

Fundamentals of Microbiology

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Preface

Audience

Fundamentals of Microbiology is intended for introductory level courses in microbiology. The text assumes little previous experience in science other than a basic course in biology and some fundamental chemistry. It is intended to serve students in health science programs such as nursing, medical laboratory technology, and dental hygiene, as well as those in curricula such as food science, agriculture, business, and environmental science. Students in premedical and predental courses of study will also find it useful, since it provides a foundation for more advanced programs.

Overview

Microbiology is a broad and complex science that explores the significance of the microorganisms. It encompasses highly technical research performed in sophisticated laboratories and includes multiple applications in everyday life. Microbiology is essential to both the fabric of medicine and the emerging technology of the present era.

The unifying concept of this textbook is an understanding of the spectrum of microorganisms and their relationship to public health and human welfare. The material includes discussions of microbial anatomy and growth patterns, and the pathology of infectious diseases. It outlines the natural mechanisms for body defense as well as the methods for controlling the proliferation of microorganisms by physical and chemical means. Ample coverage is also given to the positive roles played by microorganisms in the environment and in industry.

The reader will note that emphasis has been placed on the application of modern research to practical problems and that germane historical accounts have been included to give a perspective on the

growth of microbiology. Both associate and baccalaureate degree students should find the reading easy to handle and the microbiology enjoyable to learn.

Pedagogical Features

In the development of the textbook a concerted effort has been made toward enhancing its use as a learning aid. Accordingly, several features are included in each chapter:

1. **Introductory comments** inform the student of the material to be covered and the sequence of topics to be encountered.
2. **Mid-chapter summaries**, entitled "To This Point," summarize the information previously studied in the chapter and preview the next several pages.
3. A **marginal pronunciation guide** provides pronunciation of difficult terms as they are encountered in the text.
4. **Boxes** in each chapter permit diversion from the text for discussion of a stimulating topic of microbiological interest.
5. A **Note to the Student** in each chapter presents an editorial comment on a topic relative to the chapter and gives insight on an application of the text material.
6. **Summary Statements** at the conclusion of the chapters review the major points of the text in concise fashion.
7. **Questions for Thought and Discussion** encourage use of the material in the text to solve thought-provoking problems.
8. **End-of-chapter tables** provide a summary of the important aspects of the chapter and serve as a valuable study tool.
9. **Marginal representations of microorganisms** place a vision of the organism in the mind of the reader while information about that organism is being learned.
10. **Appendixes** include the classification of bacteria according to *Bergey's Manual of Determinative Bacteriology*, temperature and metric conversion charts, and a listing of the incubation periods of important diseases.
11. A **Glossary** lists over 850 words used in the text with the chapter location for each word.

Organization

Fundamentals of Microbiology is organized into seven parts that cover the broad scope of microbiology.

Part I: Foundations of Microbiology reviews the early development of microbiology, the basic chemistry of living things, and some fundamental concepts that apply to all microorganisms. The first chapter recounts many of the discoveries that led to a recognition of the role of microorganisms in disease and brings the reader from the 1800s into the early part of this century. Basic chemistry is presented in Chapter 2 as a refresher for those with limited backgrounds in this science and because chemistry is inexorably linked to the structure and function of microbes. In Chapter 3, the various types of microorganisms are briefly surveyed with discussions of such concepts as classification, size, nomenclature, and microscopy.

Part II: The Bacteria contains three detailed chapters on the significance of bacteria. Chapter 4 discusses their structures and the conditions necessary for their growth. Chapter 5 surveys bacterial metabolism and explains how the microorganisms obtain energy and synthesize organic compounds. Chapter 6 details the recent discoveries in bacterial genetics and includes a description of the research in genetic engineering used in modern technology. Detailed discussions of bacterial disease are withheld until a firmer grasp of infection patterns and resistance mechanisms has been established.

Part III: Rickettsiae and Other Microorganisms includes chapters on the rickettsiae, viruses, fungi, and protozoa. The anatomy and growth patterns of these organisms are considered, and their important diseases are surveyed. These discussions support the later presentations on the mechanisms of disease by creating a storehouse of information. Special attention is placed on viral diseases in Chapters 9 and 10 because of their importance in modern medicine.

Part IV: Disease and Resistance contains four chapters on the development of disease and the methods available to the body for resistance. The host-parasite relationship is explored in Chapter 13, and Chapter 14 contains discussions of nonspecific processes for resistance and outlines of specific mechanisms involving the immune system. Fundamental interactions of immunity and the applications of immunology to the diagnostic laboratory are then reviewed in Chapter 15. Chapter 16 treats disorders of the immune system and surveys various types of hypersensitivity reactions.

Part V: Bacterial Disease of Humans presents a detailed analysis of many of the common problems with which public health is concerned. Bacterial diseases are examined in four chapters, grouped according to the principal mode of transmission of the disease. Such factors as symptomology, treatment, detection methods, and immunization are reviewed. Many of the banes of civilization are included in this section, and insight is given to prevention and control of the diseases.

Part VI: Control and Destruction of Microorganisms encompasses three chapters on the methods used for eliminating microorganisms outside and inside the body. Physical agents such as heat are discussed in Chapter 21, and the disinfectants and antiseptics comprise the main body of Chapter 22. In Chapter 23 the emphasis moves inside the body with consideration of the chemotherapeutic agents and antibiotics.

Part VII: Microbiology and Public Health contains five chapters, the first three of which outline the measures used by public health agencies to control the spread of microorganisms in foods, dairy products, and water. Laboratory methods are also explored in detail, and liberal mention is made of the positive role played by the microorganisms in the production of food and dairy products, in the treatment of sewage, and in the elemental cycles of the soil. Chapter 27 considers the multicellular parasites that infect major populations of the world and Chapter 28 reviews many of the industrial uses of microorganisms that add to the quality of life.

Acknowledgments

The author is happy to acknowledge the many men and women who have contributed to the development of this book. First among these is James Funston, Life Sciences Editor at Addison-Wesley, who in the summer of 1979 encouraged me to write this text, signed me to a contract, and then became a trusting and devoted mentor.

Special recognition is also due to Professors William Tidwell of San Jose State University and Harry Peery of Tompkins-Cortland Community College who read the manuscript with fine-tooth combs and offered fruitful advice. In addition, helpful suggestions were made by Professors R. E. Pacha of Central Washington University, Philip W. Mohr of Pennsylvania State University, David Ballard of Utah Technical College, Joan Handley of the University of Kansas, Douglas P. Bingham of West Texas State University, and Violet Schirone of Suffolk County Community College.

A special note of thanks is extended to the many investigators and industrial corporations who were most generous with their photographs. Cindy Thomas merits applause for her tireless research efforts and Kathy Erickson and Ted Salzman are to be commended for their typing skills. The staff members at Addison-Wesley deserve special credit for the expertise they displayed during the production of this book, with particular recognition to Marion Howe and Dick Morton, and to Kathy Aronson for her organizational talents.

I am particularly proud of my wife, Judy, and my children, Michael, Elizabeth, and Patricia. For three long years they have given meaning to the words *patience* and *support*. This book is for them.

Huntington, New York
January 1983

I.E.A.

To the Student

When I was a student, I hardly ever read the "To the Student" sections of my textbooks, and it was only later in my years that I learned what they were all about. Therefore, I am encouraged that you are reading this, and while I have your attention, I should like to let you know what this book contains and explain some of my intentions in putting it together.

I have yet to meet a student who has read a microbiology textbook for the sheer joy of it. I assume, therefore, that you have been assigned this book as part of your microbiology program and I have worked hard to present the material in a useful and timely fashion. Let me tell you how.

I have kept the chapters to approximately the same length so you can gauge the time necessary for each and plan your study time accordingly. I have also avoided lengthy presentations and have focused on smaller sections, each with a heading that identifies the right for instance, you will find independent sections on each of the major antibiotic, cell structure, and so forth. This should account for moderate short, interrupted study times.

I have written historical narratives in many chapters to show how real people like ourselves sweat and sometimes gave their lives to make the knowledge of microbiology possible. It may be difficult to comprehend that only a hundred years ago little of the material presented in this book was known. I have also tried to give you a glimpse into the future by explaining current trends in microbiological research.

I have included introductory remarks with each chapter to let you know what is coming and mid-chapter pauses to allow you to review yourself before getting too deeply into the text. Sometimes we lose

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I have included introductory remarks with each chapter to let you know what is coming, and mid-chapter pauses to allow you to reorient yourself before getting too deeply into the forest. Sometimes we lose

sight of our objectives, and these pauses may help to keep us on the straight and narrow path.

In each chapter you will find two Boxes that convey useful material associated with the text, such as a problem of current significance, an historical perspective, an ironic situation, or an application of microbiology. I hope you will find these stimulating.

At the end of each chapter, I have included a Note to the Student. This is where I have an opportunity to present a personal opinion related to the chapter. A textbook writer has to be very noncommittal, and one soon gets tired of "just the facts." I have therefore added a thought or two of my own.

I have listed at the end of each chapter a dozen Summary Statements to highlight the most important ideas presented in the text. You will find them helpful for a quick review of the material; it is also valuable to read them through before beginning your study of the chapter.

I trust you will find the Questions for Thought and Discussion to be challenging applications of microbiology. They may start a classroom discussion or two, in which case they will have fulfilled my hope that you will use the text information for problem solving. If you have a question or two that might be appropriate, please send it along and perhaps it can be included in the next edition. The more traditional types of questions asking you to choose, list, compare, and summarize are presented in the Study Guide that accompanies this text.

I have also included the pronunciation of difficult words in the margins of the pages on which they occur. This should increase your familiarity with the terms, make you more confident in using them, and add to your enjoyment of microbiology. You will also find marginal illustrations of the organisms being discussed and summary tables in most chapters for a quick review.

In the back of the book, I have provided a glossary with over 850 terms briefly defined. Each item includes the chapter number from which it is taken so you can find it easily for additional information. There are also four appendixes for quick reference.

I would like to hear from you. Please let me know what is good about the book so I can build on it and what is bad so I can eliminate or change it. I am as human as your instructor, and I am trying to make this text as useful to your study time as your instructor is making the lectures to your class time. Also, I would enjoy hearing about any local news of microbiology in your community. I can be reached by writing to the Life Sciences Editor, Addison-Wesley Publishing Company, Reading, Massachusetts 01867.

If I may leave you with a thought, it would be something a student named Michael said to me back in 1968. As I recall, it was a Spring

afternoon, and he was working in the lab with his microscope. Quite spontaneously, he looked up and said, "You know, Dr. Alcamo, education is like soup; the more you put into it, the more you get out of it."

Good luck with your studies and I hope your life's goals become realities.

I. Edward Alcamo



Airborne
Food, Waterborne
Soil, Arthropodborne
Contact, Endogenous

Disease
Resistance
Immunity, Serology
Immune Disorders

DISEASE AND
RESISTANCE

BACTERIAL
DISEASES
OF HUMANS

Rickettsiae
Viruses
Fungi
Protozoa

RICKETTSIAE AND OTHER
MICROORGANISMS

Physical Methods
Chemical Methods
Chemotherapeutic Agents

CONTROL OF
MICROORGANISMS

Microbiology of Foods
Microbiology of
Dairy Products

Morphology and Growth
Metabolism
Genetics

THE BACTERIA

MICROBIOLOGY AND PUBLIC HEALTH
Microbiology of Water
Multicellular Parasites
Industrial Microbiology

Principles of chemistry

Basic Concepts

Early History

Foundations of
Microbiology

The Scope of Microbiology

Contents in Brief

Foundations of Microbiology I

- 1 The Development of Microbiology
- 2 Fundamentals of Chemistry
- 3 Basic Concepts of Microbiology

The Bacteria II

- 4 Morphology and Growth of Bacteria
- 5 Bacterial Metabolism
- 6 Bacterial Genetics

Rickettsiae and Other Microorganisms III

- 7 The Rickettsiae and Chlamydiae
- 8 The Viruses
- 9 The Viral Diseases of Humans I
- 10 The Viral Diseases of Humans II
- 11 The Fungi
- 12 The Protozoa

Disease and Resistance IV

- 13 Infection and Disease
- 14 Resistance to Disease
- 15 Antibodies, Immunity, and Serology
- 16 Disorders of the Immune System

85

119

152

185

213

244

278

310

342

379

406

439

471

Bacterial Diseases of Humans V

17	Airborne Bacterial Diseases of Humans	501
18	Foodborne and Waterborne Bacterial Diseases of Humans	530
19	Soilborne and Arthropodborne Bacterial Diseases of Humans	560
20	Contact and Endogenous Bacterial Diseases of Humans	586

Control of Microorganisms VI

21	Physical Methods for Controlling Microorganisms	617
22	Chemical Methods for Controlling Microorganisms	641
23	Chemotherapeutic Agents and Antibiotics	669

Microbiology and Public Health VII

24	Microbiology of Foods	703
25	Microbiology of Milk and Dairy Products	728
26	Microbiology of Water	752
27	Multicellular Parasites of Humans	784
28	Industrial Microbiology	811

Detailed Contents

The Development of Microbiology 1

THE DISCOVERY ERA

THE TRANSITION PERIOD

- Spontaneous Generation
- Disease Transmission

THE GOLDEN AGE OF MICROBIOLOGY

- Louis Pasteur
- Pasteur and Disease
- Robert Koch
- Pure Culture Techniques
- The Competition Period
- Other Pioneers of Microbiology
- End of the Golden Age

Fundamentals of Chemistry 2

THE ELEMENTS

- Atoms
- Atomic Ions
- Electron Placement
- Molecules

CHEMICAL BONDING

- Ionic Bonding
- Covalent Bonding
- Hydrogen Bonding
- Acids and Bases
- Chemical Reactions

Foundations of Microbiology I

3

3

6

6

7

8

8

11

13

15

15

21

22

27

27

28

31

32

33

34

34

34

38

39

41

CHEMICAL COMPOUNDS OF ORGANISMS

Carbohydrates	42
Lipids	44
Proteins	44
Nucleic Acids	48

Basic Concepts of Microbiology 3

A BRIEF SURVEY OF MICROORGANISMS

Bacteria	54
Viruses	56
Protozoa	58
Fungi	58
Algae	59

CLASSIFICATION

Modern Classification	59
-----------------------	----

NOMENCLATURE

60

SIZE RELATIONSHIPS

65

MICROSCOPY

Bright-Field Microscopy	66
Dark-Field Microscopy	67
Phase-Contrast Microscopy	71
Fluorescent Microscopy	72
Electron Microscopy	73

74

Morphology and Growth of Bacteria 4

MORPHOLOGY OF THE BACTERIA

FINE CELLULAR STRUCTURE

Flagellum	89
Pili	89
Capsule	89
Cell Wall	91
Cell Membrane	92
Cytoplasm	95
Spore	95

BACTERIAL REPRODUCTION

Bacterial growth curve	96
------------------------	----

BACTERIAL NUTRITION

Cultivation of the Bacteria	100
Patterns of Nutrition	102
Intermicrobial Relationships	105
Temperature	107

The Bacteria

85

85

89

89

89

91

92

95

95

96

100

102

105

105

107

107

108

Oxygen	108
Acidity/Alkalinity	111
STAINING OF BACTERIA	112
Simple Stain Technique	112
Negative Stain Technique	114
Gram Stain Technique	114
Acid-Fast Technique	115
Special Stain Techniques	116
Bacterial Metabolism 5	119
ENZYMES AND CELLULAR ENERGY REACTIONS	119
Enzymes	119
Energy	123
CATABOLISM OF CARBOHYDRATES	125
Carbohydrate Catabolism by Aerobic Respiration	126
Glycolysis	126
The Krebs Cycle	128
Oxidative Phosphorylation	130
Catabolism of Other Carbohydrates	132
Carbohydrate Catabolism by Anaerobic Respiration	133
Fermentation	135
CATABOLISM OF PROTEINS AND FATS	135
ANABOLISM OF CARBOHYDRATES AND FATS	138
Photosynthesis in Microorganisms	138
Anabolism of Fats	140
ANABOLISM OF PROTEINS	141
Transcription	143
Translation	145
Control of Protein Anabolism	147
Bacterial Genetics 6	152
THE BACTERIAL CHROMOSOME	153
Duplication of the Chromosome	153
BACTERIAL MUTATION	156
Types of Mutations	156
Effect of Mutations	159
BACTERIAL RECOMBINATION	161
Transformation	161
Conjugation	163
High-Frequency Recombination	165
Plasmids	166
Transduction	167