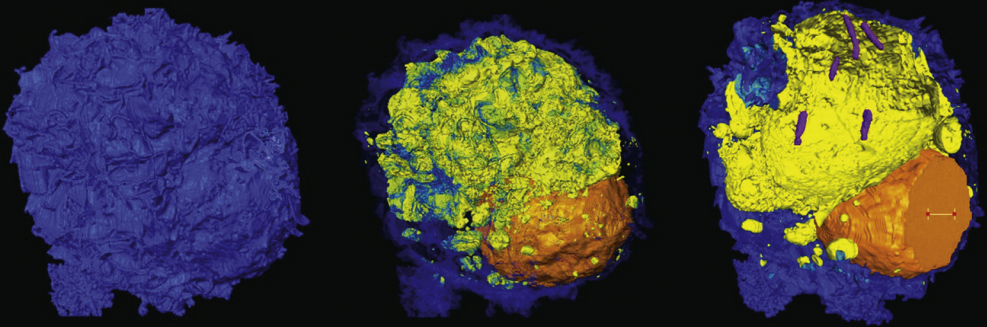


Second Edition

# Introductory Immunology



Basic Concepts for  
Interdisciplinary Applications

Jeffrey K. Actor



# INTRODUCTORY IMMUNOLOGY

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Interdisciplinary  
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SECOND EDITION

JEFFREY K. ACTOR



**ACADEMIC PRESS**

An imprint of Elsevier

Academic Press is an imprint of Elsevier  
125 London Wall, London EC2Y 5AS, United Kingdom  
525 B Street, Suite 1650, San Diego, CA 92101, United States  
50 Hampshire Street, 5th Floor, Cambridge, MA 02139, United States  
The Boulevard, Langford Lane, Kidlington, Oxford OX5 1GB, United Kingdom

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### Library of Congress Cataloging-in-Publication Data

A catalog record for this book is available from the Library of Congress

### British Library Cataloguing-in-Publication Data

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

ISBN : 978-0-12-816572-0

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*Publisher:* Andre G. Wolff

*Acquisition Editor:* Linda Versteeg-Buschman

*Editorial Project Manager:* Timothy Bennett

*Production Project Manager:* Maria Bernard

*Designer:* Christian Bilbow

Typeset by SPi Global, India

# Dedication

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To my father, Paul Actor, PhD, who instilled in me a sense of excitement about the wonders of science and the curiosity to seek questions about how biological systems function; and to my mother, Ruthe Actor, who taught me to seek value in everything I accomplish and to approach all challenges with an open mind.

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# Contents

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<b>Preface</b>	<b>xi</b>
<b>Acknowledgments</b>	<b>xv</b>
<b>1. A Functional Overview of the Immune System and Immune Components</b>	
Chapter Focus	1
Immune Homeostasis	1
Self versus Nonself	2
Innate and Adaptive Immunity	3
Anatomy of the Immune System	5
Cells of the Immune System	8
First-Line Defenders: The Myeloid Cells	10
Adaptive Avengers: The Lymphoid Cells	12
Lymphocytes	12
Cluster of Differentiation	14
Summary	14
<b>2. The Inflammatory Response</b>	
Chapter Focus	17
Inflammation	17
Initiation of the Inflammatory Response	19
The Role of Antibodies in Inflammation	20
Biological Functions of Complement	21
Activation and Directed Migration of Leukocytes	22
Pathogen Recognition and Cytokine Signaling	23
Feedback and Adaptation From a Distance	24
Pathological Consequences of the Inflammatory Response	29
Summary	30
<b>3. The B Lymphocyte: Antibodies and How They Function</b>	
Chapter Focus	31
B Lymphocytes Produce Antibodies	31
Structural Characteristics of Immunoglobulins	32
Immunoglobulin Nomenclature	35
Biologic Properties of Antibody Isotypes	36
Kinetics of Antibody Response	39
Membrane-Bound Immunoglobulin	40
Development of B Cells	40



Gene Recombination	40
Development and Selection of Mature B Cells	42
Activation and Differentiation of B Cells	42
Summary	43
<b>4. T Lymphocytes: Ringleaders of Adaptive Immune Function</b>	
Chapter Focus	45
T Lymphocytes: Specific and Long-Lasting Immunity	45
The T Cell Receptor	46
T-Cell Development	46
Antigen Recognition by T Cells: Requirement of Major Histocompatibility Molecules	49
The HLA Locus	49
MHC Class I	50
MHC Class II	52
T Lymphocyte Functions	52
CD4+ T-Helper Cells	54
Events Involved in T Lymphocyte Activation	55
Role of T Cells in B-Cell Activation	57
Cytotoxic T-Cell Effectors	58
Innate Lymphocytes and Superantigens	59
$\gamma\delta$ T Cells	59
Natural Killer T (NKT) Cells	60
Superantigens	61
Summary	61
<b>5. How We Defend Against Infectious Agents</b>	
Chapter Focus	63
Immune Homeostasis and Pathogenic Organisms	63
Major Immune Defense Mechanisms Against Pathogens	64
Physical Barriers to Infection	65
Bacterial Infections	66
Mycobacterial Infections	71
Viral Infections	73
Parasitic Infections (Helminths)	76
Fungal Infections	77
Evasion of Immune Response	78
Summary	79
<b>6. Basic Disorders of Immune Function</b>	
Chapter Focus	81
Immunodeficiency Disorders	81
Genetic Basis for Primary Immunodeficiency	82
Innate Deficiencies	82
Complement Disorders	83
Adaptive Immune Disorders	84

Treatment of Immunodeficiency Diseases	87
Immunodeficiency as a Predisposition to Disease	89
Summary	90

## 7. Autoimmunity: Regulation of Response to Self

Chapter Focus	91
Homeostasis, Immune Regulation, and Autoimmunity	91
Tolerance to Self	92
Etiology of Autoimmune Disease	94
Role of Autoantibodies and Self-Reactive T Lymphocytes in Autoimmune Disorders	98
Laboratory Tests for Autoimmunity	100
Targeted Therapeutics	101
Summary	102

## 8. Immune Hypersensitivities

Chapter Focus	103
Hypersensitive Disorders	103
Type I Hypersensitivity: Immunoglobulin E (IgE)-Mediated Immediate Hypersensitivity	104
Type II Hypersensitivity: Antibody-Mediated Cytotoxic Hypersensitivity	105
Type III Hypersensitivity: Immune Complex-Mediated Hypersensitivity	107
Type IV Hypersensitivity: Delayed-Type (Cell-Mediated) Hypersensitivity	108
Alternative Hypersensitivity Classifications	110
Summary	110

## 9. Vaccines and Immunotherapy

Chapter Focus	111
Principles of Vaccination	111
Basic Concepts of Protective Immunization	112
Types of Immunizations	114
Age and Timing of Immunizations	114
Passive Immunization	118
Therapeutic Uses of Immunoglobulins	119
Other Ways of Modifying Immunity	120
Summary	120

## 10. Cancer Immunology

Chapter Focus	123
Understanding Immune Defenses Against Cancers	123
Tumor Antigens	124
Effector Mechanisms in Tumor Immunity	125
Natural Killer (NK) Cells and Innate Response to Tumor Cells	125
Adaptive Response to Tumor Cells	126
Escape Mechanisms of Tumor Elimination	128

Tumors of the Immune System	128
Immunodiagnosis and Immunotherapy	129
Summary	131

## 11. Transplantation Immunology

Chapter Focus	133
Transplantation Defined	133
Tissue Histocompatibility	134
Natural Isohemagglutinins	135
Human Leukocyte Antigens	135
Allograft Rejection	136
Hyperacute Rejection	137
Accelerated Rejection	137
Acute Rejection	138
Chronic Rejection	138
Graft-Versus-Host Disease (GVHD)	138
Pretransplantation Histocompatibility Evaluation	139
Immunosuppressive Drugs to Prevent Allograft Rejection	140
Immunosuppressive Therapy	141
Summary	142

## 12. Assessment of Immune Parameters and Immunodiagnostics

Chapter Focus	143
Antibody-Antigen Reactions	143
Affinity	144
Secondary Manifestations of Antibody-Antigen Binding	145
Solid-Phase Precipitation Assays	148
Radial Immunodiffusion	149
The Ouchterlony Assay	150
Immunelectrophoresis	150
Latex Agglutination	150
Lateral Flow	150
Western Blot	151
Immunoassays	152
Enzyme-Linked Immunosorbent Assay (ELISA)	152
Detection of Cellular Antigens	154
Immunohistochemistry	154
Fluorescence-Activated Cell Sorting (FACS) Analysis	155
Multiplex Bead Arrays	157
Assays to Determine Immune Function	157
Complement Fixation Test	158
Lymphocyte Function Assays	159
Other Tools to Measure Immunological Status	159
Summary	161

<b>Glossary</b>	<b>163</b>
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<b>Index</b>	<b>171</b>
--------------	------------

# Preface

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Our bodies have evolved a protective set of mechanisms, comprised of cells and organs, as a primary defense to maintain health. In essence, we have developed internal tools to preserve health and homeostasis. Indeed, a working definition of *health* embraces the effective elimination or control of life-threatening agents. This includes both infectious agents attacking from the outside and internal threats, such as tumors. Immune responses, therefore, are designed to interact with, and respond to, the environment to protect the host against pathogenic invaders and internal dangers. The goal of this book is to appreciate the components of the human immune system that work together to confer protection.

We will begin our discussion by establishing a foundation for subsequent chapters, through the presentation of the systems and cells involved in immune responses. [Chapter 1](#) will give a general overview on the mechanisms in place to fight against disease. Components and pathways will be defined to allow the presentation of concepts of innate (always present) and adaptive (inducible and specific) responses, and how these responses interact with one another to form the basis for everyday protection. These concepts will form the foundation to examine the process of defense against various classes of pathogens. [Chapter 2](#) will examine the coordinated effort of cells and blood components in the development of inflammation as it is related to protection against infection. [Chapter 3](#) will introduce the basis for the function of adaptive components, exploring the generation of B lymphocytes and the nature of antibodies. [Chapter 4](#) will extend this discussion to T-lymphocyte populations and examine how they serve as ringleaders for immune function. [Chapter 5](#) will discuss immune responses, with an element of detail focused on commonly encountered infectious organisms. This overview also will include how the initial engagement of pathogens by innate components triggers pathways that cause inflammation. A section of this chapter will introduce the concept of opportunistic infections and diminished response when individuals are immunocompromised.

Effective immune surveillance is paramount to maintaining health. [Chapter 6](#) will examine the basic disorders of immune function. Too little of a response results in an inability to control threats, which thus is ineffective to eliminate infectious agents. This lack of reactivity (*hyporeactivity*) leads to holes in our immune repertoire. This may be the result of genetic deficiencies or acquired compromise of immune function. In the same

manner, responses representing excessive activity also can lead to damage to the host. This overaggressive response, a state of *hyperreactivity*, may reflect a productive response that increases in intensity and duration without effective control. The dysregulation leads to tissue-damaging events and eventual states of disease.

The chief function of the immune system is to distinguish between what is you (self) and what constitutes external threats. When the ability to distinguish these elements is compromised, autoimmunity may arise. In [Chapter 7](#), autoimmune dysfunction will be addressed, moving from basic concepts to the specific mechanisms involved in major clinical disorders. This includes a detailed discussion of how the self is recognized, as well as the mechanisms involved in tolerance that limit reactivity to our own tissues. The goals here are to present the clinical manifestation of autoimmunity in such a manner that outward symptoms are understood through investigation of the molecular targets involved in the host immune self-recognition response. At other times, misdirected recognition of nonself elements, such as environmental allergens that typically are considered harmless, result in the development of clinical presentations. Therefore, [Chapter 8](#) will examine the processes involved in the manifestation of immune dysfunction, including the concepts of immune hypersensitivities that lead to clinical disease.

The general topic of vaccines will be addressed in [Chapter 9](#), including both how they work and a frank discussion of the relative truths and myths surrounding their use. This chapter also will contain information on newly developed therapeutics that are grounded in methods that lead to immune modification and factors that promote a healthy immune response (for example, lifestyle activities and good common practices). Indeed, it is critical that we maintain a healthy balance throughout our lives to ensure functional immune response as we age. The challenges faced at each stage of our lives, from that found in the prenatal/newborn period, to midlife, to so-called maturity, are mentioned in a way that encourages a healthy condition to allow the optimization of immune function.

A discussion of natural (effective) response to tumor development in [Chapter 10](#) will lead to an investigation into the components of immune function to eliminate potentially dangerous precancerous events naturally. This will be followed by coverage of the challenges that we face when protective responses fail and tumors develop. A section also will contain information on cancers of the immune system and the problems that arise when the protective cells themselves become the cause of tumorigenic activity.

[Chapter 11](#) will delve once more into details underlying the concepts of “self” versus “nonself” and blood types, with the goal to present genetic relationships (similarities as well as differences) between individuals. The

mechanisms of the immunobiology of transplantation will be discussed, with details about the contributing cells and factors involved in transplant acceptance and rejection. The challenge is to appreciate the importance of innate and adaptive components in graft recognition, as well as to recognize the clinical consequences of transplantation that affect aspects of daily activities. Rejection topics will be discussed, including graft-versus-host disease (GVHD), as well as modern immune-based therapeutics designed to alter immune function to limit graft rejection.

Finally, additional information and resources will be provided in [Chapter 12](#) to allow readers to develop an immune-based foundation of knowledge to understand the clinical tests associated with identifying immune parameters that arise during development of disease states. As such, this includes an introduction to mechanisms that form the basis of immune-related diagnostics and identification of immune properties of the blood during disorders.

All in all, the hope is that this book will present the concept of the immune system so that readers may better understand immune-based diseases resulting from either immune system component deficiencies or excess activity. This book is aimed at those who want to know more, to encourage readers to explore deeper. It is aimed at the curious who have never previously considered the underlying facets of effective immune function. To students who wish to expand their basic knowledge of biological systems. To physicians seeking to refresh their understanding of the immune concepts that cause clinical disease. To nurses who desire to expand their view of symptom development in patients. To patients who want a simple explanation for the complex way that their bodies respond in the context of the world they live in. And finally, to all who seek to find out how the body confers protection against infectious agents, maintains everyday homeostasis, and guards against dysregulation of the normal response to confer health and control the development of disease.

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