
Acknowledgments

Preface

This book is written for students who are learning about viruses for the first time in a university course at the undergraduate or graduate level. As the title implies, it concentrates on the molecular mechanisms of virus replication, and on the interactions between viruses and the cells in which they replicate. The book approaches learning about virology by presenting a set of chapters each of which covers a specific virus family, using one or two well-studied viruses as examples. Each chapter is designed to tell a story about the virus under discussion, and to portray the “personality” of that virus, with the idea that this will help students to learn about and remember each virus.

This organizational scheme has been used in a number of successful virology textbooks, including Salvador Luria’s classic 1953 book, *General Virology*. Luria was one of the founding members of the “phage group”, a loose coalition of physicists, biologists and chemists who chose during the 1940’s to study bacteriophages in order to understand the molecular basis of life, and who invented the field of molecular biology. Their approach was to study how the proteins and nucleic acids of viruses interact with cellular molecules and organelles, transforming the cell into a factory that can produce many new progeny virus particles. Their underlying hope, largely achieved, was to use viruses as a tool to help understand how cells work.

The amount of knowledge that has accumulated about viruses has expanded enormously in recent years, as in many other areas of biomedical sciences. *Fields Virology* has become the classic reference book for knowledge about human and animal viruses during the past 20 years; that book is also organized in chapters that cover specific virus families. My own teaching experience and conversations with numerous colleagues convinced me that there is a real need for a concise, up-to-date textbook organized around the concept of virus families and designed specifically for teaching.

The problem was to make such a book accessible for beginning students but not to oversimplify the material. My approach was to ask a number of prominent virology researchers and teachers to write chapters on viruses that they knew well, using a set of criteria that I provided. I then edited and sometimes rewrote these chapters into a common style, and in many cases I re-designed or created the illustrations. No individual can possibly write knowledgeably about the large spectrum of viruses that a virology course should cover, so a collaborative approach was necessary. However, a textbook

that is an effective learning tool must have a coherent organization and a clear and consistent style of writing and illustration. My job has been to craft the original chapters that I received into what I hope are readable and easily understood units.

The emphasis of this textbook is on virus replication strategies; it is directed towards university students studying microbiology and the biomedical sciences. It does not go deeply into pathogenesis, epidemiology, disease symptoms, or host responses to virus infection. However, some information and stories about medical and historical aspects of virology are included, particularly in introductory sections of each chapter. Students who understand what diseases are caused by particular viruses, and the importance of these diseases in human history, may be motivated to learn more about those viruses.

How To Use This Book

This textbook is designed to be used in a modular fashion. No course would be expected to use all the chapters in the book, nor necessarily in same order in which they appear. The organization of the book gives wide latitude to course coordinators to make their own choices of which virus groups will be covered. Chapters are designed to accompany a 50-minute lecture on the subject, or in some cases, two or three such lectures. Each chapter should be able to be read in 30-60 minutes, including examination of figures and tables. Lecturers might want to supplement material given in the text with experimental methods or results, which are not covered because of lack of space.

The book is organized into nine sections and 34 chapters. Four introductory chapters in section I cover the virus life cycle, virus structure, virus classification, and the entry of viruses into animal cells. The chapters in section II cover four well-studied bacteriophages. These are included because bacteriophages are among the best known viruses, and because much of our knowledge of molecular biology and virology began with their study. Furthermore, bacteriophages are the source of many tools commonly used in modern molecular and cell biology laboratories.

Sections III through VII cover viruses that primarily infect animals, with emphasis on viruses that infect humans. The division into sections is based on the nature of the virus genome and virus replication strategies: DNA viruses (sections III and IV), positive-strand

RNA viruses (section V), negative strand and double-stranded RNA viruses (section VI), and viruses that use a reverse transcriptase (section VII). Within a section, smaller and simpler viruses are discussed first, then larger and more complex viruses. In this way, concepts that are learned about simpler viruses can be applied when more complex viruses are encountered.

Section VIII covers small infectious entities that are not viruses: viroids, which are virus-like nucleic acids that replicate but code for no proteins; and prions, which are infectious proteins that contain no detectable nucleic acid. Section IX finishes the book by reviewing some important applications in virology: interferons, antiviral chemotherapy, virus vectors, and vaccines.

Each chapter begins with an outline. For chapters that cover virus families, these outlines are “thumbnail sketches” that contain some basic information about virion structure, genome organization, replication strategies, diseases caused, and distinctive characteristics shared by viruses in that family. These outlines are designed to serve as study aids that will help students understand and remember common features of the viruses they study.

Subheadings within each chapter are explanatory phrases, telling the reader what will be discussed in the next several paragraphs. These subheadings (collected in the Table of Contents) can also be read separately to provide an overview of the material presented in the chapter, and to follow the steps of the virus replication cycle. Figures concentrate on individual well-studied steps in virus replication. Most figures are designed to be simple and easily understood while reading the accompanying text, rather than comprehensive descriptions of the entire replication cycle. Figure legends are kept to a minimum.

Specialized terms that may be unfamiliar to students are presented in bold type at their first appearance in the chapter. These terms are collected at the end of each chapter as a review aid, and definitions are given in a combined glossary at the end of the book. Many chapters have text boxes that cover intriguing applications or recent developments in research. A short list of references to reviews and recent articles is available at the end of each chapter. This is meant to provide an entry into the literature for students; no references are cited within the chapter texts.

Key Features of This Book

- A concise, up-to-date textbook designed for university-level virology courses for students in biomedical sciences and microbiology
- Written in a simple and clear style for students with a background in cell and molecular biology
- Explains replication mechanisms of viruses representing many of the major virus families
- Each chapter is designed to tell a story about a specific virus family and to portray the “personality” of the virus covered
- Chapter introductions give historical background and information about viral diseases
- Includes study aids such as thumbnail sketches of each virus group, informative chapter subheadings, text boxes outlining recent research and applications, and a comprehensive glossary with definitions of numerous terms
- Many two-color figures complement the text and illustrate virus structure, genome organization and individual steps in virus replication
- Introductory section provides basic information about virus replication, structure, classification and entry into cells
- A section on bacteriophages covers four of the best-known phages: single-stranded RNA phages, phiX174, T7 and lambda
- Five sections containing 20 chapters cover a wide variety of animal and insect viruses, with emphasis on viruses that cause human disease
- Includes chapters that cover important human pathogens such as smallpox virus, measles virus, poliovirus, herpes viruses, human immunodeficiency virus, hepatitis B virus, Ebola virus, SARS coronavirus, West Nile virus and others
- A separate chapter on viroids: small infectious nucleic acids that code for no proteins but cause important plant diseases
- A separate chapter on prions: infectious proteins that cause mad cow disease and Creutzfeld-Jacob disease in humans
- A concluding section with four chapters on interferons, antiviral chemotherapy, virus vectors, and vaccines