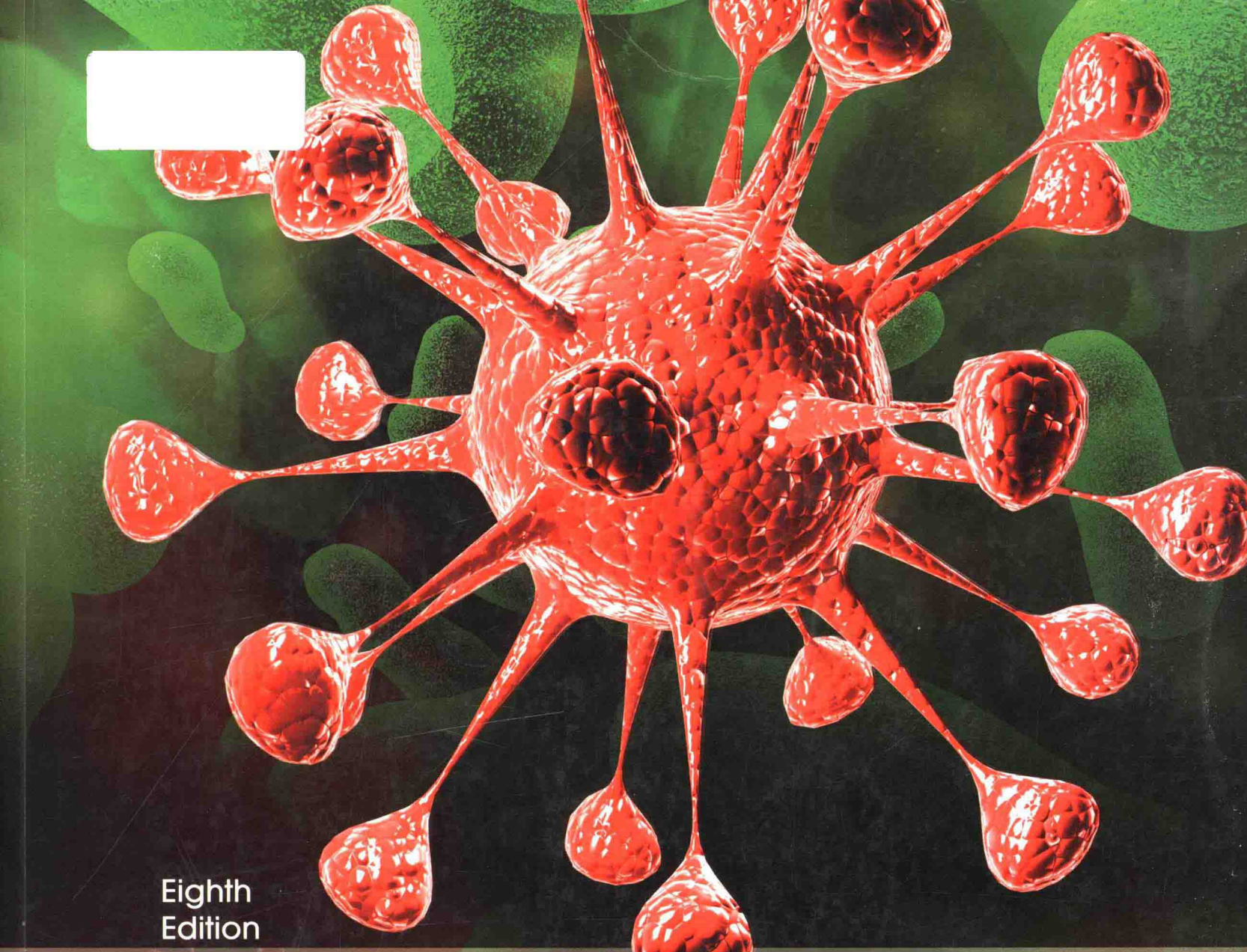

Eighth
Edition

Microbiology

JACQUELYN G. BLACK

International Student Version

Microbiology 8TH EDITION

International Student Version

JACQUELYN G. BLACK

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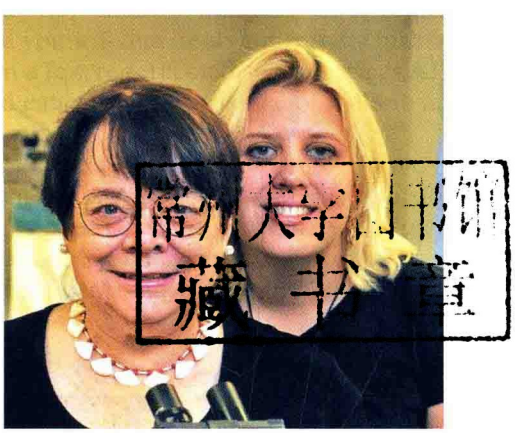
Laura Black has been working on this book since she was ten years old. She has been a contributing author for the past two editions.



JACQUELYN and LAURA BLACK

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TO LAURA . . .
for sharing her mother and much of her childhood
with that greedy sibling "the book."

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ISBN: 978-0-470-64621-2

Printed in Asia
10 9 8 7 6 5 4 3 2 1

Diseases and the Organisms that Cause Them

BACTERIAL DISEASES—ALSO SEE APPENDIX B

Disease	Organism	Type*	Page
acne	*Propionibacterium acnes*	R, +	513
actinomycosis	*Actinomyces israelii*	I, +	523
anthrax	*Bacillus anthracis*	R, +	85, 641–643
bacterial meningitis	*Haemophilus influenzae*	R, –	675
	Neisseria meningitidis	C, –	389, 670
	Streptococcus pneumoniae	C, +	671
	Listeria monocytogenes	R, –	671
bacterial vaginitis	*Gardnerella vaginalis*	R, –	543
botulism	*Clostridium botulinum*	R, +	361, 668, 680–681
brucellosis (undulant fever, Malta fever)	*Brucella* sp.†	CB, –	646–647
cat scratch fever	*Afipia felis*, *Bartonella henselae*	R, – CB,NA	528
chancroid	*Haemophilus ducreyi*	R, –	551
cholera (Asiatic cholera)	*Vibrio cholerae*	vibrio, –	361, 611–612
conjunctivitis	*Haemophilus aegyptius*	CB, –	523
dental caries	*Streptococcus mutans*	C, +	603–605
diptheria	*Corynebacterium diptheriae*	R, +	603–605
ehrlichiosis	*Ehrlichia* sp.	R,NA	653
endocarditis	*Enterococcus faecalis*	C, +	637–638
food poisoning	*Staphylococcus aureus*	C, +	361, 607–609
	Streptococcus pyogenes	C, +	631
	Clostridium perfringens	R, +	361, 608
	Clostridium botulinum	R, +	608
	Bacillus cereus	R, +	608
	Listeria monocytogenes	R, +	671
	Campylobacter sp.	R, –	345, 607–609, 612
	Shigella sp.	R, –	361, 610–611
	Salmonella sp.	R, –	344, 609
	Vibrio parahaemolyticus	R, –	612
gas gangrene	*Clostridium perfringens* and others	R, –	527–528
gonorrhea	*Neisseria gonorrhoeae*	C, –	545–548
granuloma inguinale (donovanosis)	*Calymmatobacterium granulomatis*	R, –	554
Hansen's disease (leprosy)	*Mycobacterium leprae*	R, A-F	676–680
Legionnaires' disease (legionellosis)	*Legionella pneumophilia*	R, –	579–581
leptospirosis	*Leptospira interrogans*	S, –	542–543
listeriosis	*Listeria monocytogenes*	R, +	671
Lyme disease	*Borrelia burgdorferi*	S, –	292, 647–650
lymphogranuloma venereum	*Chlamydia trachomatis*	coccoid, NA	554
Madura foot (maduromycosis)	*Actinomadura*, *Streptomyces*, *Nocardia*	I, +, some A-F	523
nongonococcal urethritis (NGU)	*Chlamydia trachomatis*	R,VAR	552–553
	Ureaplasma urealyticum	I,NA	553
ornithosis (psittacosis)	*Chlamydia psittaci*	coccoid, NA	585
Oroyo fever (Carrion's disease, bartonellosis)	*Bartonella bacilliformis*	coccoid, –	652
peptic ulcer	*Helicobacter pylori*	R, –	614–615
periodontal disease	*Porphyromonas gingivalis* and others	R, –	605–606
pharyngitis (strep throat)	*Streptococcus pyogenes*	C, +	571–572
plague (black death) bubonic plague pneumonic plague	*Yersinia pestis*	R, –	293, 643–645
pneumonia	*Streptococcus pneumoniae*	C, +	578–579
	Klebsiella pneumoniae	R, –	113, 152, 579, 595
pneumonia, atypical (walking pneumonia)	*Mycoplasma pneumoniae*	I,NA	579
pseudomembranous colitis	*Clostridium difficile*	R, +	615–616
puerperal fever (childbed fever)	*Streptococcus pyogenes*	C, +	637
Q fever	*Coxiella burnetti*	CB, NA	292, 585–586
rat bite fever	*Spirillum minor*	S, –	529
	Streptobacillus moniliformis	R, –	529
relapsing fever	*Borrelia* sp.	S, –	646–647
rheumatic fever	*Streptococcus pyogenes*	C, +	637
rickettsialpox	*Rickettsia akari*	CB, NA	651
Rocky Mountain spotted fever	*Rickettsia rickettsii*	CB, NA	651
salmonellosis	*Salmonella* sp.	R, –	609
shigellosis (bacillary dysentery)	*Shigella* sp.	R, –	610–611
skin and wound infections (scalded skin syndrome, scarlet fever, erysipelas, impetigo, etc.)	*Staphylococcus aureus*	C, +	512
	Staphylococcus epidermidis	C, +	513
	Streptococcus sp.	C, +	513
	Providencia stuartii	R, –	513
	Pseudomonas aeruginosa	R, –	513
	Serratia marcescens	R, –	178, 514
syphilis	*Treponema pallidum*	S, –	548–552
tetanus	*Clostridium tetani*	R, +	679–680
toxic shock syndrome	*Staphylococcus aureus*	C, +	544
trachoma	*Chlamydia trachomatis*	coccoid, NA	525
trench fever	*Rochalimaea quintana*	CB, NA	293, 652
tuberculosis	*Mycobacterium tuberculosis*	R, A-F	581–585
tuberculosis, avian	*Mycobacterium avium*	R, A-F	583
tularemia	*Francisella tularensis*	R, –	293, 645–646
typhoid fever	*Salmonella typhi*	R, –	609–610
typhus, endemic (murine typhus)	*Rickettsia typhi*	CB,NA	650–651
typhus, epidemic	*Rickettsia prowazekii*	CB,NA	650
typhus, recrudescent (Brill-Zinsser disease)	*Rickettsia prowazekii*	CB,NA	650
typhus, scrub (tsutsugamushi disease)	*Rickettsia tsutsugamushi*	CB,NA	650

Diseases and the Organisms that Cause Them (*Continued*)

BACTERIAL DISEASES—ALSO SEE APPENDIX B

Disease	Organism	Type*	Page
verruga peruana (bartonellosis)	*Bartonella bacilliformis*	coccoid, –	652
vibriosis	*Vibrio parahaemolyticus*	R, –	612
whooping cough (pertussis)	*Bordetella pertussis*	CB, –	575–578
yersiniosis	*Yersinia enterocolitica*	R, –	613

*Key to types:
C = coccus; CB = coccobacillus; R = rod; S = spiral; I = irregular; – = Gram-negative; + = Gram-positive; VAR = Gram-variable; A-F = acid-fast; NA = not applicable

†Species

VIRAL DISEASES

Disease	Virus	Reservoir	Page
aplastic crisis in sickle cell anemia	erythrovirus (B19)	humans	658
avian (bird) flu	influenza	birds	586–588
bronchitis, rhinitis	parainfluenza	humans, some other mammals	575
Burkitt's lymphoma	Epstein-Barr	humans	655–657
cervical cancer	human papillomavirus	humans	245, 520 558
chickenpox	varicella-zoster	humans	248–251 516–517
coryza (common cold)	rhinovirus	humans	244, 574–575
	coronavirus	humans	574
cytomegalic inclusion disease	cytomegalovirus	humans	559
Dengue fever	Dengue	humans	292, 653–654
encephalitis	Colorado tick fever	mammals	292, 658
	Eastern equine encephalitis	birds	244, 377, 673
	St. Louis encephalitis	birds	675
	Venezuelan equine encephalitis	rodents	244, 675
	Western equine encephalitis	birds	244, 292, 378, 675
epidemic keratoconjunctivitis	adenovirus	humans	526
fifth disease (erythema infectiosum)	erythrovirus (B19)	humans	245, 658
hantavirus pulmonary syndrome	bunyavirus	rodents	245, 592
hemorrhagic fever	Ebola virus (filovirus)	humans (?)	245, 657
	Marburg virus (filovirus)	humans (?)	245, 657
hemorrhagic fever, Bolivian	arenavirus	rodents and humans	657
hemorrhagic fever, Korean	bunyavirus (Hantaan)	rodents	245, 657
hepatitis A (infectious hepatitis)	hepatitis A	humans	244, 617–619
hepatitis B (serum hepatitis)	hepatitis B	humans	245, 619
hepatitis C (non-A, non-B)	hepatitis C	humans	620
hepatitis D (delta hepatitis)	hepatitis D	humans	620
hepatitis E (enterically transmitted non-A, non-B, non-C)	hepatitis E	humans	620
herpes, genital	usually herpes simplex type 2, sometimes type 1	humans	245, 556–557
herpes, oral	usually herpes simplex type 1, sometimes type 2	humans	245, 554–555
HIV disease, AIDS	human immunodeficiency virus (HIV)	humans	244, 489–496
infectious mononucleosis	Epstein-Barr	humans	655
influenza	influenza	swine, humans (type A)	244, 247, 454 585–588
		humans (type B)	244, 247 454, 586–591
		humans (type C)	671 586–591
Lassa fever	arenavirus	rodents	657
measles (rubeola)	measles	humans	244, 515–516
meningoencephalitis	herpes	humans	557, 675
molluscum contagiosum	poxvirus group	humans	519
monkeypox	orthopoxvirus	humans, monkeys	519
mumps	paramyxovirus	humans	606–607
pneumonia	adenoviruses, respiratory syncytial virus	humans	578–579
poliomyelitis	poliovirus	humans	244, 681–682
rabies	rabies	all warm-blooded animals	672–675
respiratory infections	adenovirus	humans	595
	polyomavirus	none	675
Rift Valley fever	bunyavirus (phlebovirus)	humans sheep, cattle	658
roseola	human herpes virus-6	humans	516
rubella (German measles)	rubella	humans	244, 514–515
SARS (sudden acute respiratory syndrome)	coronavirus	animal	591
shingles	varicella-zoster	humans	245, 516–517
smallpox	variola (major and minor)	humans	245, 518–519
viral enteritis	rotavirus	humans	616–617
warts, common (papillomas)	human papillomavirus	humans	245, 519–521
warts, genital (condylomas)	human papillomavirus	humans	245, 519–521 558–559
West Nile	West Nile	birds	675
yellow fever	yellow fever	monkeys, humans, mosquitoes	244, 245 292, 655

The tables of fungal and parasitic diseases appear on the following page.

Diseases and the Organisms that Cause Them (*Concluded*)

UNCONVENTIONAL AGENTS

Disease	Agent	Resevior	Page
chronic wasting disease	prion	elk, deer	685
Creutzfeldt-Jacob disease	prion	humans	683–684
kuru	prion	humans	684
mad cow disease (bovine spongiform encephalopathy)	prion	cattle	685
scrapie	prion	sheep	684–685

FUNGAL DISEASES

Disease	Organism	Page
aspergillosis	*Aspergillus* sp	523, 594
blastomycosis	*Blastomyces dermatitidis*	522
candidiasis	*Candida albicans*	522
coccidioidomycosis (San Joaquin valley fever)	*Coccidioides immitis*	593–594
cryptococcosis	*Filobasidiella neoformans*	594
ergot poisoning	*Claviceps purpurea*	722
histoplasmosis	*Histoplasma capsulatum*	593
Pneumocystis pneumonia	*Pneumocystis carinii*	594
ringworm (tinea)	various species of *Epidermophyton, Trichophyton, Microsporum*	521–522
sporotrichosis	*Sporothrix schenckii*	522
zygomycosis	*Rhizopus* sp., *Mucor* sp	523

PARASITIC DISEASES

Disease	Organism	Type	Page
Acanthamoeba keratitis	*Acanthamoeba culbertsoni*	protozoan	386
African sleeping sickness (trypanosomiasis)	*Trypanosoma brucei gambiense* and *T. brucei rhodesiense*	protozoan	293–294, 686–689
amoebic dysentery	*Entamoeba histolytica*	protozoan	621–622
ascariasis	*Ascaris lumbricoides*	roundworm	627–628
babesiosis	*Babesia microti*	protozoan	662
balantidiasis	*Balantidium coli*	protozoan	622–623
Chagas' disease	*Trypanosoma cruzi*	protozoan	292, 687–689
chigger dermatitis	*Trombicula* sp.	mite	530
chigger infestation	*Tunga penetrans*	sandflea	530
Chinese liver fluke	*Clonorchis sinensis*	flatworm	624
crab louse	*Phthirus pubis*	louse	531
cryptosporidiosis	*Cryptosporidium* sp.	protozoan	623
dracunculiasis (Guinea worm)	*Dracunculus medinensis*	roundworm	289, 525
elephantiasis (filariasis)	*Wuchereria bancrofti*	roundworm	289, 640
fasciiolopsiasis	*Fasciolopsis buski*	flatworm	624
giardiasis	*Giardia intestinalis*	protozoan	620–621
heartworm disease	*Dirofilaria immitis*	roundworm	274, 636
hookworm	*Ancylostoma duodenale* (Old World hookworm)	roundworm	727
	Necator americanus (New World hookworm)	roundworm	727
leishmaniasis	*Leishmania braziliensis*	protozoan	292, 659
kala azar	*L. donovani*		
oriental sore	*L. tropica*		
liver/lung fluke (paragonimiasis)	*Paragonimus westermani*	flatworm	286, 594
loaiasis	*Loa loa*	roundworm	294, 527
malaria	*Plasmodium* sp.	protozoan	277, 389, 659–661
pediculosis (lice infestation)	*Pediculus humanus*	louse	530
pinworm	*Enterobius vermicularis*	roundworm	629
river blindness (onchocerciasis)	*Onchocerca volvulus*	roundworm	526–527
scabies (sarcoptic mange)	*Sarcoptes scabiei*	mite	530
schistosomiasis	*Schistosoma* sp.	flatworm	287, 638–640
sheep liver fluke (fascioliasis)	*Fasciola hepatica*	flatworm	624
strongyloidiasis	*Strongyloides stercoralis*	roundworm	629
swimmer's itch	*Schistosoma* sp.	flatworm	525
tapeworm infestation (taeniasis)	*Hymenolepsis nana* (dwarf tapeworm)	flatworm	625–626
	Taenia saginata (beef tapeworm)	flatworm	285–286, 288, 625–626
	Taenia solium (pork tapeworm)	flatworm	625–626
	Diphyllobothrium latum (fish tapeworm)	flatworm	625–626
	Echinococcus granulosus (dog tapeworm)	flatworm	625–626
toxoplasmosis	*Toxoplasma gondii*	protozoan	661–662
trichinosis	*Trichinella spiralis*	roundworm	274, 289, 626
trichomoniasis	*Trichomonas vaginalis*	protozoan	544–545
trichuriasis (whipworm)	*Trichuris trichiura*	roundworm	626–628
visceral larva migrans	*Toxocara* sp.	roundworm	626–628

Preface

The development of microbiology—from Leeuwenhoek's astonished observations of "animalcules," to Pasteur's first use of rabies vaccine on a human, to Fleming's discovery of penicillin, to today's race to develop an AIDS vaccine is one of the most dramatic stories in the history of science. To understand the roles microbes play in our lives, including the interplay between microorganisms and humans, we must examine, learn about, and study their world—the world of microbiology.

Microorganisms are everywhere. They exist in a range of environments from mountains and volcanoes to deep-seas vents and hot springs. Microorganisms can be found in the air we breathe, in the food we eat, and even within our own body. In fact, we come in contact with countless numbers of microorganisms every day. Although some microbes can cause disease, most are not disease producers; rather they play a critical role in the processes that provide energy and make life possible. Some even prevent disease, and others are used in attempts to cure disease. Because microorganisms play diverse roles in the world, microbiology continues to be an exciting and critical discipline of study. And because microbes affect our everyday lives, microbiology provides many challenges and offers many rewards. Look at your local newspaper, and you will find items concerning microbiology: to mention a few, reports on diseases such as AIDS, tuberculosis, and cancer; the resurgence of malaria and dengue fever, or "new" diseases.

For example the current public health problem with people dying of *Listeria* infections gotten from cantaloupes, can be prevented. Chapter 1 describes an anti-*Listeria* bacteriophage product licensed by the U.S. government, which kills all *Listeria* on the surface of cut melons, if only we would use it. In Chapter 26, we discuss a technique developed by the U.S. Department of Agriculture to pasteurize cantaloupes. It kills 99.999% of all Salmonella found on the rind. *Listeria* is more resistant to pasteurization, but, as with milk, perhaps some tweaking of the procedure would kill *Listeria*.

One of the most exciting and controversial new developments occurred 2 years ago, when J. Craig Venter (of Human Genome fame) made a synthetic bacterium (*Synthia laboratorium*). Was he usurping the role of God? Did we have to fear a whole new horde of man-made bacteria which would ruin the environment, create new diseases, or set off huge epidemics? Or, would they be the answer to problems such as providing biofuels that would take care of energy needs? Read about Dr. Venter's work in Chapter 10. Incidentally, he already created the first synthetic virus a few years ago, from parts that he ordered from biological supply houses.

FIGURE 26.3 Surface pasteurization of cantaloupes.

NAVIGATING MICROBIOLOGY

The theme that permeates this book is that microbiology is a current, relevant, exciting central science that affects all of us. I would like to share this excitement with you. Come with me as I take you, and your students, on a journey through the relevancy of microbiology. In countless areas—from agriculture to evolution, from ecology to dentistry—microbiology is contributing to scientific knowledge as well as solving human problems. Accordingly, a goal of this text is to offer a sense of the history of this science, its methodology, its many contributions to humanity, and the many ways in which it continues to be on the cutting edge of scientific advancement.

AUDIENCE AND ORGANIZATION

This book meets the needs of students in the health sciences as well as biology majors and students enrolled in other science programs who need a solid foundation in microbiology. It is designed to serve both audiences—in part by using an abundance of clinically important information to illustrate the general principles of microbiology and in part by offering a wide variety of additional applications.

The organization of the eighth edition continues to combine logic with flexibility. The chapters are grouped in units from the fundamentals of chemistry, cells, and microscopy; to metabolism, growth, and genetics; to

taxonomy of microbes and multicellular parasites; to control of microorganisms; to host-microbe interactions; to infectious diseases of humans; and finally to environmental and applied microbiology. The chapter sequence will be useful in most microbiology courses as they are usually taught. However, it is not essential that chapters be assigned in their present order; it is possible to use this book in courses organized along different lines.

STYLE AND CURRENCY

In a field that changes so quickly—with new research, new drugs, and even new diseases—it is essential that a text be as up-to-date as possible. This book incorporates the latest information on all aspects of microbiology, including geomicrobiology, phage therapy, deep hot biosphere vents, and clinical practice. Special attention has been paid to such important, rapidly evolving topics as genetic engineering, taxonomy, lateral gene transfer, cervical cancer, and immunology.

One of the most interesting ideas new to immunology is found in the opener to Chapter 18: are worms our friends? Many autoimmune diseases such as Crohn's disease and irritable bowel disease are being treated by giving the patient 2,500 whipworm eggs every 2 or 3 weeks. They hatch, but can't develop as they are in the wrong host. But they induce a win—win symbiosis: They induce a dampening of the host's inflammatory immune response, meaning that they don't get killed (their win). The human host wins by not having a huge inflammatory immune response which would lead to an autoimmune disease. Our ancestors must have all had many kinds of worms with which they could have evolved symbioses. Maybe it's time to go back to "our old friends, the worms."

The rapid advances being made in microbiology make teaching about—and learning about—microorganisms challenging. Therefore, every effort has been made in the eighth edition of Microbiology to ensure that the writing is simple, straightforward, and functional; that microbiological concepts and methodologies are clearly and thoroughly described; and that the information presented is as accessible as possible to students. Students who enjoy a course are likely to retain far more of its content for a longer period of time than those who take the course like a dose of medicine. There is no reason for a text to be any less interesting than the subject it describes. So, in addition to a narrative that is direct and authoritative, students will find injections of humor, engaging stories, and personal reflections that I hope impart a sense of discovery and wonder and a bit of my passion for microbial life.

DESIGN AND ILLUSTRATIONS

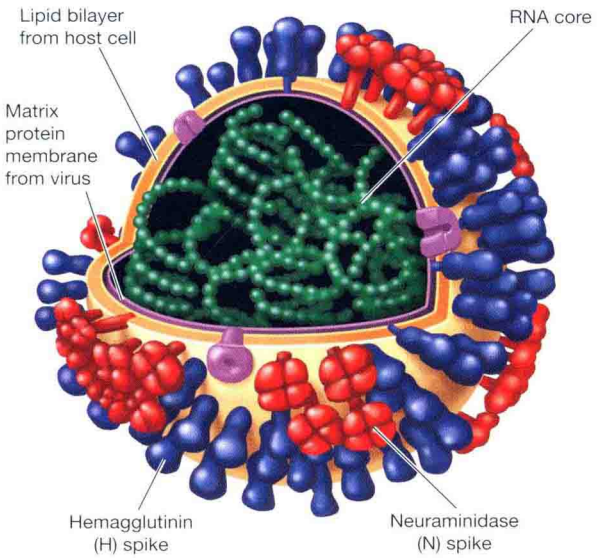
The eighth edition of Microbiology has been completely redesigned with an eye toward increasing the readability, enhancing the presentation of illustrations and photographs, and making the pedagogical features more effective for use. The use of clear, attractive drawings and carefully chosen photographs can significantly contribute to the student's understanding of a scientific subject. Throughout, color has been used not just decoratively but for its pedagogic value. For example, every effort has been made to color similar molecules and structures the same way each time they appear, making them easier to recognize.

Illustrations have been carefully developed to amplify and enhance the narrative. The line art in this text is sometimes as simple as a flow diagram or just as often a complex illustration of a structure drawn by some of the best medical illustrators working today.

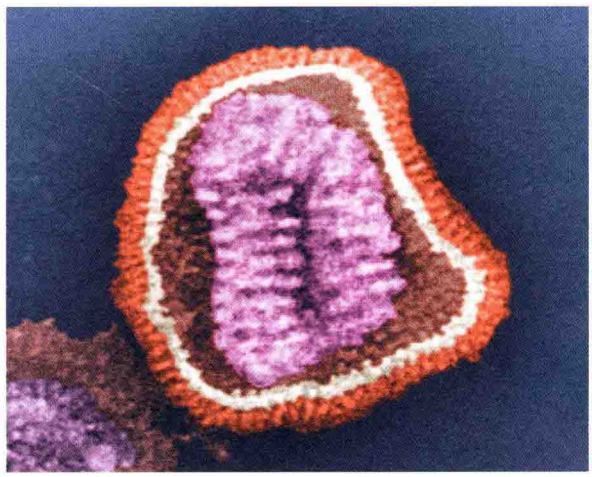
Photographs also richly enhance the text. The diversity of the photo program encompasses numerous micrographs, photographs of clinical conditions, microbiologists at work, and some laboratory techniques and results. Often, you will find a photograph accompanied by a line drawing aiding in the understanding of an unfamiliar subject.

Should boys be vaccinated with Gardasil against HPV?

FIGURE 20.24 **Genital warts of the penis.**



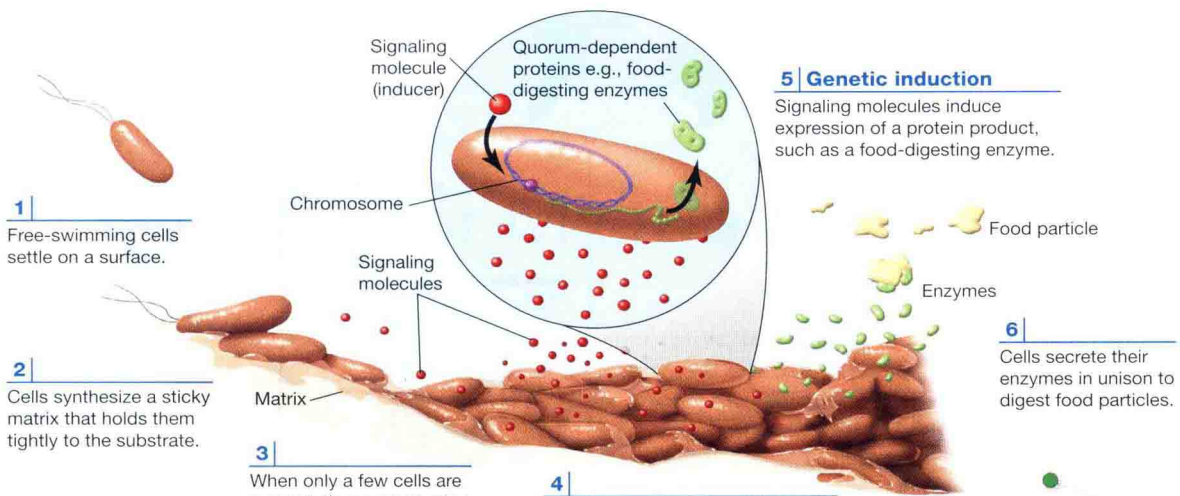
(a)



(b)

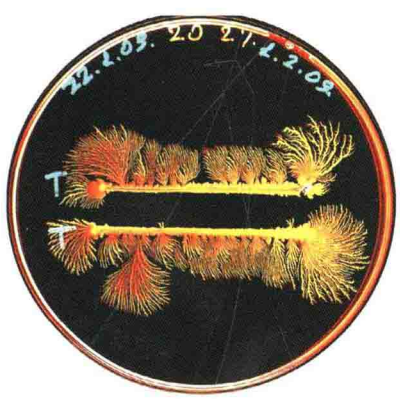
FIGURE 21.20 The influenza virus. (a) The virus shows hemagglutinin and neuraminidase spikes on its outer surface and an RNA core. **(b)** A colorized TEM of an influenza virion (Mag. unknown). *(Science Source/Photo Researchers).*

Line drawings and photos complement each other.



(a)

New illustrations combine art and photos.



(b)

FIGURE 6.17 (a) Quorum sensing. (b) Sibling warfare. Bacteria in streaks from the same original colony will only grow away from each other, another example of microbial communication. *(Eshel Ben-Jacob)*

Paired photos illustrate the text discussion.

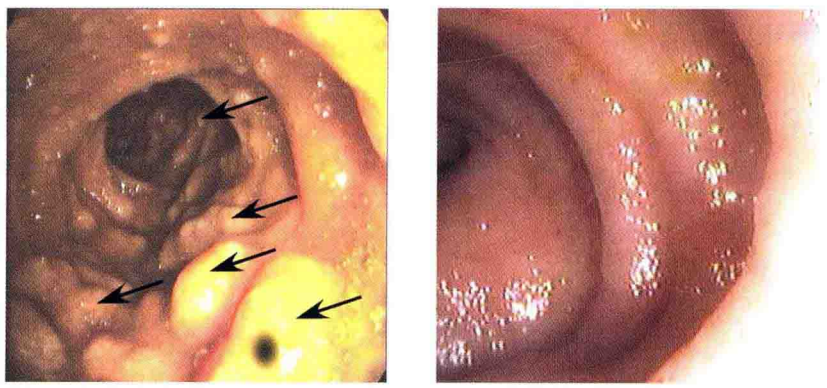


FIGURE 18.24 How soon does HIV infection cause damage? The yellow tissue, marked by arrows, is gut-associated immune system components, collectively the largest in the human body. The first photo shows the normal amount. The second photo shows its complete loss only a few weeks after becoming infected with HIV.

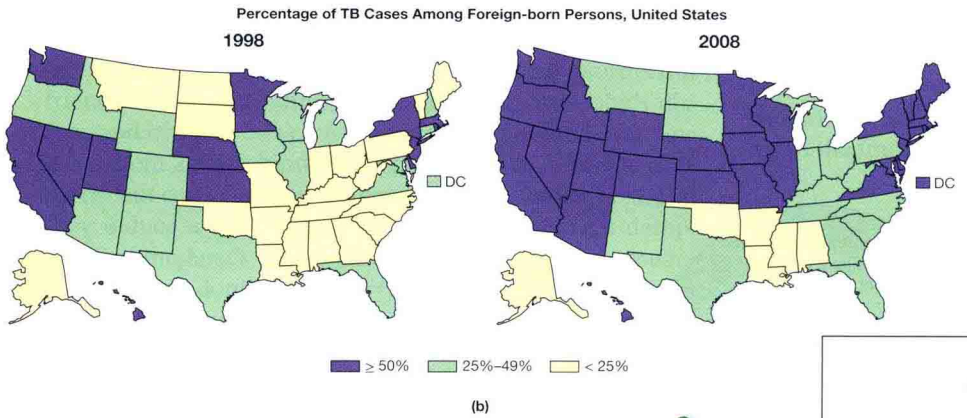


FIGURE 21.13 **The U.S. incidence of tuberculosis, 2008.**

The effect of migration and immigration on disease spread. Updated statistics on many topics, including the effect of migration and immigration on disease spread.

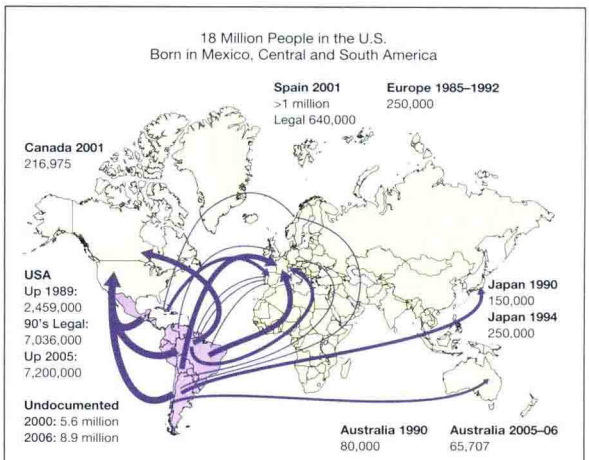


FIGURE 24.20 **Chagas' disease.**

TABLE 3.3 Comparison of Staining Techniques

Type	Examples		Result	Uses
Simple Stains				
Use a single dye; do not distinguish organisms or structures by different staining reactions	Methylene blue Safranin Crystal violet →	 a	Uniform blue stain Uniform red stain Uniform purple stain	Shows sizes, shapes, and arrangements of cells
Differential Stains				
Use two or more dyes that react differently with various kinds of bacteria, allowing them to be distinguished	Gram stain		Gram +: purple with crystal violet Gram −: red with safranin	Distinguishes Gram +, Gram −, Gram-variable, and Gram

Tables include photographs and illustrations.

TABLE 10.2 Classification of Major Groups of DNA Viruses That Cause Human Diseases

Family	Envelope and Capsid Shape	Example (Genus or Species)	Infection or Disease	Typical Size (nm)	
Double-Stranded DNA Viruses					
Adenoviridae (linear DNA)	Naked, polyhedral	Human adenoviruses	Respiratory infections	75	
Herpesviridae (linear DNA)	Enveloped, polyhedral	*Simplexvirus* *Varicellovirus*	Oral and genital herpes Chickenpox, shingles	120–200	
Poxviridae (linear DNA)	Enveloped, complex shape	*Orthopoxvirus*	Smallpox, cowpox	230 × 270	
Papovaviridae (circular DNA)	Naked, polyhedral	Human papillomaviruses	Warts, cervical and penile cancers	45–55	

WileyPLUS for Microbiology

WileyPLUS is an innovative, research-based online environment designed for effective teaching and learning. Utilizing *WileyPLUS* in your course provides students with an accessible, affordable, and active learning platform and provides you with tools and resources to efficiently build presentations for a dynamic classroom experience and manage effective assessment strategies.

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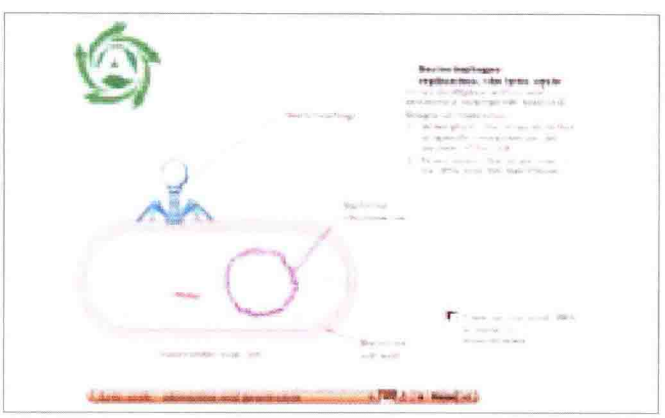

Come with Me Videos Come with Me features a video to accompany each visually stimulating chapter opener in which Jackie Black invites the student to accompany her into the exciting world of microbiology.

- **Microbiology Videos** Additional videos relating to key applications and current news stories appear in the WileyPLUS course. These videos link each topic to the broader world, enabling students to see the reach microbiology and how the material connects to their daily lives.
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- **Online Microbiology Roadmap** This unique study tool is available for student use through both the WileyPLUS course and book companion site. Containing additional practice questions, vocabulary quizzes, visual guides to reading an illustration, and working with animations, this new features helps students navigate and practice the concepts of each chapter.

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  - **Come With Me and Microbiology Video Lecture Launchers.** Each video available in the *Microbiology* 8e WileyPLUS course is

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Instructor's Manual

- **All Line Illustrations and Photos** from *Microbiology* 8e, in jpeg files and PowerPoint format are available both on the instructor companion site and within *WileyPLUS*.
- **Cell, Molecular, and Microbiology Visual Library** containing all of the line illustrations in the textbook in jpeg format, as well as access to numerous other life science illustrations from other Wiley texts is available in *WileyPLUS* and on the instructor companion site.
- **PowerPoint Presentations** by Anne Hemsley of Antelope Valley College are tailored to *Microbiology* 8e's topical coverage and learning objectives. These presentations are designed to convey key text concepts, illustrated by embedded text art. An effort has been made to reduce the number of words on each slide and increase the use of visuals to illustrate concepts. Available on the instructor companion site and within *WileyPLUS*.
- **Pre and Post Lecture Questions** written by James Yount of Brevard Community College, are available in WileyPLUS to help assess student performance.
- **Personal Response System** questions by Anne Hemsley of Antelope Valley College are specifically designed to foster student discussion and debate in class. Available on the instructor companion site and within *WileyPLUS*.
- **Animations** Select text concepts are illustrated using flash animation for student self-study or classroom presentation.

Animations

Animation offerings, listed below, continue to bring to life illustrations in Microbiology. An animation icon accompanying an illustration indicates when students may access animations within *WileyPLUS*.

CHAPTER 2

Acids and Bases
Chemical Bonding
Polarity and Solubility
Types of Reactions and Equilibrium

CHAPTER 3

Staining Bacteria: The Gram Stain
Wavelength Analogy

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Prokaryotic Cell Structure and Function
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Enterotube

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CHAPTER 16

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Inflammation

CHAPTER 17

Introduction to Specific Immunity
Production of Monoclonal Antibodies
Antibody Mediated Immunity
Cell Mediated Immunity

CHAPTER 18

Myasthenia Gravis
Four Types of Hypersensitivity

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- Quizzes for student self-testing
- Clinical Case Study and Answers
- Flash Cards and Glossary

For Instructors

- Cell, Molecular, and Biology Visual Library
- All images in jpg and PowerPoint formats.
- Instructor's Manual
- Test Bank available both in RTF and as a part of the Respondus Learning System
- Lecture PowerPoint Presentations

Instructor Resources are password protected.

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ACKNOWLEDGMENTS

Thanks really must go to the many people who have helped this eighth edition become a reality. Critical team members include Kevin Witt, Senior Acquisitions Editor; Merillat Staat, Outside Development Editor; Elizabeth Swain, Senior Production Editor; Madelyn Lesure, Senior Designer; Clay Stone, Executive Marketing Manager; Anna Melhorn, Senior Illustration Editor; Hilary Newman, Photo Manager; Mary Ann Price, Photo Researcher; Jennifer Dearden, Editorial Assistant; and Lucy Parkinson, Senior Marketing Assistant.

My thanks and appreciation go to Anne Hemsley of Antelope Valley college for her insightful advice and many comments on the revision.

Most importantly, I would like to thank the many reviewers who have taken the time to share their comments and suggestions for enhancing each edition of this text. Your input makes a considerable difference.

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Arlington,Virginia

CHAPTER 1

Scope and History of Microbiology

Can this really be a microbiologist? Aren't microbiologists people in long white lab coats, working in hospital labs, growing disease-causing organisms from patient samples? Well, of course there are hospital microbiologists—but microbiology is so much more! It's adventure: taking you into realms you may never have thought about before.

Courtesy Kenneth Ingham

Courtesy Kenneth Ingham

Let us descend with geomicrobiologists Dr. Diana E. Northrup of the University of New Mexico (on the right, testing pH) and Dr. Penny Boston of New Mexico Technical University into the caves of Lechu-guilla, New Mexico. It's necessary to carry meters to detect toxic gases and have protective masks at the ready. Sulfuric acid, strong as car battery acid, drips from the walls, eating holes in clothing and skin that it touches. Bacteria eating the walls are producing this acid, which drips from long, slimy strings of bacterial colonies called "snotites." Geologists used to think that all caves were eroded out by water dissolving the original limestone. But now

"It's just some 'bug' going around." You have heard that from others or said it yourself when you have been ill for a day or two. Indeed, the little unidentified illnesses we all have from time to time and attribute to a "bug" are probably caused by viruses, the tiniest of all *microbes*. Other groups of **microorganisms**—bacteria, fungi, protozoa, and some algae—also have disease-causing members. Before studying microbiology, therefore, we are likely to think of microbes as germs that cause disease. Health scientists are concerned with just such microbes and with treating and preventing the diseases they cause. Yet less than 1% of known microorganisms cause disease, so focusing our study of microbes exclusively on disease gives us too narrow a view of microbiology.

WHY STUDY MICROBIOLOGY?

Microbes in the Environment and Human Health

If you were to dust your desk and shake your dust cloth over the surface of a medium designed for growing microorganisms, after a day or so you would find a variety of organisms growing on that medium. If you were to cough onto such a medium or make fingerprints on it, you would later find a different assortment of microorganisms growing on the medium. When you have a sore throat and your physician orders a throat culture, a variety of organisms will be present in the culture—perhaps including the one that