Chapter 14 (Remaining) & Chapter 15

NIMESH PATEL| HLSC 2400

SEPTEMBER 19, 2017

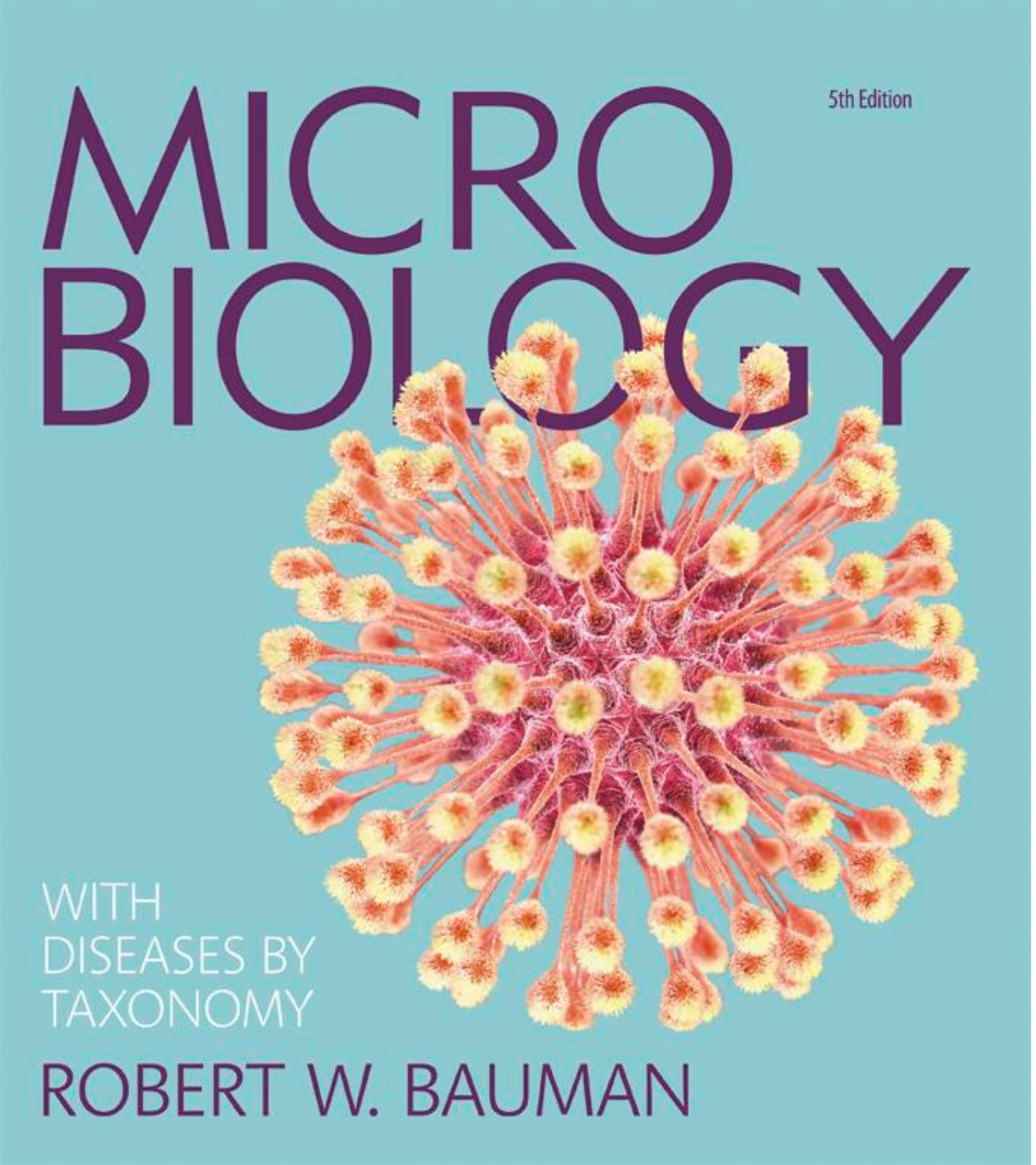
Announcements

- **TA:** Amy Henrickson
  - Contact: amy.henrickson@uleth.ca

- **Oral presentations**
  - **Email TA immediately** if you still do not have a group
  - Pick up an infectious disease for the presentation by end of today (extended deadline), if you haven't already

Oral Presentations

- Grading rubric: Available on Moodle
- Presentation should include the following topics:
  - Background about disease/organism, why this is a public health concern, etiology of a disease, sign and symptoms, management, mode of spread, prevention, surveillance, information about the first case ever diagnosed, any interesting fact about a disease/organism, etc.
- Length: 20 minutes (including 5 minutes of discussion)



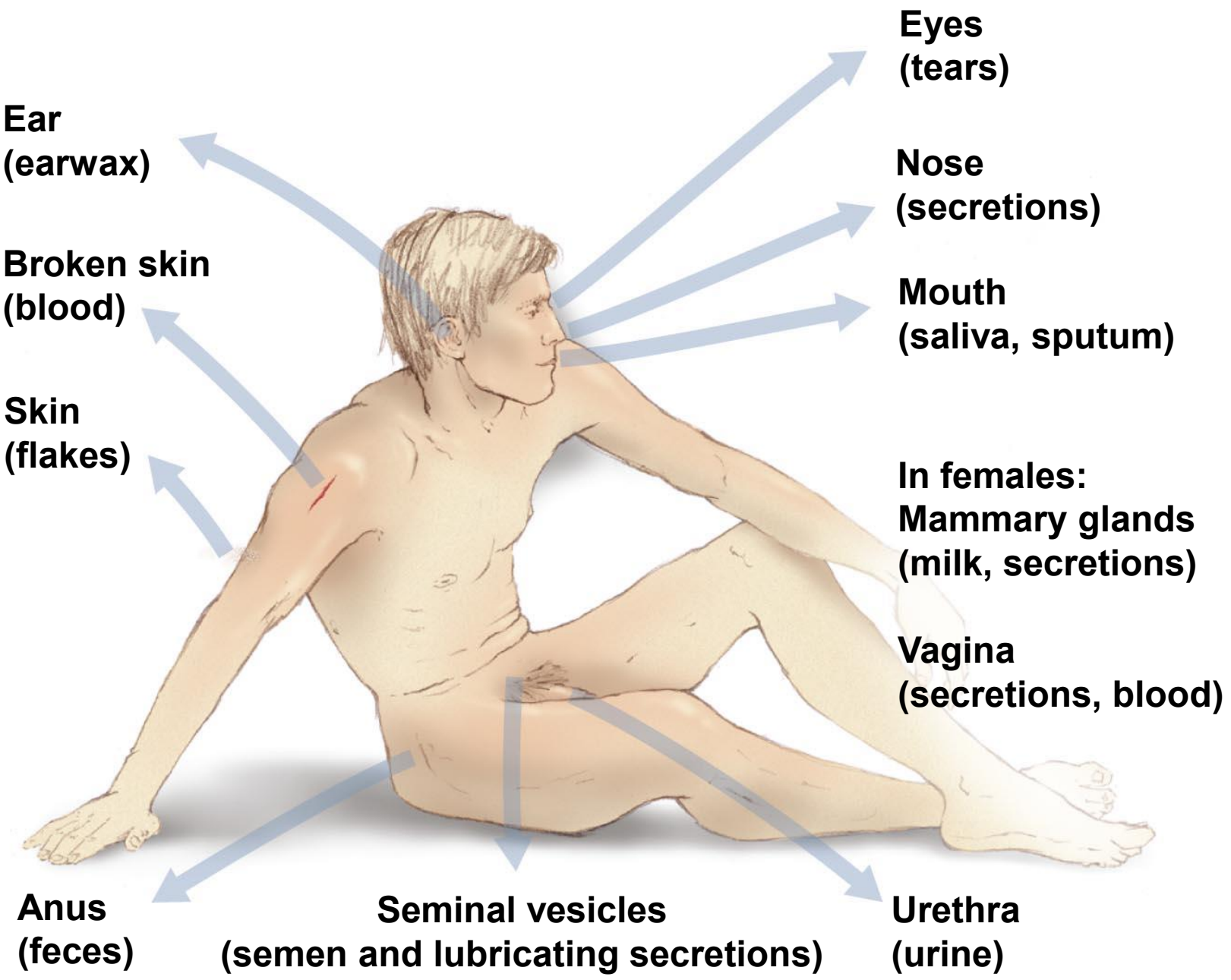
PowerPoint® Lecture Presentations prepared by Mindy Miller-Kittrell, North Carolina State University

C H A P T E R

The Movement of Pathogens Out of Hosts: Portals of Exit

- Pathogens leave host through portals of exit
- Many portals of exit are the same as portals of entry
- Pathogens often leave hosts in materials the body secretes or excretes

Figure 14.11 Portals of exit.



Modes of Infectious Disease Transmission

- Transmission is from a reservoir or a portal of exit to another host's portal of entry
- Three groups of transmission:
  - Contact transmission
  - Vehicle transmission
  - Vector transmission

Modes of Infectious Disease Transmission

- **Contact Transmission**
  - Direct contact transmission
    - Usually involves body contact between hosts
    - Transmission within a single individual can also occur
  - Indirect contact transmission
    - Pathogens are spread from host to host by **fomites**
      - Inanimate objects – needles, toothbrushes, paper tissues, toys, money, diapers, drinking glasses
  - Droplet transmission
    - Spread of pathogens in droplets of mucus by exhaling, coughing, and sneezing
      - Travel less than a meter, if travel >1 meter then considered as *airborne transmission*
      - Examples: cold and flu viruses

Figure 14.12 Droplet transmission.

Modes of Infectious Disease Transmission

- **Vehicle Transmission**
  - Airborne transmission
    - When pathogens travel more than 1 meter via an **aerosol**
    - Aerosols can occur from various activities
      - Sneezing, coughing, air-conditioning systems, sweeping
    - Carry microbes on dust or droplets
      - Measles, TB, streptococcus
  - Waterborne transmission
    - Important in the spread of many gastrointestinal diseases
    - Fecal-oral infection
    - Cholera, dysentery, giardiasis

Modes of Infectious Disease Transmission

- **Vehicle Transmission**
  - Foodborne transmission
    - Spread of pathogens in and on foods
    - Inadequately processed, cooked, or refrigerated foods
    - Foods may become contaminated with feces
  - Bodily fluid transmission
    - Bodily fluids such as blood, urine, saliva can carry pathogens
    - Prevent contact with conjunctiva or breaks in the skin or mucous membranes

Modes of Infectious Disease Transmission

- **Vector Transmission**
  - Biological vectors
    - Transmit pathogens and serve as host for some stage of the pathogen's life cycle
    - Biting arthropods transmit many diseases to humans
      - Mosquitoes, fleas, lice, bloodsucking bugs, and mites
  - Mechanical vectors
    - Passively transmit pathogens present on their body to new hosts
    - Houseflies and cockroaches may introduce salmonella and shigella into drinking water and food or into skin

Clinical Case Study: TB in the Nursery

- Neonatal nurse became ill with cough and fever in the early fall
- Initially misdiagnosed as seasonal allergy – returned to work
- Three weeks later, symptoms were complicated (shortness of breath and bloody sputum)
- Later, diagnosis of TB was made
- Treatment started and kept in respiratory isolation for 6 weeks
- During the three weeks he worked, he infected over 900 obstetric patients, including 620 newborns

TABLE 14.10 Selected Arthropod Vectors

	Disease	Causative Agent (bacteria unless otherwise indicated)
Biological Vectors		
Mosquitoes		
Anopheles	Malaria	*Plasmodium* spp. (protozoan)
Aedes	Yellow fever	*Flavivirus* sp. (virus)
	Elephantiasis	*Wuchereria bancrofti* (helminth)
	Dengue	*Flavivirus* spp. (virus)
	Viral encephalitis	*Alphavirus* spp. (virus)
Ticks		
Ixodes	Lyme disease	*Borrelia burgdorferi*
Dermacentor	Rocky Mountain spotted fever	*Rickettsia rickettsii*
Fleas		
Xenopsylla	Bubonic plague	*Yersinia pestis*
	Endemic typhus	*Rickettsia prowazekii*
Louses		
Pediculus	Epidemic typhus	*Rickettsia typhi*
Bloodsucking Flies		
Glossina	African sleeping sickness	*Trypanosoma brucei*
Simulium	River blindness	*Onchocerca volvulus* (helminth)
Bloodsucking Bugs		
Triatoma	Chagas' disease	*Trypanosoma cruzi* (protozoan)
Mites (chiggers)		
Leptotrombidium	Scrub typhus	*Orientia tsutsugamushi*

TABLE 14.10 Selected Arthropod Vectors *(Continued)*

	Disease	Causative Agent (bacteria unless otherwise indicated)
Mechanical Vectors		
Houseflies		
Musca	Foodborne infections	*Shigella* spp., *Salmonella* spp., *Escherichia coli*
Cockroaches		
Blatella, *Periplaneta*	Foodborne infections	*Shigella* spp., *Salmonella* spp., *Escherichia coli*

TABLE 14.11 Modes of Disease Transmission

Mode of Transmission	Examples of Diseases Spread
Contact Transmission	
Direct Contact (e.g., handshaking, kissing, sexual intercourse, bites)	Cutaneous anthrax, genital warts, gonorrhea, herpes, rabies, staphylococcal infections, syphilis
Indirect Contact (e.g., drinking glasses, toothbrushes, toys, punctures)	Common cold, enterovirus infections, influenza, measles, Q fever, pneumonia, tetanus
Droplet Transmission (e.g., droplets from sneezing, within 1 meter)	Whooping cough, streptococcal pharyngitis (strep throat)
Vehicle Transmission	
Airborne (e.g., dust particles or droplets carried more than 1 meter)	Chicken pox, coccidioidomycosis, histoplasmosis, influenza, measles, pulmonary anthrax, tuberculosis
Waterborne (e.g., streams, swimming pools)	*Campylobacter* infections, cholera, *Giardia* diarrhea
Foodborne (e.g., poultry, seafood, meat)	Food poisoning (botulism, staphylococcal); hepatitis A, listeriosis, tapeworms, toxoplasmosis, typhoid fever
Vector Transmission	
Mechanical (e.g., on bodies of flies, roaches)	*E. coli* diarrhea, salmonellosis, trachoma
Biological (e.g., lice, mites, mosquitoes, ticks)	Chagas' disease, Lyme disease, malaria, plague, Rocky Mountain spotted fever, typhus fever, yellow fever

Classification of Infectious Diseases

- Diseases can be classified in a number of ways
  - The body system they affect
  - Their longevity and severity
  - How they are spread to their host
  - The effects they have on populations
  - Taxonomic categories

TABLE 14.12 Terms Used to Classify Infectious Diseases

Term	Definition
Acute disease	Disease in which symptoms develop rapidly and that runs its course quickly
Chronic disease	Disease with usually mild symptoms that develop slowly and last a long time
Subacute disease	Disease with time course and symptoms between acute and chronic
Asymptomatic disease	Disease without symptoms
Latent disease	Disease that appears a long time after infection
Communicable disease	Disease transmitted from one host to another
Contagious disease	Communicable disease that is easily spread
Noncommunicable disease	Disease not passed from person to person
Local infection	Infection confined to a small region of the body
Systemic infection	Widespread infection in many systems of the body; often travels in the blood or lymph
Focal infection	Infection site that serves as a source of pathogens for infections at other sites in the body
Primary infection	Initial infection within a given patient
Secondary infection	Infections that follow a primary infection; often by opportunistic pathogens

Epidemiology of Infectious Diseases

- **Frequency of Disease**
  - Track occurrence of diseases using two measures
    - **Incidence**
      - Number of ***new*** cases of a disease in a given area during a given period of time
    - **Prevalence**
      - Number of ***total*** *cases* of a disease in a given area during a given period of time
  - Occurrence also evaluated in terms of frequency and geographic distribution

Figure 14.14 Curves representing the incidence and the estimated prevalence of AIDS among U.S. adults.

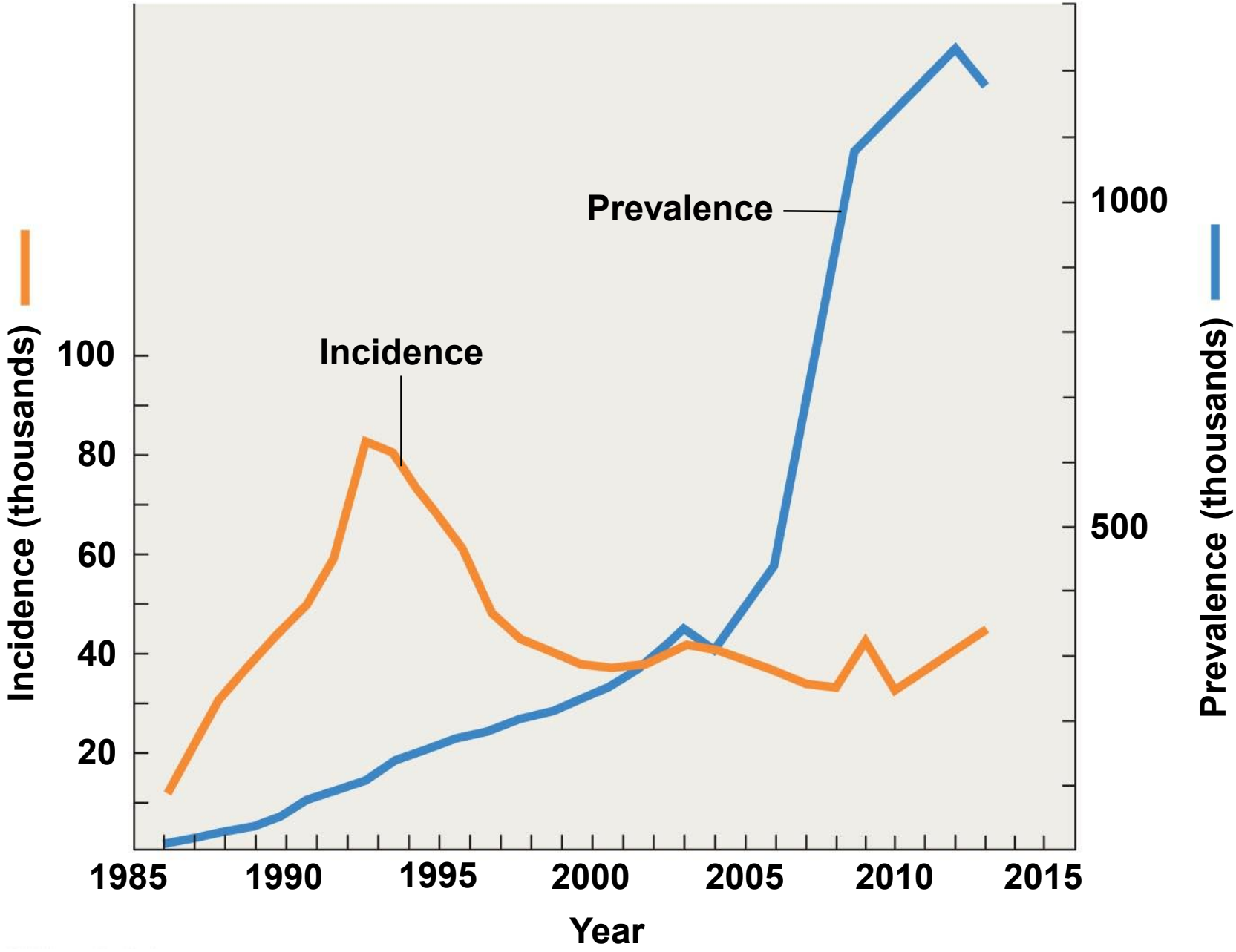
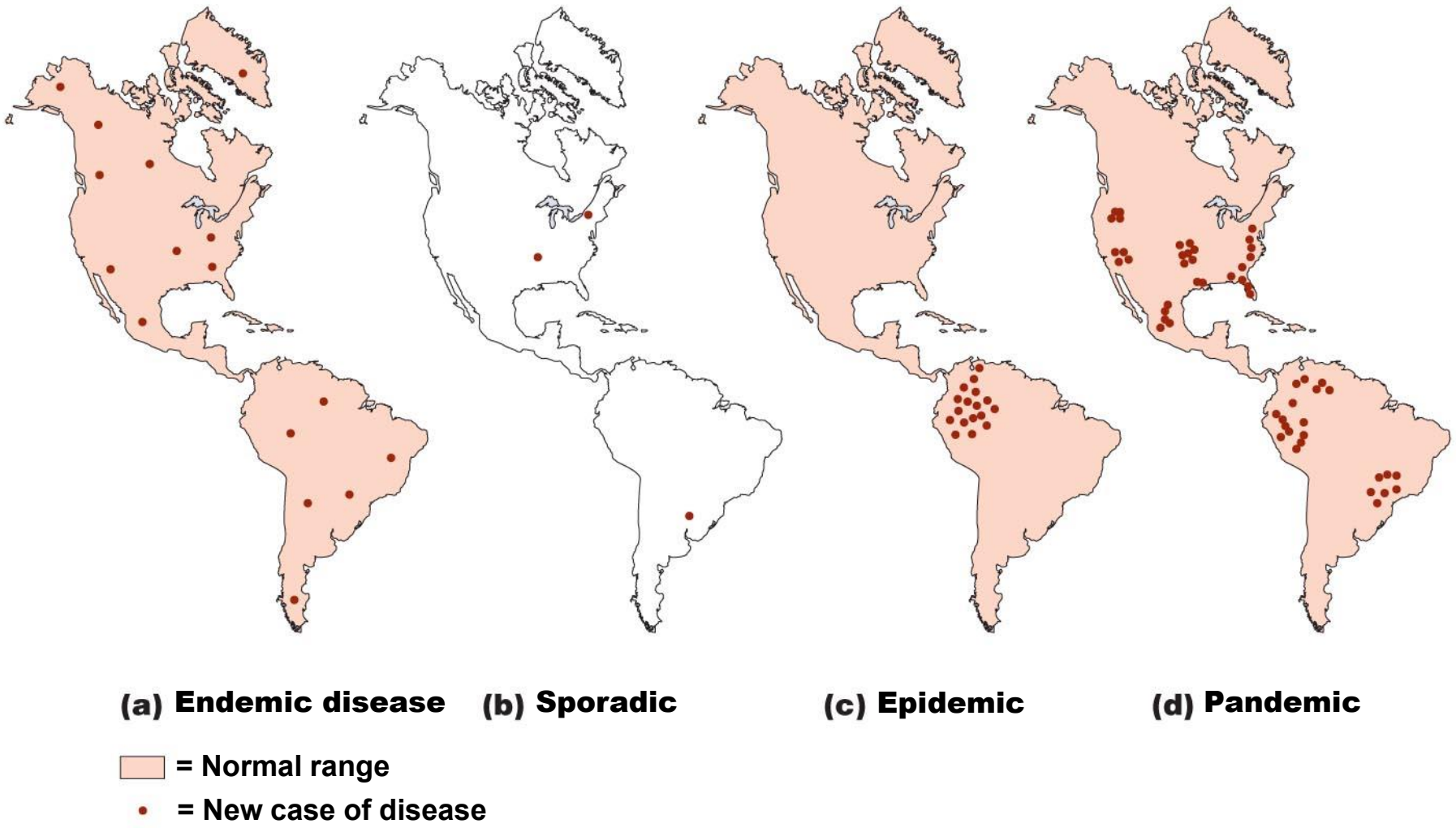
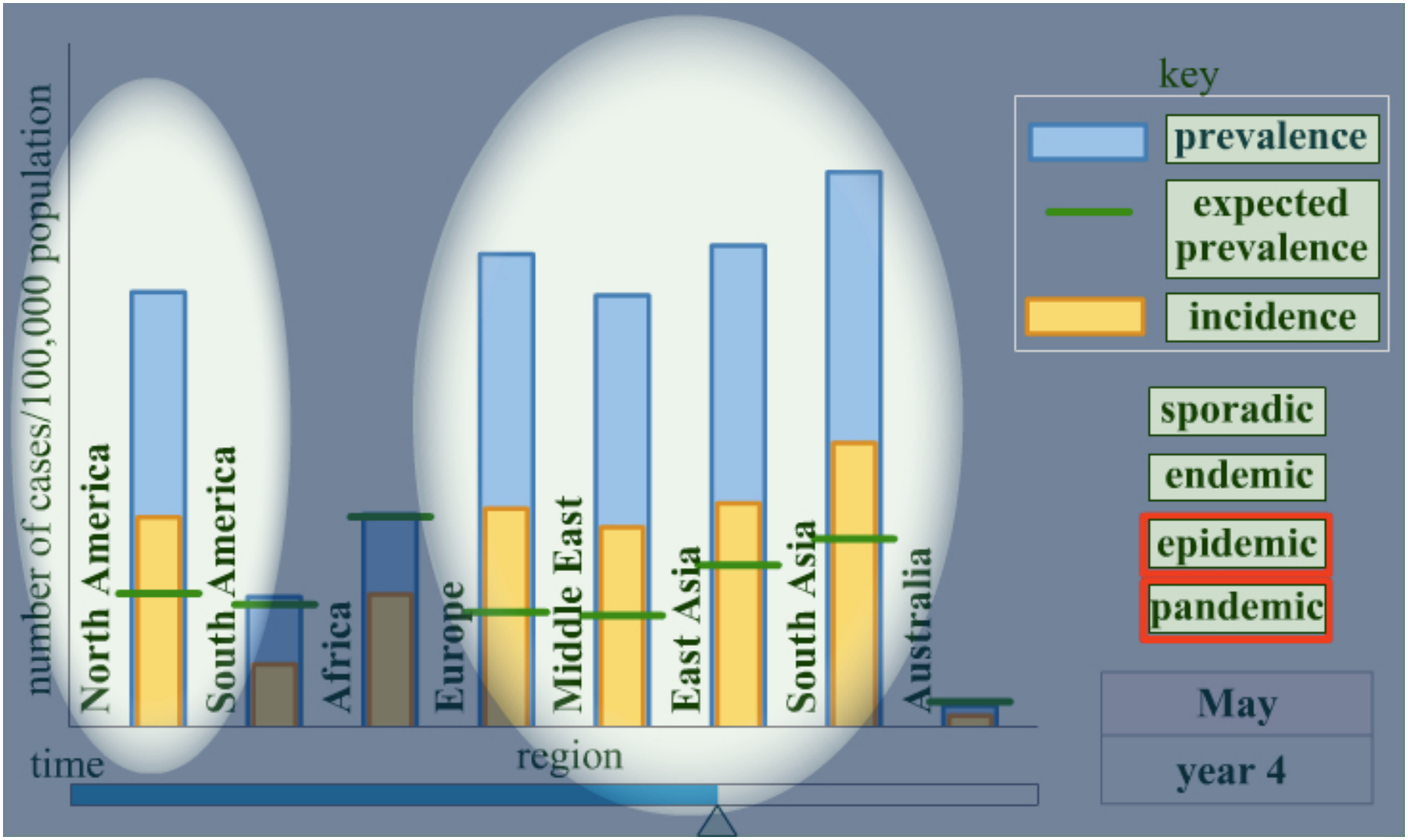


Figure 14.16 Illustrations of the different terms for the occurrence of disease.



Epidemiology: Occurrence of Diseases



PLAY **Epidemiology: Occurrence of Diseases**

Figure 14.17 Epidemics may have fewer cases than nonepidemics.

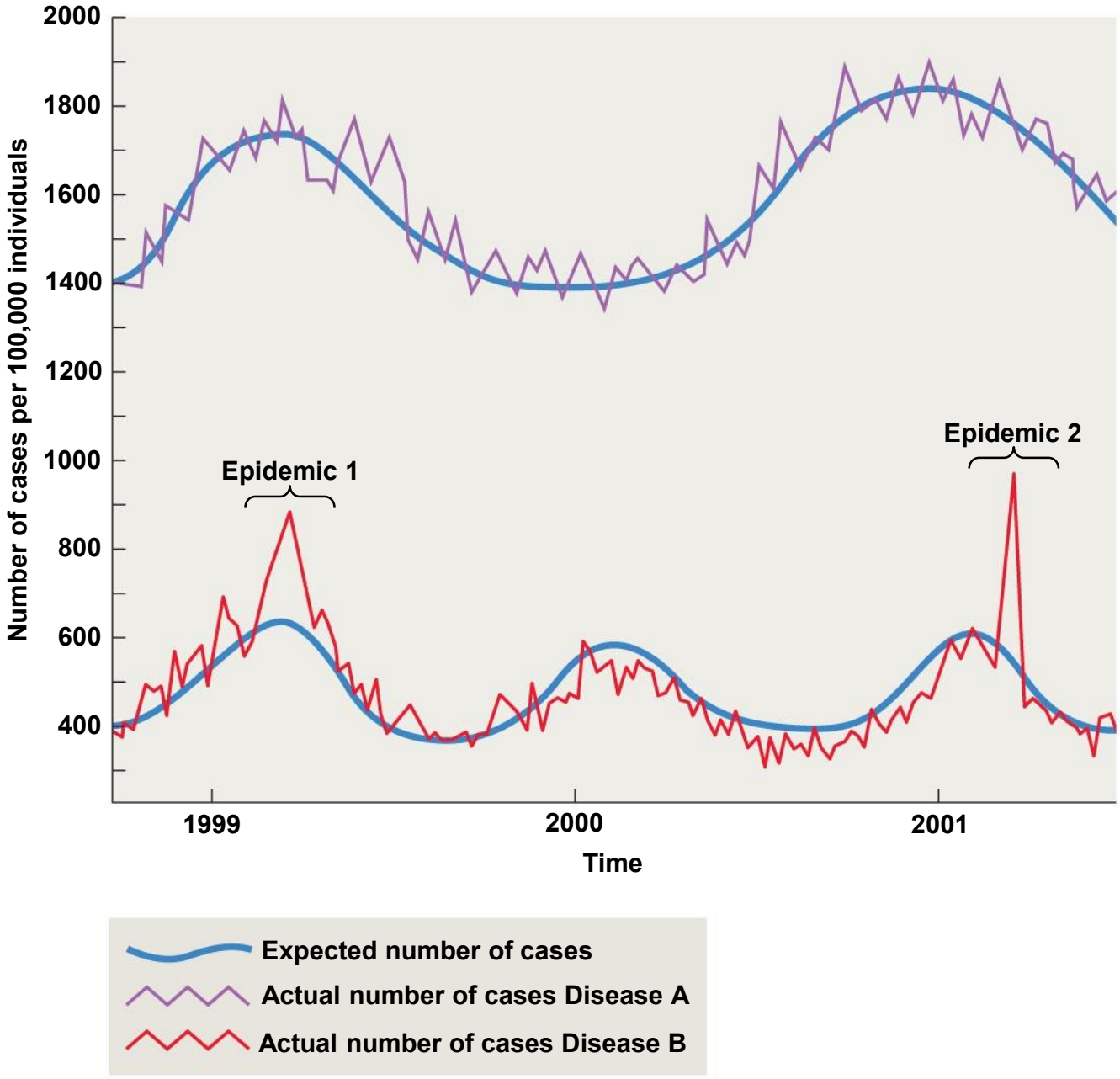


TABLE 14.13 Nationally Notifiable Infectious Diseases[a]

- Anthrax
- Arboviral diseases
- Babesiosis
- Botulism
- Brucellosis
- Chancroid
- Chicken pox (varicella)
- *Chlamydia trachomatis* infection
- Cholera
- Coccidioidomycosis
- Cryptosporidiosis
- Cyclosporiasis
- Dengue virus infections
- Diphtheria
- Ehrlichiosis/anaplasmosis
- Giardiasis
- Gonorrhea
- *Haemophilus influenzae*, invasive disease
- Hansen disease (leprosy)
- *Hantavirus* pulmonary syndrome
- Hemolytic uremic syndrome, postdiarrheal
- Hepatitis A
- Hepatitis B
- Hepatitis C
- HIV infection
- Influenza-associated infant deaths
- Invasive pneumococcal disease
- Legionellosis
- Listeriosis
- Lyme disease
- Malaria
- Measles
- Meningococcal disease
- Mumps
- Novel influenza type A infections
- Pertussis
- Plague
- Poliomyelitis
- Psittacosis
- Q fever
- Rabies, animal and human
- Rubella
- Rubella, congenital syndrome
- Salmonellosis
- Severe acute respiratory syndrome (SARS)
- Shiga-toxin-producing *Escherichia coli*
- Shigellosis
- Smallpox
- Spotted fever rickettsiosis
- Streptococcal toxic-shock syndrome
- *Streptococcus pneumoniae*, invasive disease
- Syphilis
- Tetanus
- Toxic shock syndrome, nonstreptococcal
- Trichinellosis
- Tuberculosis
- Tularemia
- Typhoid fever
- Vancomycin-intermediate *Staphylococcus aureus*
- Vancomycin-resistant *Staphylococcus aureus*
- Vibriosis
- Viral hemorrhagic fever
- Yellow fever

[a]Diseases for which hospitals, physicians, and other health care workers are required to report cases to state health departments and then forward the data to the CDC.

Epidemiology of Infectious Diseases

- **Epidemiological Studies**
  - Descriptive Epidemiology
    - Careful tabulation of data concerning a disease
      - Record location and time of the cases of disease
      - Collect patient information
    - Try to identify the **index case** of the disease

Figure 14.19 A map showing cholera deaths in a section of London, 1854.

Epidemiology of Infectious Diseases

- **Epidemiological Studies**
  - Analytical Epidemiology
    - Seeks to determine the probable cause, mode of transmission, and methods of prevention
    - Useful in situations when Koch's postulates can't be applied
    - Often retrospective
      - Investigation occurs after an outbreak has occurred

Epidemiology of Infectious Diseases

- **Epidemiological Studies**
  - Experimental Epidemiology
    - Test a hypothesis concerning the cause of a disease
    - Application of Koch's postulates

Nosocomial Infections: Overview

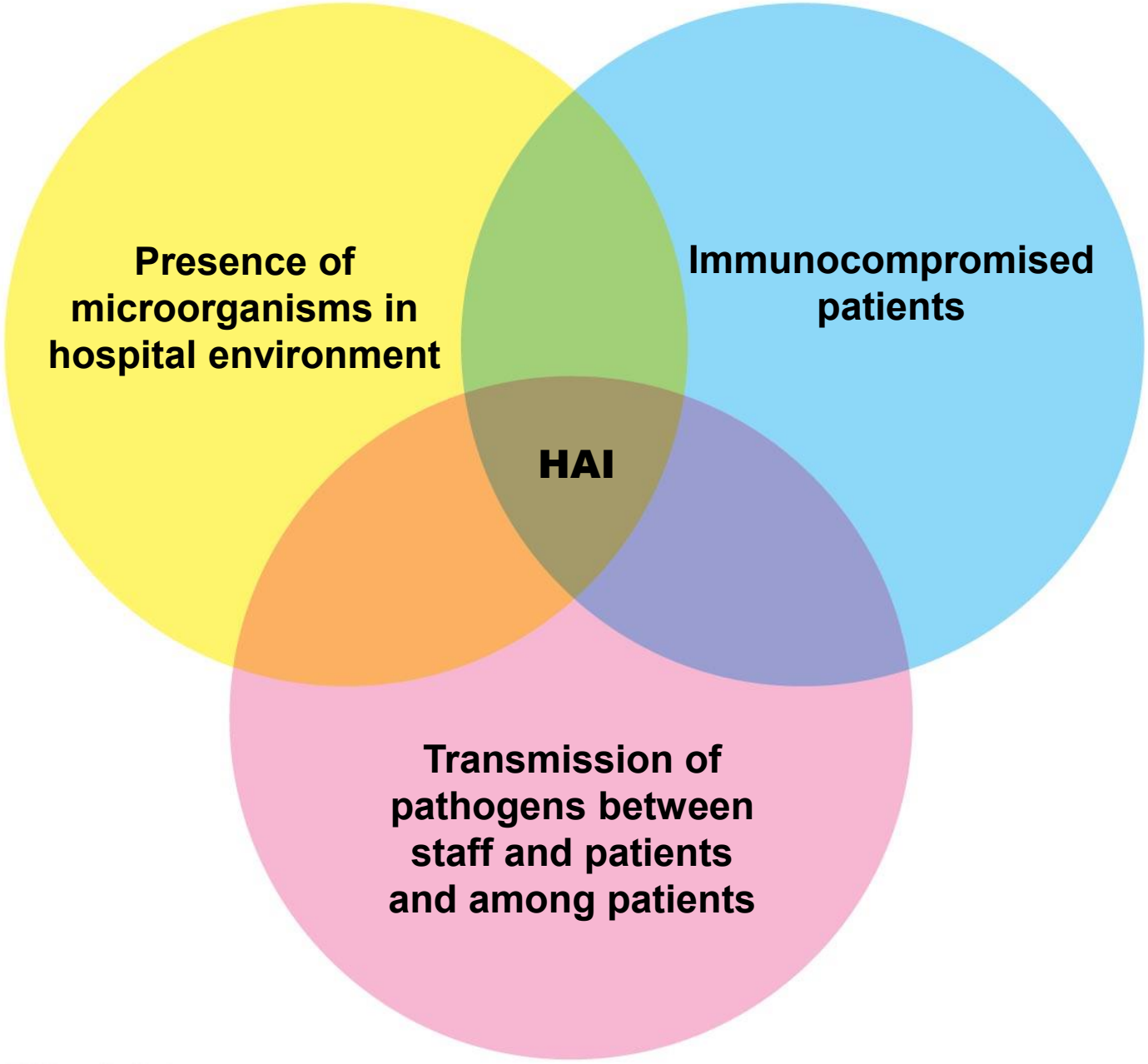
- weakened defenses

PLAY **Nosocomial Infections: Overview**

Epidemiology of Infectious Diseases

- **Hospital Epidemiology: Healthcare-Associated (Nosocomial) Infections**
  - Types of healthcare-associated infections
    - Exogenous
      - Pathogen acquired from the health care environment
    - Endogenous
      - Pathogen arises from normal microbiota within patient
    - Iatrogenic
      - Results from modern medical procedures
    - Superinfections
      - Use of antimicrobial drugs inhibits some resident microbiota allowing other microbes to thrive

Figure 14.20 The interplay of factors that result in healthcare-associated infections (HAIs).



Epidemiology of Infectious Diseases

- **Hospital Epidemiology: Healthcare-Associated (Nosocomial) Infections**
  - Control of Healthcare-Associated Infections
    - Requires aggressive control measures
    - Handwashing is the most effective way to reduce healthcare-associated infections

Nosocomial Infections: Prevention

PLAY **Nosocomial Infections: Prevention**

Epidemiology of Infectious Diseases

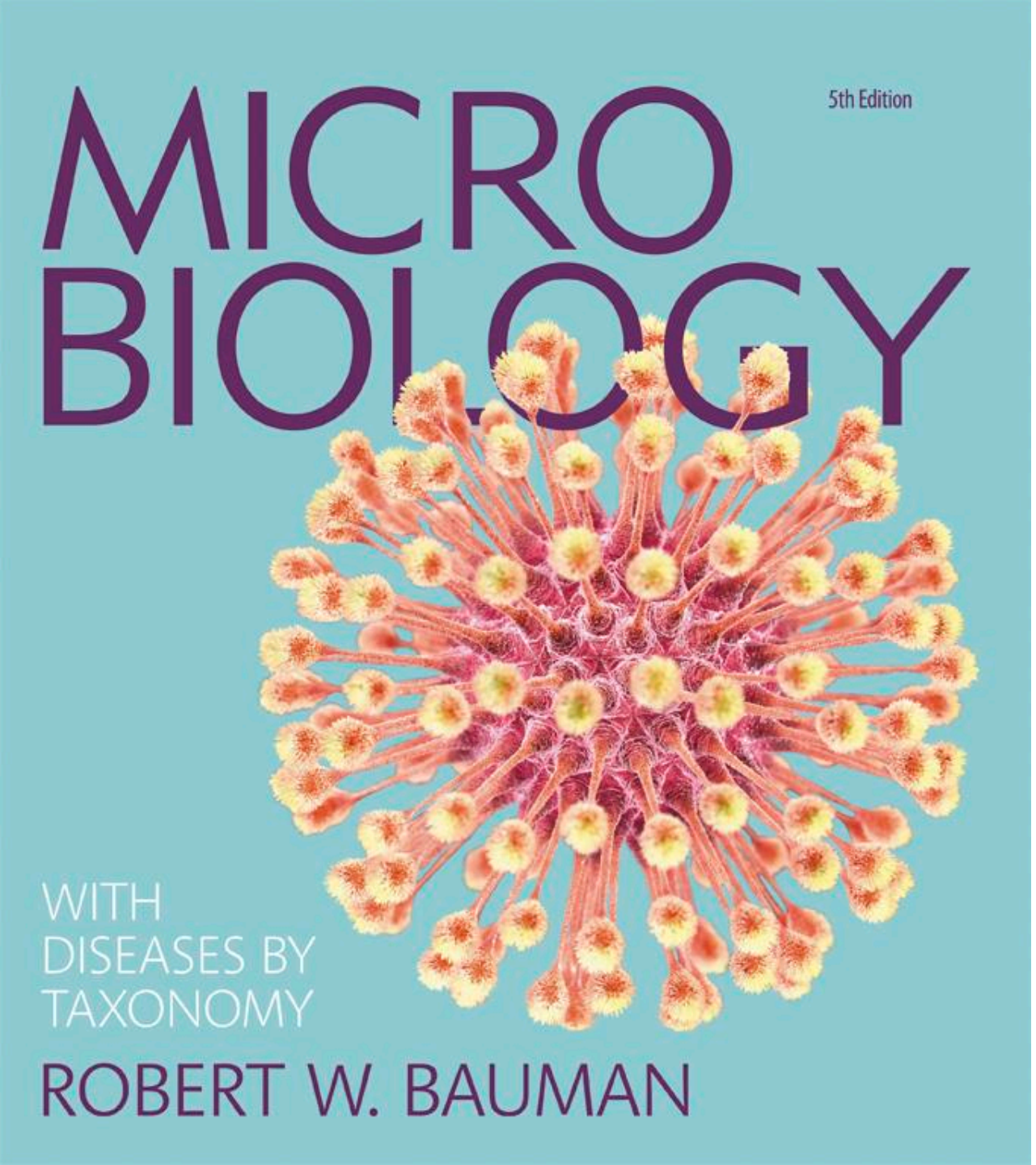
- **Epidemiology and Public Health**
  - The Sharing of Data Among Public Health Organizations
    - Agencies at the local, state, national, and global level
      - The United States Public Health Service
        - National public health agency
        - CDC is one branch
      - World Health Organization (WHO)
        - Coordinates public health efforts worldwide

Epidemiology of Infectious Diseases

- **Epidemiology and Public Health**
  - The Role of Public Health Agencies in Interrupting Disease Transmission
    - Public health agencies work to limit disease transmission
      - Enforce cleanliness of water and food supplies
      - Work to reduce disease vectors and reservoirs
      - Establish and enforce immunization schedules
      - Locate and treat individuals exposed to contagious pathogens
      - Establish isolation and quarantine measures

Epidemiology of Infectious Diseases

- **Epidemiology and Public Health**
  - Public Health Education
    - Diseases transmitted sexually and through the air are difficult to control
    - Public health agencies campaign to educate the public on healthful choices to limit disease



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CHAPTER 15

Innate Immunity

An Overview of the Body's Defenses

- Resistance to most plant and animal pathogens
- **Species resistance**
  - Due to physiological processes of humans that are incompatible with those of the pathogen
    - Correct chemical receptors not present on human cells
    - Conditions may be incompatible with those needed for pathogen's survival
- Humans don't have innate resistance to a number of pathogens

- **Innate (Non-specific) defenses**
  - First line of defense
    - External barriers, especially skin and mucous membranes
  - Second line of defense
    - Internal: protective cells, bloodborne chemicals, and processes that inactivate or kill invaders (phagocytosis, inflammation, complement system)
- **Adaptive (specific) defenses**
  - Third line of defense
    - Lymphocytes, antibodies, cytotoxic cells
    - Must be activated by antigen-specific cells
    - More effective against subsequent infections

The Body's First Line of Defense

- Structures, chemicals, and processes that work to prevent pathogens entering the body
- Skin and mucous membranes of the respiratory, digestive, urinary, and reproductive systems

The Body's First Line of Defense

- **The Role of Skin in Innate Immunity**
  - Skin composed of two major layers:
    - **Epidermis**
      - Multiple layers of tightly packed cells
        - Few pathogens can penetrate these layers
        - Shedding of dead skin cells removes microorganisms
      - Epidermal dendritic cells phagocytize pathogens
    - **Dermis**
      - Contains hair follicles, glands, blood vessels, and nerve endings
      - Collagen fibers help skin resist abrasions that could introduce microorganisms

The Body's First Line of Defense

- **The Role of Skin in Innate Immunity**
  - Skin has chemicals that defend against pathogens
    - Perspiration secreted by sweat glands
      - Salt inhibits growth of pathogens
      - Antimicrobial peptides act against microorganisms
      - Lysozyme destroys cell wall of bacteria
    - Sebum secreted by sebaceous (oil) glands
      - Helps keep skin pliable and less likely to break or tear
      - Lowers skin pH to a level inhibitory to many bacteria

The Body's First Line of Defense

- **The Role of Mucous Membranes in Innate Immunity**
  - Mucous membranes line all body cavities open to environment
  - Two distinct layers:
    - *Epithelium*
      - Thin, outer covering of the mucous membranes
      - Epithelial cells are living
      - Tightly packed to prevent entry of many pathogens
      - Continual shedding of cells carries away microorganisms
      - Dendritic cells below epithelium phagocytize pathogens
      - Goblet and ciliated columnar cells help remove invaders
    - Deeper connective layer that supports the epithelium
  - Produce chemicals that defend against pathogens

Figure 15.2 The structure of the respiratory system, which is lined with a mucous membrane.

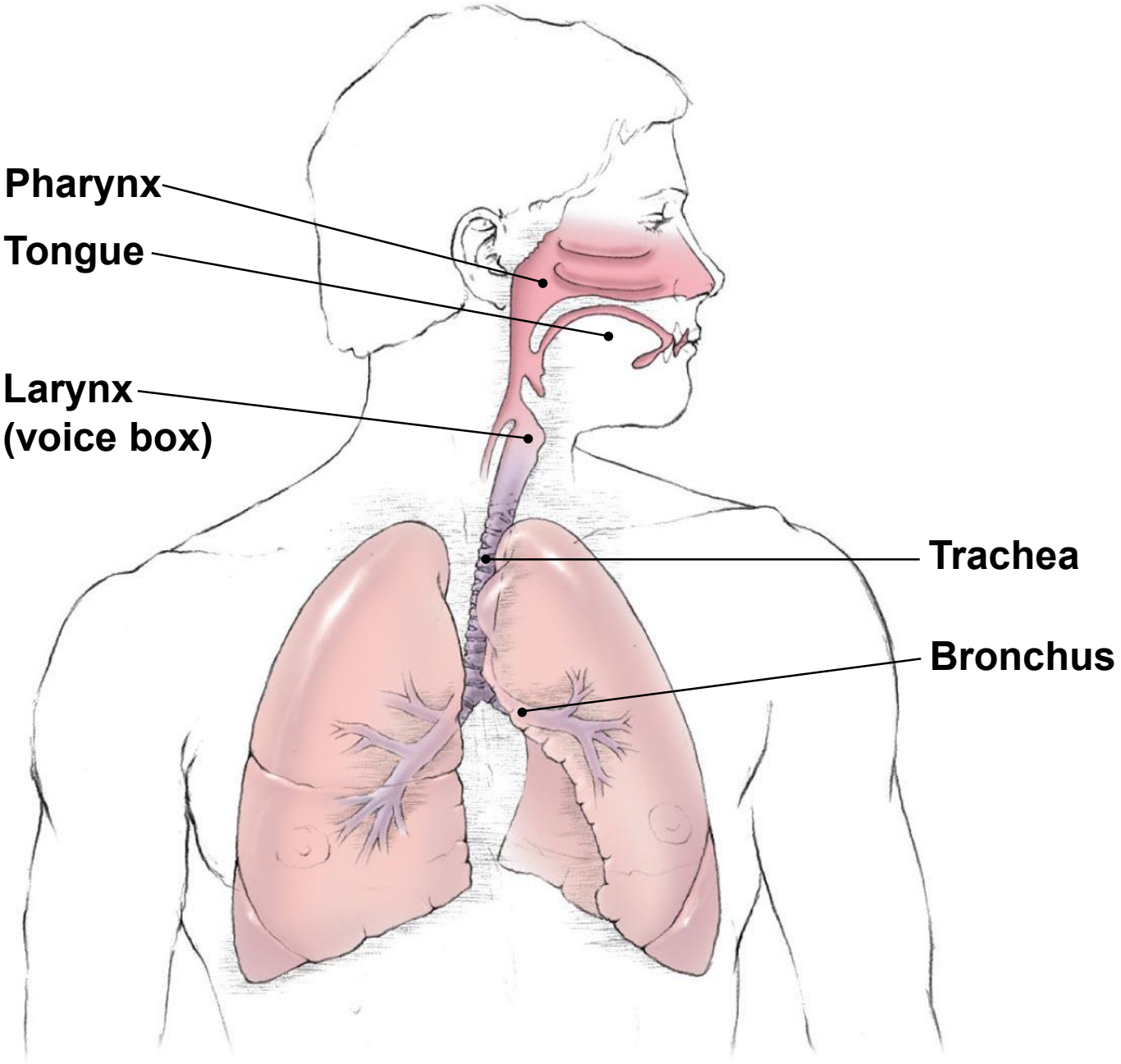


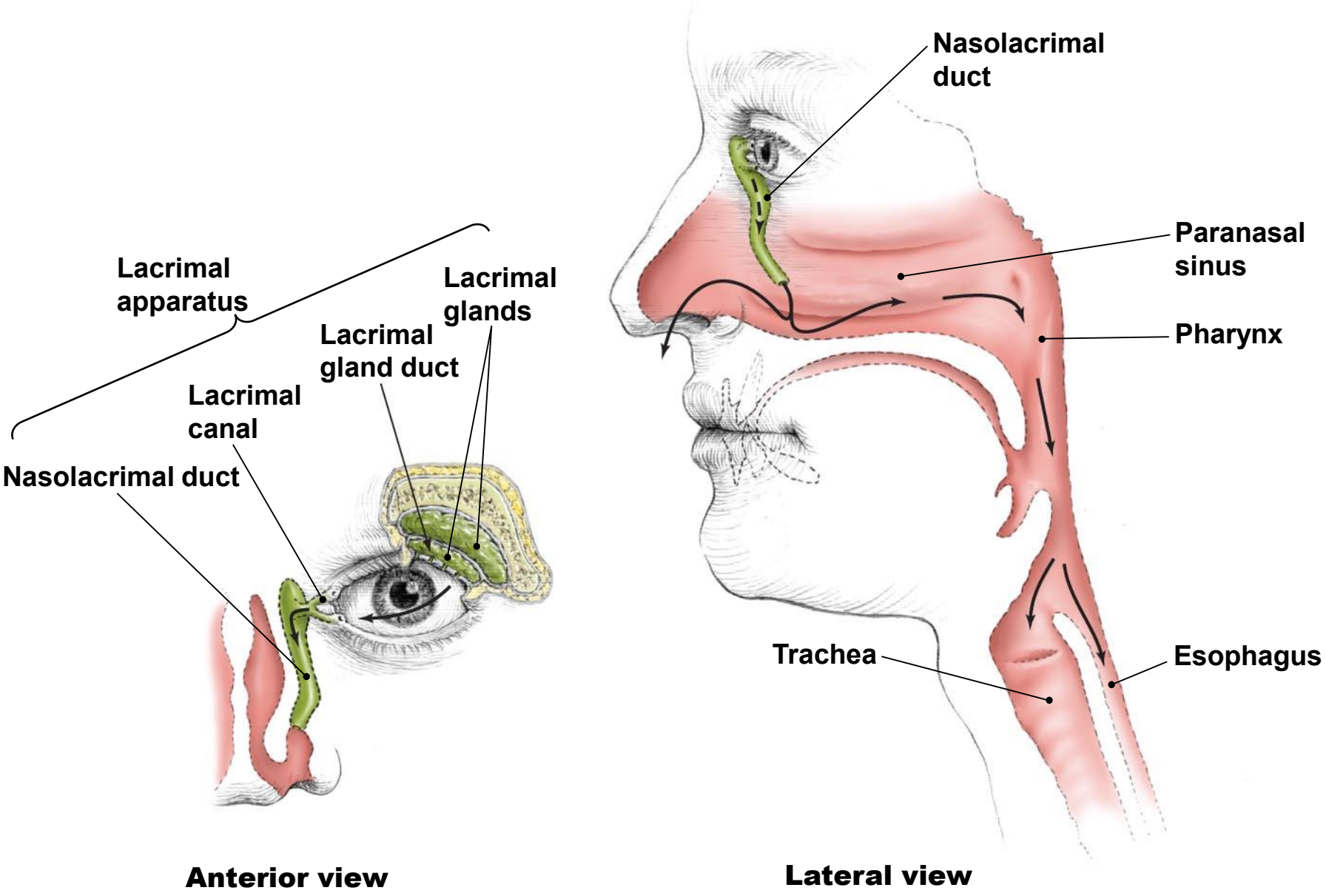
TABLE 15.1 The First Line of Defense: A Comparison of the Skin and Mucous Membranes

	Skin	Mucous Membrane
Number of Cell Layers	Many	One to a few
Cells Tightly Packed?	Yes	Yes
Cells Dead or Alive?	Outer layers: dead; inner layers: alive	Alive
Mucus Present?	No	Yes
Relative Water Content	Dry	Moist
Defensins Present?	Yes	With some
Lysozyme Present?	Yes	With some
Sebum Present?	Yes	No
Cilia Present?	No	Trachea, uterine tubes
Constant Shedding and Replacement of Cells?	Yes	Yes

The Body's First Line of Defense

- **The Role of the Lacrimal Apparatus in Innate Immunity**
  - Lacrimal apparatus
    - Produces and drains tears
    - Blinking spreads tears and washes surface of the eye
    - Lysozyme in tears destroys bacteria

Figure 15.3 The lacrimal apparatus.



The Body's First Line of Defense

- **The Role of Normal Microbiota in Innate Immunity**
  - **Microbial antagonism**
    - **Normal microbiota** compete with potential pathogens aka microbial antagonism
  - Activities of normal microbiota make it hard for pathogens to compete
    - Consumption of nutrients
    - Create an environment unfavorable to other microorganisms
    - Help stimulate the body's second line of defense
      - Normal microbiota in intestines
    - Promote overall health by providing vitamins to host

The Body's First Line of Defense

- **Other First-Line Defenses**
  - Antimicrobial Peptides
    - Present in skin, mucous membranes, neutrophils
    - Act against a variety of microbes
    - Work in several ways
      - Punch holes in cytoplasmic membranes of pathogens
      - Interrupt enzymatic reaction
      - Recruit leukocyte to a site
  - Other Processes and Chemicals
    - Many organs secrete chemicals with antimicrobial properties

TABLE 15.2 Secretions and Activities That Contribute to the First Line of Defense

Secretion/Activity	Function
Digestive System	
Saliva	Washes microbes from teeth, gums, tongue, and palate; contains lysozyme, an antibacterial enzyme
Stomach acid	Digests and/or inhibits microorganisms
Gastroferritin	Sequesters iron being absorbed, making it unavailable for microbial use
Bile	Inhibitory to most microorganisms
Intestinal secretions	Digests and/or inhibits microorganisms
Peristalsis	Moves gastrointestinal (GI) contents through GI tract, constantly eliminating potential pathogens
Defecation	Eliminates microorganisms
Vomiting	Eliminates microorganisms
Urinary System	
Urine	Contains lysozyme; urine's acidity inhibits microorganisms; may wash microbes from ureters and urethra during urination

TABLE 15.2 Secretions and Activities That Contribute to the First Line of Defense *(Continued)*

Secretion/Activity	Function
Reproductive System	
Vaginal secretions	Acidity inhibits microorganisms; contains iron-binding proteins that sequester iron, making it unavailable for microbial use
Menstrual flow	Cleanses uterus and vagina
Prostate secretion	Contains iron-binding proteins that sequester iron, making it unavailable for microbial use
Cardiovascular System	
Blood flow	Removes microorganisms from wounds
Coagulation	Prevents entrance of many pathogens