# Preface

The mission of this book is to share with the interested reader the pleasure of understanding one of the greatest achievements of science—uncovering the mystery of DNA. To fully appreciate this achievement, I have strived to explain in a simple but scientifically correct manner the key experiments and concepts that led to our current knowledge of what DNA is, how it works and the increasing impact it has on our lives. Although the book was written for a layperson to understand, I also kept in mind students, teachers, and young scientists.

In addition to emphasizing the observations and reasoning behind each novel idea and the critical experiments that were performed to test them, I have provided a brief sketch of the lives and personalities of key scientists, many of whom I knew personally. The importance of DNA research to science and medicine is reflected by the fact that 27 Nobel Prizes have been awarded for research on DNA. The prizes were awarded to scientists from 12 countries (Appendix). Among the pioneers of DNA research that will be discussed in this book are four extraordinary women, who have become feminine icons: Rosalind Franklin, whose X-ray pictures of DNA made possible the discovery of the double-strand helix structure of DNA; Barbara McClintock, whose discovery of "jumping genes" gave rise to genetic engineering; Lynn Margulis, who put forth original ideas on evolution that were initially controversial but are now accepted; and Elizabeth Blackburn, who discovered that shortening the ends of the DNA molecule contributes to aging. Telling a science story from the point of view of the scientist enables the reader to imagine themselves in that position.

In narrating the DNA story, I have used the historical or case-study approach, in which I describe the seminal ideas in DNA research from their conception to their latest development, emphasizing the observations and reasoning behind each concept and the critical experiments that were performed to test them. In this way, I intend to stimulate the reader's innate sense of scientific inquiry. Learning how someone made an important discovery can be as interesting as the discovery itself. In the DNA story, the journey matters. For it is precisely in the substitution of evidence for dogma, as a basis for belief, that science has made its greatest offering.

The historical approach also leads the reader to appreciate how science progresses. An important discovery leads to a new question. Often the question is put in the form of a hypothesis that can be tested experimentally. The results of the experiment can lead to a new concept, which again provokes another question. Revolutions occur when disparities or anomalies arise between theoretical expectation and research findings that can be resolved only by changing fundamental rules of practice. These changes can occur suddenly: in a relative instant, the perceived relationships among the parts of a picture shift, and the whole takes on a new meaning. Examples that are included in this book include Darwin's evolutionary theory, Mendel's gene concept, Avery's demonstration that DNA is the genetic material, the helical model of DNA, the one gene–one enzyme concept, and more recently, the key role of symbiotic microorganisms in adaptation, behavior, development, metabolism, and evolution of plants and animals, including humans.

Throughout the book, I have attempted to strike a balance between theoretical and applied aspects of DNA research. Scientific progress is motivated by both a desire to know and a desire to use this knowledge. Nowhere is this more evident than in DNA biology. The ability to manipulate DNA has led to genetically engineering microbes to produce valuable drugs, such as the human hormone insulin, human growth hormones to prevent dwarfism, blood-clotting factors for treating hemophilia (the "bleeding disease"), and vaccines. Genetic engineering is used in agriculture to produce plants with beneficial characteristics, such as herbicide resistance, improved shelf life, disease resistance, stress resistance, and resistance to insects. The DNA engineered crop that probably has the greatest potential to improve human health worldwide is Golden rice, created to fight vitamin A deficiency, which affects 250 million people around the world and can cause blindness and even death.

Genetic engineering has also been performed on animals. Although most of the genetically modified animals were produced for research purposes, some were engineered to enhance production or food quality traits. Two of the most interesting are genetically modified salmon for use in the aquaculture industry to increase the speed of development and potentially reduce fishing pressure on wild stocks and dairy cows genetically engineered with human genes to produce milk that would be the same as human breast milk. This could potentially benefit mothers who cannot produce breast milk but want their children to have breast milk rather than formula.

Genetic engineering of humans is in its infancy. Recently, the British House of Commons approved a technique of creating babies from three people, the mother, the father, and a female mitochondrial donor. The technique was developed to help women with mitochondrial disease have healthy babies. Eggs are collected from a potential mother with damaged mitochondrial DNA and a female donor with healthy mitochondria. The nucleus which contains the vast majority of the genetic material is then removed from both eggs. The mother's nucleus is inserted into the donor egg, which can then be fertilized by sperm from the father. It results in babies with 0.1% of their DNA from the second woman and is a permanent change that would be passed down through the generations.

I hope this book stimulates interest in DNA and provides the necessary background for a greater appreciation of the increasing number of discoveries that are making an impact on our way of life.