

Preface

We also now appreciate that molecular biology is not a trivial aspect of biological systems. It is at the heart of the matter. Almost all aspects of life are engineered at the molecular level, and without understanding molecules we can only have a very sketchy understanding of life itself. All approaches at a higher level are suspect until confirmed at the molecular level.

Francis Crick, *What Mad Pursuit*, 1988

This is a book about DNA, the most central substance in the workings of all life on Earth. It is a book about the way in which DNA works at a molecular level. We have used the title *Understanding DNA...* because our subject has now reached the stage where many aspects of it are well enough understood for us to be able to give a clear and uncluttered presentation of the main ideas. But we shall not disguise the fact that there is still a great deal which is not known or understood.

The book can be read at two different levels. First, it can be taken as an easy-to-read textbook for undergraduate or graduate students of chemistry and biology at university. Second, it may be read by ordinary people who have no prior knowledge of biochemistry, but who want to understand something of the fundamental processes of life. The sort of people we have in mind here are those who have learned something about DNA from popular magazines, newspapers, and TV programs. They know, for example, that DNA contains the 'genes' of classical genetics – those units of inheritance which pass on characteristics such as red hair or a long nose from parent to child, or even crippling diseases such as sickle-cell anemia or thalassemia. They probably also know that DNA is a long molecule, like a computer tape – the tape which tells our bodies how to grow and how to digest food and (perhaps) how to behave. And they may even know, if they are into quiz games and the like, that the initials 'DNA' stand for 'Deoxyribo-Nucleic Acid,' a certain kind of acid found in the cell nucleus, which was first identified over 100 years ago. People like this, who are curious to know more, will be able to

learn a lot from this book about how DNA performs its tasks in our bodies at a molecular level.

This third edition of the book comprises 11 chapters. Chapter 1 is a general introduction to molecular biology: it is aimed at the non-specialist reader, and so it may be passed over by a student who already knows some biology. Chapters 2, 3 and 4 give some lessons about various aspects of the molecular structure of DNA, such as why it is helical, and how it can bend around proteins; this is basic material, which is nevertheless not yet available in other textbooks. Chapters 5 and 6 discuss the three-dimensional structure of DNA at a higher level. These chapters include some mathematics and geometry that may be unfamiliar to non-specialists and biology students; but we take care to present the key ideas by means of clear diagrams wherever possible. Chapter 7 gives an overview of the organization of chromosomes, which are large particles that contain both protein and DNA: there the DNA wraps about the protein into several different levels of structure. Chapter 8 discusses the mechanism of 'direct reading' of DNA sequences by proteins: this is an area that has expanded greatly since the first edition appeared in 1992. Chapter 9 explains the various experimental techniques which scientists use to study DNA. Chapter 10 describes the way in which DNA techniques are increasingly being used in medicine; while Chapter 11, which is new to this edition, summarizes the fast-growing area of cytosine methylation and DNA epigenetics. We end with a Postscript on what we have left out, followed by three Appendices on matters too detailed for the main part of the book. At the end of most chapters we give a bibliography of works to which we have referred in the text; and we provide some further reading for the student, and also some pointers to web-based resources. We have substantially updated the reference lists for this third edition. We have also supplied a few exercises at the end of most chapters.

We have made many changes from the two earlier editions apart from those mentioned above. Thus, we have updated the text and figures where necessary, particularly in Chapters 7 to 10 and the Appendices: the two new members of our author team, B.F.L. and A.A.T., have played a major part in these revisions. As in the earlier editions, we have tried to write in plain English, with minimum use of jargon which might confuse the reader.

Understanding DNA: the molecule & how it works should be suitable as a small text to accompany the very large, general textbooks which are now used widely in university biochemistry courses; or else it may be employed as a main text for a course specializing in DNA structure, provided the students have a background in biology and are willing to pursue more detailed readings in the

scientific literature, as suggested. Or, of course, it may just be read as a book.

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