SEVENTH EDITION

INTRODUCTION TO MODERN VIROLOGY

N.J. DIMMOCK, A.J. EASTON AND K.N. LEPPARD

WILEY Blackwell

Introduction to Modern Virology

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N. J. Dimmock
A. J. Easton
K. N. Leppard
School of Life Sciences
University of Warwick
Coventry

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This edition first published 2016 © 2016 by John Wiley & Sons, Ltd

First to sixth editions © 1974, 1980, 1987, 1994, 2001, 2007 by Blackwell Publishing Ltd

Registered office: John Wiley & Sons, Ltd, The Atrium, Southern Gate, Chichester, West Sussex, PO19 8SQ, UK

Editorial offices: 9600 Garsington Road, Oxford, OX4 2DQ, UK
The Atrium, Southern Gate, Chichester, West Sussex, PO19 8SQ, UK
111 River Street, Hoboken, NJ 07030-5774, USA

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Library of Congress Cataloging-in-Publication Data

Dimmock, N. J.
Introduction to modern virology / N. J. Dimmock, A. J. Easton, K. N. Leppard, School of Life Sciences, University of Warwick, Coventry. – Seventh edition.
pages cm
Includes index.
ISBN 978-1-119-97810-7 (pbk.)
1. Virology. 2. Virus diseases. I. Easton, A. J. (Andrew J.) II. Leppard, K. N. (Keith N.) III. Title.
QR360.D56 2016
579.2–dc23

2015031818

A catalogue record for this book is available from the British Library.

Wiley also publishes its books in a variety of electronic formats. Some content that appears in print may not be available in electronic books.

Cover design by Jeremy Tilston

Set in 10/12.5pt MeridienLTStd-Roman by Thomson Digital, Noida, India

1 2016

Contents in brief

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Preface

As before, our aim in this 7th edition of *Introduction to Modern Virology* is to provide a broad introduction to virology, which includes the nature of viruses, the interaction of viruses with their hosts, and the consequences of those interactions that lead to the diseases we see. In doing so, we have focused predominantly on viruses that infect humans, with some examples of viruses of other animals where they illustrate a specific point. However, in the sections covering general principles and processes of virology, we have also included bacterial and plant viruses. The revised text is aimed at undergraduate students at all levels and postgraduates who are learning virology as a new subject.

We have retained the four thematic sections that were introduced in the previous edition. These cover the fundamental nature of viruses, their growth in cells, their interactions with the host organism, and their role as agents of human disease. To complement these, we have added a fifth section that incorporates material relating to virology in a wider context. Each section contains a series of chapters that are typically focused on a topic rather than concentrating on a single virus. Inevitably, some of these topics relate to information in different parts of the book and we have included extensive cross-referencing to allow the reader to explore a broader picture than is possible within a single chapter.

The pace of discovery in the field of virology has continued unabated since the last edition. Our knowledge of the molecular detail of viruses, including their interaction with the host, has increased considerably and continues to grow. We have tried to explore the breadth of this new information while retaining a concise style. Inevitably, this has meant that we have had to choose specific examples while leaving out many others of interest, but we have tried to use examples which demonstrate broad principles as well as specific detail. There is suggested reading for those who want to follow up a subject in more depth.

The study of viruses is as topical and important as ever. The global impact of HIV and chronic hepatitis virus infections continues to be severe and, as we completed this edition, we are seeing hopeful indications of the ending of the most devastating Ebola virus outbreak ever recorded. Beyond these direct impacts on our health, viruses also continue to threaten us through effects on food supplies and our economies. Thus, a good basic understanding of viruses is important for generalists and specialists alike. Our aim in writing this book has been to try to make such understanding as accessible as possible, allowing students across the biosciences spectrum to improve their knowledge of these fascinating entities.

New to this edition

This edition contains a number of important changes and innovations. A major change has been the expansion of the consideration of immunology which now covers two chapters, one on innate immunity and the other on adaptive immunity. This reflects the growing understanding of the importance of the immune system in determining the outcome of virus infection and the contribution of the immune system to viral diseases. These chapters also consider some of the ways that viruses evade the immune response. The consideration

of vaccines and antivirals has been expanded and separated into two new chapters to reflect the importance of these approaches to prevention and treatment. Virus evolution is considered in more detail than previously, and we have added new chapters on viral hepatitis, influenza, vector-borne diseases, and exotic and emerging viral infections. Finally, in the last section we have introduced three new chapters on the broader aspects of the influence of viruses on our lives, focusing on the economic impact of virus infections, the ways we can use viruses in clinical and other spheres, and the impact that viruses have on the planet and almost every aspect of our lives.

The text is supplemented throughout by information boxes of two types. These are now distinguished by different colours. One type of box provides supporting information or additional detail about the subject matter of the chapter while the other provides the experimental evidence by which selected key points were established. The aim is to assist the reader in understanding the facts but to also allow them to appreciate the nature of the evidence that underpins them.

We very much hope that the 7th edition of *Introduction to Modern Virology* will enrich the virology experience of students and teachers alike.

Finally, we would like express our thanks the staff at Wiley for their generous support throughout the production of this book.

Nigel Dimmock, Andrew Easton
and Keith Leppard
University of Warwick, October 2015

About the companion website

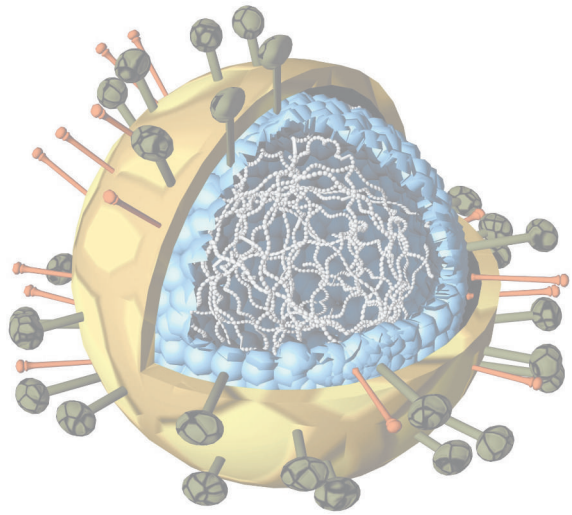
This book is accompanied by a companion website:

www.wiley.com/go/dimmock/virology

The website includes powerpoints of all figures from the book for downloading

Part I

The nature of viruses



Chapter 1

Towards a definition of a virus

Viruses occur universally, but they can only be detected indirectly. Viruses are obligate intracellular parasites that require a host within which they replicate. Although they are well known for causing disease, most viruses coexist peacefully with their hosts.

Chapter 1 Outline

Viruses are arguably the most ubiquitous and widespread group of organisms on the planet, with every animal, plant and protist species susceptible to infection. The efficiency of replication demonstrated by viruses is such that the infection of a single host can generate more new viruses than there are individuals in the host population. For example, a single human infected with influenza virus can shed sufficient virus particles to be theoretically capable of infecting the entire human population. While not every species has been examined for the presence of viruses, those that have been tested have all yielded up new virus isolates. Further, not only do viruses occur universally but each species has its own specific range of viruses that, by and large, infects only that species. In recent years, the application of new nucleic acid sequencing techniques has demonstrated that a vast array of previously unknown viruses remains to be studied.

Current estimates of the number of individual viruses on earth suggest that they considerably exceed the total number of stars in the known universe, i.e. more than 10^{23} (100 sextillion). This vast number raises questions as to what the viruses are doing there, and what selective advantage, if any, they afford to the species that host them. The answer to the first of these is the same as if the question was posed about any organism – it is simply occupying a particular environmental niche which, in the case of a virus, is another species. The answer to whether or not any benefit accrues for hosting a virus is usually not known, though the adverse effects of virus infections are all too well known. However, it is clear that, despite their adverse effects and the dramatic depictions of viruses in popular media and cinema, viruses have not made their hosts extinct.

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