test herself/himself as to how much she/he has understood the subject matter. There are questions which are purely of information recall type; there are questions which need analytical thinking to answer and hence test true understanding; there are questions which are problems to solve and finally there are questions which need analysis and speculation as there is no one to answer to such questions. This tests the critical understanding of the subject matter in the mind of the student.

Special emphasis has been given on the narrative style, illustrations, activity exercises, clarity of expression, coverage of topics within the available time in school. A large number of extremely talented and dedicated people including practising teachers helped in bringing out this beautiful book. Our main purpose was to make sure that school level biology is not a burden for students and teachers. We sincerely wish that teaching biology and learning biology would become an enjoyable activity.

*Professor K. Muralidhar*  
Department of Zoology  
University of Delhi





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