

## Appendix E

# Glossary

**454 sequencing (pyrosequencing)** a next generation sequencing technique in which fragmented DNA has DNA adapters attached, is amplified by PCR, is attached to a bead, and then placed into a well with sequencing reagents, and the flash of light produced by the release of pyrophosphate on addition of a nucleotide is monitored

**5' cap** methylguanosine nucleotide added to 5' end of a eukaryotic primary transcript

**70S ribosome** a ribosome composed of 50S and 30S subunits

**80S ribosome** cytoplasmic eukaryotic ribosome composed of 60S and 40S subunits

### A

**α-helix** secondary structure consisting of a helix stabilized by hydrogen bonds between nearby amino acid residues in a polypeptide

**A (aminoacyl) site** functional site of an intact ribosome that binds incoming charged aminoacyl tRNAs

**A-B exotoxin** class of exotoxin that contains A subunits, which enter the cell and disrupt cellular activities, and B subunits, which bind to host cell receptors

**ABO blood group system** set of glycoprotein antigens found on the surface of red blood cells; the presence or absence of specific carbohydrates determining blood type

**absorbance** when a molecule captures energy from a photon and vibrates or stretches, using the energy

**Acanthamoeba keratitis** a condition characterized by damage to the cornea and possible blindness caused by parasitic infection of the protozoan *Acanthamoeba*

**acellular** not made of cells

**acid-fast stain** a stain that differentiates cells that have waxy mycolic acids in their gram-positive cell walls

**acidic dye** a chromophore with a negative charge that attaches to positively charged structures

**acidophile** organism that grows optimally at a pH near 3.0

**acne** a skin disease in which hair follicles or pores become clogged, leading to the formation of comedones and infected lesions

**acquired immunodeficiency syndrome (AIDS)** disease caused by HIV, characterized by opportunistic infections and rare cancers

**actin** a protein that polymerizes to form microfilaments

**activation energy** energy needed to form or break chemical bonds and convert a reactant or reactants to a product or products

**activator** protein that increases the transcription of a gene in response to an external stimulus

**active carrier** an infected individual who can transmit the pathogen to others regardless of whether symptoms are currently present

**active immunity** stimulation of one's own adaptive immune responses

**active site** location within an enzyme where substrate(s) bind

**acute disease** disease of a relatively short duration that develops and progresses in a predictable pattern

**acute glomerulonephritis** inflammation of the glomeruli of the kidney, probably resulting from deposition of immune complexes and an autoimmune response caused by self-antigen mimicry by a pathogen

**acute necrotizing ulcerative gingivitis** a severe form of gingivitis, also called trench mouth

**acute otitis media** inflammatory disease of the middle ear resulting from a microbial infection

**acute rheumatic fever** sequela of streptococcal pharyngitis; comorbidities include arthritis and carditis

**acute-phase proteins** antimicrobial molecules produced by liver cells in response to pathogen-induced stimulation events

**acyclovir** antiviral guanosine analog; inhibits DNA replication

**adaptive immunity** third-line defense characterized by specificity and memory

**Addison disease** autoimmune disease affecting adrenal gland function

**adenine** purine nitrogenous base found in nucleotides

**adenosine diphosphate (ADP)** nucleotide derivative and relative of ATP containing only one high-energy phosphate bond

**adenosine monophosphate (AMP)** adenine molecule bonded to a ribose molecule and to a single phosphate group, having no high-energy phosphate bonds

**adenosine triphosphate (ATP)** energy currency of the cell; a nucleotide derivative that safely stores chemical energy in its two high-energy phosphate bonds

**adhesins** molecules on the surface of pathogens that promote colonization of host tissue

**adhesion** the capability of microbes to attach to host cells

**aerobic respiration** use of an oxygen molecule as the final electron acceptor of the electron transport system

**aerotolerant anaerobe** organism that does not use oxygen but tolerates its presence

**affinity maturation** function of the immune system by which B cells, upon re-exposure to antigen, are selected to produce higher affinity antibodies

**affinity** measure of how tightly an antibody-binding site binds to its epitope

**aflatoxin** chemical produced by the fungus *Aspergillus flavus*; both a toxin and the most potent known natural carcinogen

**African sleeping sickness** see *human African trypanosomiasis*

**agarose gel electrophoresis** a method for separating populations of DNA molecules of varying sizes by differential migration rates caused by a voltage gradient through a horizontal gel matrix

**agglutination** binding of different pathogen cells by Fab regions of the same antibody to aggregate and enhance elimination from body

**agranulocytes** leukocytes that lack granules in the cytoplasm

**alarmone** small intracellular derivative of a nucleotide that signals a global bacterial response (i.e., activating a regulon of operons) to an environmental stress

**albendazole** antihelminthic drug of the benzimidazole class that binds to helminthic  $\beta$ -tubulin, preventing microtubule formation

**algae** (singular: alga) any of various unicellular and multicellular photosynthetic eukaryotic organisms; distinguished from plants by their lack of vascular tissues and organs

**alkaliphile** organism that grows optimally at pH above 9.0

**alkylating agent** type of strong disinfecting chemical that acts by replacing a hydrogen atom within a molecule with an alkyl group, thereby inactivating enzymes and nucleic acids

**allergen** antigen capable of inducing type I hypersensitivity reaction

**allergy** hypersensitivity response to an allergen

**allograft** transplanted tissue from an individual of the same species that is genetically different from the recipient

**allosteric activator** molecule that binds to an enzyme's allosteric site, increasing the affinity of the enzyme's active site for the substrate(s)

**allosteric site** location within an enzyme, other than the active site, to which molecules can bind, regulating enzyme activity

**allylamines** class of antifungal drugs that inhibit ergosterol biosynthesis at an early point in the pathway

**Alphaproteobacteria** class of Proteobacteria that are all oligotrophs

**alveoli** cul-de-sacs or small air pockets within the lung that facilitate gas exchange

**amantadine** antiviral drug that targets the influenza virus by preventing viral escape from endosomes upon host cell uptake, thus preventing viral RNA release and subsequent viral replication

**amensalism** type of symbiosis in which one population harms the other but remains unaffected itself

**Ames test** method that uses auxotrophic bacteria to detect mutations resulting from exposure to potentially mutagenic chemical compounds

**amino acid** a molecule consisting of a hydrogen atom, a carboxyl group, and an amine group bonded to the same carbon. The group bonded to the carbon varies and is represented by an *R* in the structural formula

**aminoacyl-tRNA synthetase** enzyme that binds to a tRNA molecule and catalyzes the addition of the correct amino acid to the tRNA

**aminoglycosides** protein synthesis inhibitors that bind to the 30S subunit and interfere with the ribosome's proofreading ability, leading to the generation of faulty proteins that insert into and disrupt the bacterial cytoplasmic membrane

**amoebiasis** intestinal infection caused by *Entamoeba histolytica*

**amoebic dysentery** severe form of intestinal infection caused by *Entamoeba histolytica*, characterized by severe diarrhea with blood and mucus

**amphipathic** a molecule containing both polar and nonpolar parts

**amphitrichous** having two flagella or tufts of multiple flagella, with one flagellum or tuft located at each end of the bacterial cell

**amphotericin B** antifungal drug of the polyene class that is used to treat several systemic fungal infections

**amplitude** the height of a wave

**anabolism** chemical reactions that convert simpler molecules into more complex ones

**anaerobe chamber** closed compartment used to handle and grow obligate anaerobic cultures

**anaerobe jar** container devoid of oxygen used to grow obligate anaerobes

**anaerobic respiration** use of a non-oxygen inorganic molecule, like  $\text{CO}_2$ , nitrate, nitrite, oxidized iron, or sulfate, as the final electron acceptor at the end of the electron transport system

**analytical epidemiology** study of disease outbreaks to establish associations between an agent and a disease state through observational studies comparing groups of individuals

**anaphylactic shock** another term for anaphylaxis

**anaphylaxis** systemic and potentially life-threatening type I hypersensitivity reaction

**nergy** peripheral tolerance mechanism that prevents self-reactive T cells from being activated by self-antigens through lack of co-stimulation

**annealing** formation of hydrogen bonds between the nucleotide base pairs of two single-stranded complementary nucleic acid sequences

**anoxygenic photosynthesis** type of photosynthesis found in many photosynthetic bacteria, including the purple and green bacteria, where an electron donor other than  $H_2O$  is used to replace an electron lost by a reaction center pigment, resulting no oxygen production

**anthrax** a disease caused by *Bacillus anthracis*; the cutaneous form causes a skin lesion to develop; gastrointestinal and inhalation anthrax have high mortality rates

**antibiogram** compilation of the antimicrobial susceptibilities recorded for local bacterial strains, which is useful for monitoring local trends in antimicrobial resistance and aiding the prescription of appropriate empiric antibacterial therapy

**antibiotic-associated diarrhea** diarrhea that develops after antibiotic treatment as a result of disruption to the normal microbiota; *C. difficile* is a particularly serious example

**antibody screen** test to make sure that a potential blood recipient has not produced antibodies to antigens other than the ABO and Rh antigens

**antibody** Y-shaped glycoprotein molecule produced by B cells that binds to specific epitopes on an antigen

**antibody-dependent cell-mediated cytotoxicity (ADCC)** mechanism by which large pathogens are marked for destruction by specific antibodies and then killed by secretion of cytotoxins by natural killer cells, macrophages, or eosinophils

**anticodon** three-nucleotide sequence of a mature tRNA that interacts with an mRNA codon through complementary base pairing

**antigen (also, immunogen)** a molecule that stimulates an adaptive immune response

**antigenic** able to stimulate an adaptive immune response

**antigenic drift** form of slight antigenic variation that occurs because of point mutations in the genes that encode surface proteins

**antigenic shift** form of major antigenic variation that occurs because of gene reassortment

**antigenic variation** changing of surface antigens (carbohydrates or proteins) such that they are no longer recognized by the host's immune system

**antigen-presenting cells (APC)** macrophages, dendritic cells, and B cells that process and present foreign pathogen antigens for the purpose of activating T cells and adaptive immune defenses

**antimetabolites** compounds that are competitive inhibitors for bacterial metabolic enzymes

**antimicrobial drugs** chemical compounds, including naturally produced drugs, semisynthetic derivatives, and synthetic compounds, that target specific microbial structures and enzymes, killing specific microbes or inhibiting their growth

**antimicrobial peptides (AMPs)** class of non-specific, cell-derived chemical mediators with broad-spectrum antimicrobial properties

**antiparallel** two strands of DNA helix oriented in opposite directions; one strand is oriented in the 5' to 3' direction, while the other is oriented in the 3' to 5' direction

**antisense RNA** small noncoding RNA molecules that inhibit gene expression by binding to mRNA transcripts via complementary base pairing

**antisense strand** transcription template strand of DNA; the strand that is transcribed for gene expression

**antisepsis** protocol that removes potential pathogens from living tissue

**antiseptic** antimicrobial chemical that can be used safely on living tissue

**antiserum** serum obtained from an animal containing antibodies against a particular antigen that was artificially introduced to the animal

**apoenzyme** enzyme without its cofactor or coenzyme

**apoptosis** programmed and organized cell death without lysis of the cell

**arachnoid mater** middle membrane surrounding the brain that produces cerebrospinal fluid

**arboviral encephalitis** infection by an arthropod-borne virus that results in an inflammation of the brain

**arbovirus** any of a variety of viruses that are transmitted by arthropod vectors

**archaea** any of various unicellular prokaryotic microorganisms, typically having cell walls containing pseudopeptidoglycan

**Archaea** domain of life separate from the domains Bacteria and Eukarya

**artemisinin** antiprotozoan and antifungal drug effective against malaria that is thought to increase intracellular levels of reactive oxygen species in target microbes

**artery** large, thick-walled vessel that carries blood from the heart to the body tissues

**Arthus reaction** localized type III hypersensitivity

**artificial active immunity** immunity acquired through exposure to pathogens and pathogen antigens through a method other than natural infection

**artificial passive immunity** transfer of antibodies produced by a donor to another individual for the purpose of preventing or treating disease

**ascariasis** soil-transmitted intestinal infection caused by the large nematode roundworm *Ascaris lumbricoides*

**ascocarps** cup-shaped fruiting bodies of an ascomycete fungus

**ascospore** asexual spore produced by ascomycete fungi

**ascus** structure of ascomycete fungi containing spores

**asepsis** sterile state resulting from proper use of microbial control protocols

**aseptic technique** method or protocol designed to prevent microbial contamination of sterile objects, locations, or tissues

**aspergillosis** fungal infection caused by the mold *Aspergillus*; immunocompromised patients are primarily at risk

**asymptomatic carrier** an infected individual who exhibits no signs or symptoms of disease yet is capable of transmitting the pathogen to others

**asymptomatic** not exhibiting any symptoms of disease

**atomic force microscope** a scanning probe microscope that uses a thin probe that is passed just above the specimen to measure forces between the atoms and the probe

**ATP synthase** integral membrane protein that harnesses the energy of the proton motive force by allowing hydrogen ions to diffuse down their electrochemical gradient, causing components of this protein to spin, making ATP from ADP and  $P_i$

**attachment** binding of phage or virus to host cell receptors

**attenuation** regulatory system of prokaryotes whereby secondary stem-loop structures formed within the 5' end of an mRNA being transcribed determine both if transcription to complete the synthesis of this mRNA will occur and if this mRNA will be used for translation

**autoclave** specialized device for the moist-heat sterilization of materials through the application of pressure to steam, allowing the steam to reach temperatures above the boiling point of water

**autocrine function** refers to a cytokine signal released from a cell to a receptor on its own surface

**autograft** tissue transplanted from a location on an individual to a different location on the same individual

**autoimmune disease** loss of tolerance to self, resulting in immune-mediated destruction of self cells and tissues

**autoinducer** signaling molecule produced by a bacterial cell that can modify the activity of surrounding cells; associated with quorum sensing

**autoradiography** the method of producing a photographic image from radioactive decay; in molecular genetics the method allows the visualization of radioactively-labeled DNA probes that have hybridized to a nucleic acid sample

**autotroph** organism that converts inorganic carbon dioxide into organic carbon

**auxotroph** nutritional mutant with a loss-of-function mutation in a gene encoding the biosynthesis of a specific nutrient such as an amino acid

**avidity** strength of the sum of the interactions between an antibody and antigen

**axon** long projection of a neuron along which an electrochemical signal is transmitted

**azithromycin** semisynthetic macrolide with increased spectrum of activity, decreased toxicity, and increased half-life compared with erythromycin

## B

**$\beta$ -lactamases** bacterially produced enzymes that cleave the  $\beta$ -lactam ring of susceptible  $\beta$ -lactam antimicrobials, rendering them inactive and conferring resistance

**$\beta$ -lactams** group of antimicrobials that inhibit cell wall synthesis; includes the penicillins, cephalosporins, carbapenems, and monobactams; inhibits the transpeptidase cross-linking activity of penicillin-binding proteins

**$\beta$ -oxidation** process of fatty acid degradation that sequentially removes two-carbon acetyl groups, producing NADH and  $FADH_2$ , on entry into the Krebs cycle

**$\beta$ -pleated sheet** secondary structure consisting of pleats formed by hydrogen bonds between localized segments of amino acid residues on the backbone of the polypeptide chain

**B-cell receptors (BCRs)** membrane-bound IgD and IgM antibody that bind specific antigen epitopes with Fab antigen-binding region

**B lymphocyte** antibody-producing cells of humoral immunity; B cell

**babesiosis** tickborne protozoan infection caused by *Babesia* spp. and characterized by malaise, fatigue, fever, headache, myalgia, and joint pain

**bacillary dysentery** gastrointestinal illness caused by *Shigella* bacteria, also called shigellosis

**bacillus** (bacilli) rod-shaped prokaryotic cell

**bacitracin** group of structurally similar peptides that block the movement of peptidoglycan precursors across the cell membrane, inhibiting peptidoglycan synthesis

**bacteremia** condition marked by the presence of bacteria in the blood

**bacteria** (singular: bacterium) any of various unicellular prokaryotic microorganisms typically (but not always) having cell walls that contain peptidoglycan

**bacterial lawn** layer of confluent bacterial growth on an agar plate

**bacterial meningitis** bacterial infection that results in an inflammation of the meninges

**bacterial vaginosis** a condition caused by an overgrowth of bacteria in the vagina that may or may not cause symptoms

**bactericidal** irreversible inhibition of a microbe's ability to divide

**bactericide** chemical or physical treatment that kills bacteria

**bacteriochlorophylls** green, purple, or blue pigments of bacteria; they are similar to chlorophyll of plants

**bacteriology** the study of bacteria

**bacteriophage** virus that infects bacteria

**bacteriostatic** having the ability to inhibit bacterial growth, generally by means of chemical or physical treatment; reversible inhibition of a microbe's ability to divide

**barophile** organism that grows under high atmospheric pressure

**basal body** component of eukaryotic flagellum or cilium composed of nine microtubule triplets and attaches the flagellum or cilium to the cell

**base sequence** identity of the specific nucleotides present in a nucleic acid strand and their order within the strand

**basic dye** a chromophore with a positive charge that attaches to negatively charged structures

**basidia (basidium, sing.)** small club-shaped structures of basidiomycete fungi where basidiospores are produced

**basidiocarps** fruiting bodies of basidiomycete fungi  
**basidiospores** spores produced sexually via budding in basidiomycete fungi  
**basophils** leukocytes with granules containing histamine and other chemicals that facilitate allergic responses and inflammation when released  
**benzimidazoles** class of antihelminthic drugs that bind to helminthic  $\beta$ -tubulin, preventing microtubule formation  
**Betaproteobacteria** class of Proteobacteria that are all eutrophs  
**binary fission** predominant form of bacterial reproduction in which one cell divides into two daughter cells of equal size, which separate, each offspring receiving a complete copy of the parental genome  
**binocular** having two eyepieces  
**binomial nomenclature** a universal convention for the scientific naming of organisms using Latinized names for genus and species  
**biofilm** complex ecosystem of bacteria embedded in a matrix  
**biogeochemical cycle** recycling of inorganic matter between living organisms and their nonliving environment  
**bioinformatics** the analysis of large amounts of information required for interpretation of these data  
**biological transmission** movement of a pathogen between hosts facilitated by a biological vector in which the pathogen grows and reproduces  
**biological vector** an animal (typically an arthropod) that is infected with a pathogen and is capable of transmitting the pathogen from one host to another  
**biomarker** a protein expressed by a cell or tissue that is indicative of disease  
**biomolecule** a molecule that is part of living matter  
**bioremediation** use of microbes to remove xenobiotics or environmental pollutants from a contaminated site  
**biosynthesis** replication of viral genome and other protein components  
**biotechnology** the science of using living systems to benefit humankind  
**bisbiguanide** type of chemical compound with antiseptic properties; disrupts cell membranes at low concentrations and causes congealing of intracellular contents at high concentrations  
**blastomycosis** fungal disease associated with infections by *Blastomyces dermatitidis*; can cause disfiguring scarring of the hands and other extremities  
**blepharitis** inflammation of the eyelids  
**blocking antibodies** antigen-specific antibodies (usually of the IgG type) produced via desensitization therapy  
**blood-brain barrier** tight cell junctions of the endothelia lining the blood vessels that serve the central nervous system, preventing passage of microbes from the bloodstream into the brain and cerebrospinal fluid  
**blue-white screening** a technique commonly used for identifying transformed bacterial cells containing recombinant plasmids using *lacZ*-encoding plasmid vectors  
**blunt ends** ends of DNA molecules lacking single-stranded complementary overhangs that are produced when some restriction enzymes cut DNA  
**botulism** form of flaccid paralysis caused by the ingestion of a neurotoxin produced by *Clostridium botulinum*  
**bradykinin** activated form of a proinflammatory molecule induced in the presence of invader microbes; opens gaps between cells in blood vessels, allowing fluid and cells to leak into surrounding tissue  
**bridge reaction** reaction linking glycolysis to the Krebs cycle during which each pyruvate is decarboxylated and oxidized (forming NADH), and the resulting two-carbon acetyl group is attached to a large carrier called coenzyme A, resulting in the formation of acetyl-CoA and CO<sub>2</sub>; also called the *transition reaction*

**brightfield microscope** a compound light microscope with two lenses; it produces a dark image on a bright background  
**broad-spectrum antimicrobial** drug that targets many different types of microbes  
**bronchi** major air passages leading to the lungs after bifurcating at the windpipe  
**bronchioles** smaller air passages within the lung that are formed as the bronchi become further subdivided  
**bronchitis** inflammation of the bronchi  
**brucellosis** zoonotic disease caused by bacteria of the genus *Brucella* that results in undulant fever  
**bubo** swollen, inflamed lymph node that forms as a result of a microbial infection  
**bubonic plague** most common form of plague in humans, marked by the presence of swollen lymph nodes (bubo)  
**budding** unequal reproductive division in which a smaller cell detaches from the parent cell  
**budding yeasts** yeasts that divide by budding off of daughter cells  
**Burkitt lymphoma** disease characterized by rapidly growing solid tumor; caused by Epstein-Barr virus (HHV-4)  
**burst** release of new virions by a lysed host cell infected by a virus  
**burst size** the number of virions released from a host cell when it is lysed because of a viral infection

**C**

**Calvin-Benson cycle** most common CO<sub>2</sub> fixation pathway in most photoautotrophs; involves light-independent reactions of photosynthesis that occur in the cytoplasm of photosynthetic bacteria and in the stroma of eukaryotic chloroplasts  
**Campylobacter jejuni gastroenteritis** gastroenteritis caused by *C. jejuni*; generally mild but sometimes with serious complications  
**candidiasis** fungal infection caused by *Candida* spp., especially *C. albicans*; can affect various regions of the body, e.g., skin (cutaneous candidiasis), oral cavity (oral thrush), or vagina (yeast infection)  
**candle jar** container with a tight-fitting lid in which a burning candle consumes oxygen and releases carbon dioxide, thereby creating an environment suitable for capnophiles  
**capillary** small blood vessel found in the interstitial space of tissue; delivers nutrients and oxygen, and removes waste products  
**capnophile** organism that requires carbon dioxide levels higher than atmospheric concentration  
**capsid** protein coat surrounding the genome of the virus  
**capsomere** individual protein subunits that make up the capsid  
**capsule staining** a negative staining technique that stains around a bacterial capsule while leaving the capsule clear  
**capsule** type of glycocalyx with organized layers of polysaccharides that aid in bacterial adherence to surfaces and in evading destruction by immune cells  
**carbapenem-resistant Enterobacteriaceae (CRE)** group of bacteria that have developed resistance to all  $\beta$ -lactams, including carbapenems, and many other drug classes  
**carbohydrate** the most abundant type of biomolecule, consisting of carbon, hydrogen, and oxygen  
**carbon skeleton** chain of carbon atoms to which one or more functional groups are bound  
**carboxysome** an inclusion composed of an outer shell of thousands of protein subunits. Its interior is filled with ribulose-1,5-bisphosphate carboxylase/oxygenase (RuBisCO) and carbonic anhydrase, which are both used for carbon metabolism  
**carbuncle** abscess containing a large, deep, purulent skin lesion  
**carcinogen** agent that causes cancer  
**case-control study** a type of observational study in which a group of affected individuals are compared, usually retrospectively, to a similar group of unaffected individuals  
**catabolic activator protein (CAP)/cAMP receptor protein (CRP)** protein that, when bound to cAMP in the presence of low levels of glucose, binds to the promoters of operons that control the processing of alternative sugars  
**catabolism** chemical reactions that break down complex molecules into simpler ones  
**catabolite repression** repression of the transcription of operons encoding enzymes for the use of substrates other than glucose when glucose levels are high  
**catalase** enzyme that breaks down hydrogen peroxide to water and oxygen  
**catalyst** molecule that increases the rate of a chemical reaction but is not used or changed during the chemical reaction and, thus, is reusable  
**catarrhal stage** in pertussis, a disease stage marked by inflammation of the mucous membranes combined with excessive secretions  
**cat-scratch disease** bacterial infection of the lymph nodes caused by *Bartonella henselae*; frequently transmitted via a cat scratch  
**causative agent** the pathogen or substance responsible for causing a particular disease; etiologic agent  
**CCA amino acid binding end** region of a mature tRNA that binds to an amino acid  
**celiac disease** disease largely of the small intestine caused by an immune response to gluten that results in the production of autoantibodies and an inflammatory response  
**cell envelope** the combination of external cellular structures (e.g., plasma membrane, cell wall, outer membrane, glycocalyxes) that collectively contain the cytoplasm and internal structures of a cell  
**cell membrane** lipid bilayer with embedded proteins and carbohydrates that defines the boundary of the cell (also called the cytoplasmic membrane or plasma membrane)  
**cell morphology** cell shape, structure, and arrangement, as viewed microscopically  
**cell theory** the theory that all organisms are composed of cells and that the cell is the fundamental unit of life  
**cell wall** a structure in the cell envelope of some cells that helps the cell maintain its shape and withstand changes in osmotic pressure  
**cellular immunity** adaptive immunity involving T cells and the destruction of pathogens and infected cells  
**cellulitis** a subcutaneous skin infection that develops in the dermis or hypodermis, resulting in a red, painful inflammation  
**cellulose** a structural polysaccharide composed of glucose monomers linked together in a linear chain by glycosidic bonds  
**Centers for Disease Control and Prevention (CDC)** the national public health agency in the United States  
**central dogma** scientific principle explaining the flow of genetic information from DNA to RNA to protein  
**central nervous system (CNS)** portion of the nervous system made up of the brain and spinal cord  
**central tolerance** negative selection of self-reactive T cells in thymus  
**centriole** a component of a centrosome with the structural array of nine parallel microtubules arranged in triplets; involved in eukaryotic cell division  
**centrosome** a microtubule-organizing center for the mitotic spindle found in animal cells; it separates chromosomes during cell division and is composed of a pair of centrioles positioned at right angles to each other  
**cephalosporins** a group of cell wall synthesis inhibitors within the class of  $\beta$ -lactams  
**cerarial dermatitis** inflammation of the skin caused by a reaction to cercaria of *Schistosoma* spp., which can penetrate the skin and blood vessels; also called swimmer's itch or clam digger's itch

**cerebrospinal fluid (CSF)** sterile liquid produced in the brain that fills the subarachnoid space of the brain and spinal column

**cervix** the part of the uterus that connects to the vagina

**CFB group** phylum consisting of the gram-negative, rod-shaped nonprotoeobacteria genera *Cytophaga*, *Fusobacterium*, and *Bacteroides*

**Chagas disease** potentially fatal protozoan infection caused by *Trypanosoma cruzi* and endemic to Central and South America; transmitted by the triatomine bug (kissing bug)

**chancroid** an STI caused by *Haemophilus ducreyi* that produces soft chancres on genitals

**charged tRNA** activated tRNA molecule carrying its cognate amino acid

**chemical mediators** chemicals or enzymes produced by a variety of cells; provide nonspecific antimicrobial defense mechanisms

**chemically defined media** media in which all components are chemically defined

**chemiosmosis** flow of hydrogen ions across the membrane through ATP synthase

**chemokines** chemoattract cytokines that recruit specific subsets of leukocytes to infections, damaged tissue, and sites of inflammation

**chemotaxis** directional movement of a cell in response to a chemical attractant

**chemotroph** organism that gets its energy from the transfer of electrons originating from chemical compounds

**chickenpox** common childhood disease caused by the varicella-zoster virus and marked by the formation of pustular lesions on the trunk

**chikungunya fever** mosquito-borne viral disease caused by the chikungunya virus and characterized by high fever, joint pain, rash, and blisters

**chirality** property of stereoisomer molecules by which their structures are nonsuperimposable mirror images

**chitin** polysaccharide that is an important component of fungal cell walls

**chlamydia** a common STI caused by *Chlamydia trachomatis*

**chloramphenicol** protein synthesis inhibitor with broad-spectrum activity that binds to the 50S subunit, inhibiting peptide bond formation

**chlorophyll** a type of photosynthetic pigment found in some prokaryotic and eukaryotic cells

**chloroplast** organelle found in plant and algal cells in which photosynthesis occurs

**cholera** gastrointestinal illness caused by *Vibrio cholera* characterized by severe diarrhea

**chromatin** combination of DNA with DNA binding proteins

**chromogenic substrate** colorless substrate (chromogen) that is converted into a colored end product by the enzyme

**chromophores** pigments that absorb and reflect particular wavelengths of light (giving them a color)

**chromosome** discrete DNA structure within a cell that controls cellular activities

**chronic disease** any disease that progresses and persists over a long time

**chronic granulomatous disease** primary immunodeficiency caused by an impaired ability of phagocytic cells to kill ingested bacteria in the phagolysosome

**chronic wasting disease** prion disease of deer and elk in the United States and Canada

**cilia (singular: cilium)** short filamentous structures found on some eukaryotic cells; each is composed of microtubules in a 9+2 array, and may be used for locomotion, feeding, and/or movement of extracellular particles that come in contact with the cell

**ciliated epithelial cells** hair-like cells in the respiratory tract that beat, pushing mucus secretions and trapped debris away from the sensitive tissues of the lungs

**ciliates** protists with cilia (Ciliophora), including *Paramecium* and *Stentor*, classified within the Chromalveolata

**cisternae** the sacs of the endoplasmic reticulum

**citric acid cycle** see *Krebs cycle*

**class switching** genetic rearrangement of constant region gene segments in plasma cells to switch antibody production from IgM to IgG, IgA, or IgE

**clindamycin** semisynthetic protein synthesis inhibitor of the lincosamide class that binds to the 50S subunit, inhibiting peptide bond formation

**clone** a genetically identical cell or individual

**Clostridium perfringens gastroenteritis** relatively mild gastrointestinal illness caused by *C. perfringens*

**clusters of differentiation (CD)** cell-surface glycoproteins that serve to identify and distinguish white blood cells

**coagulase** enzyme that causes the activation of fibrinogen to form fibrin, promoting clotting of the blood

**coarse focusing knob** a knob on a microscope that produces relatively large movements to adjust focus

**coccidioidomycosis** disease caused by the highly infectious fungal pathogen *Coccidioides immitis* and related species

**codon** three-nucleotide sequence within mRNA that specifies a particular amino acid to be incorporated into the polypeptide being synthesized

**coenocyte** multinucleated eukaryotic cell that forms as a result of multiple rounds of nuclear division without the accompanying division of the plasma membrane

**coenocytic hyphae** nonseptate hyphae that are multinucleate and lack cell walls or membranes between cells; characteristic of some fungi

**coenzyme** organic molecule required for proper enzyme function that is not consumed and is reusable

**cofactor** inorganic ion that helps stabilize enzyme conformation and function

**cognate amino acid** amino acid added to a specific tRNA molecule that correctly corresponds to the tRNA's anticodon and, hence, the mRNA's codon, reflecting the genetic code

**cohort method** a method used in observational studies in which a group of individuals is followed over time and factors potentially important in the development of disease are evaluated

**colistin** membrane-active polymyxin that was historically used for bowel decontamination but now used for systemic infections with drug-resistant pathogens

**colitis** inflammation of the large intestine

**collagenase** enzyme that digests collagen, the dominant protein in connective tissue

**colony-forming unit (CFU)** a counting quantity represented by a colony formed on solid medium from a single cell or a few cells

**commensalism** type of symbiosis in which one population benefits and the other is not affected

**commercial sterilization** type of sterilization protocol used in food production; uses conditions that are less harsh (lower temperatures) to preserve food quality but still effectively destroy vegetative cells and endospores of common foodborne pathogens such as *Clostridium botulinum*

**common cold** most common cause of rhinitis in humans; associated with a variety of adenoviruses, coronaviruses, and rhinoviruses

**common source spread** a mode of disease transmission in which every infection originates from the same source

**communicable** able to be transmitted directly or indirectly from one person to another

**community** group of interacting populations of organisms

**competitive inhibitor** molecule that binds to an enzyme's active site, preventing substrate binding

**competitive interactions** interactions between populations in which one of them competes with another for resources

**complement activation** cascading activation of the complement proteins in the blood, resulting in opsonization, inflammation, and lysis of pathogens

**complement fixation test** test for antibodies against a specific pathogen using complement-mediated hemolysis

**complement system** series of proteins that can become activated in the presence of invading microbes, resulting in opsonization, inflammation, and lysis of pathogens

**complementary base pairs** base pairing due to hydrogen bonding that occurs between a specific purine and a specific pyrimidine; A bonds with T (in DNA), and C bonds with G

**complementary DNA (cDNA)** a DNA molecule complementary to mRNA that is made through the activity of reverse transcriptase

**complex media** media that contain extracts of animals and plants that are not chemically defined

**complex virus** virus shape that often includes intricate characteristics not seen in the other categories of capsid

**compound microscope** a microscope that uses multiple lenses to focus light from the specimen

**condenser lens** a lens on a microscope that focuses light from the light source onto the specimen

**conditional mutation** mutant form of a gene whose mutant phenotype is expressed only under certain environmental conditions

**confocal microscope** a scanning laser microscope that uses fluorescent dyes and excitation lasers to create three-dimensional images

**conidia** asexual fungal spores not enclosed in a sac; produced in a chain at the end of specialized hyphae called conidiophores

**conjugate vaccine** a vaccine consisting of a polysaccharide antigen conjugated to a protein to enhance immune response to the polysaccharide; conjugate vaccines are important for young children who do not respond well to polysaccharide antigens

**conjugated protein** protein carrying a nonpolypeptidic portion

**conjugation** mechanism of horizontal gene transfer in bacteria in which DNA is directly transferred from one bacterial cell to another by a conjugation pilus

**conjugation pilus (sex pilus)** hollow tube composed of protein encoded by the conjugation plasmid that brings two bacterial cells into contact with each other for the process of conjugation

**conjunctiva** the mucous membranes covering the eyeball and inner eyelid

**conjunctivitis** inflammation of the conjunctiva, the mucous membrane covering the eye and inside of the eyelid

**constitutively expressed** describes genes that are transcribed and translated continuously to provide the cell with constant intermediate levels of the protein products

**contact dermatitis** inflammation of the skin resulting from a type IV hypersensitivity to an allergen or irritant

**contact see exposure**

**contact transmission** movement of a pathogen between hosts due to contact between the two; may be direct or indirect

**contagious** easily spread from person to person

**continuous cell line** derived from transformed cells or tumors; these cells are often able to be subcultured many times, or, in the case of immortal cell lines, grown indefinitely

**continuous common source spread** a mode of disease transmission in which every infection originates from the same source and that source produces infections for longer than one incubation period

**contractile vacuoles** organelles found in some cells, especially in some protists, that take up water and then move the water out of the cell for osmoregulatory purposes (i.e., to maintain an appropriate salt and water balance)

**contrast** visible differences between parts of a microscopic specimen

**convalescence stage** the final stage of a whooping cough infection, marked by a chronic cough

**Coombs' reagent** antiserum containing antihuman immunoglobulins used to facilitate hemagglutination by cross-linking the human antibodies attached to red blood cells

**cooperative interactions** interactions between populations in which both benefit

**cortex** tightly packed layer of fungal filaments at the outer surface of a lichen; foliose lichens have a second cortex layer beneath the medulla

**counterstain** a secondary stain that adds contrasting color to cells from which the primary stain has been washed out by a decolorizing agent

**crenation** shriveling of a cell

**Creutzfeldt-Jakob disease** form of transmissible spongiform encephalopathy found in humans; typically a fatal disease

**crisis phase** point at which a fever breaks, reaching a peak before the hypothalamus resets back to normal body temperature

**critical item** object that must be sterile because it will be used inside the body, often penetrating sterile tissues or the bloodstream

**cross-match** in the major cross-match, donor red blood cells are checked for agglutination using recipient serum; in the minor cross-match, donor serum is checked for agglutinating antibodies against recipient red blood cells

**cross-presentation** a mechanism by which dendritic cells process antigens for MHC I presentation to CD8 T cells through phagocytosis of the pathogen (which would normally lead to MHC II presentation)

**cross-resistance** when a single resistance mechanism confers resistance to multiple antimicrobial drugs

**cross-sectional study** a type of observational study in which measurements are made on cases, both affected and unaffected, at one point in time and the measurements analyzed to uncover associations with the disease state

**crustose lichens** lichens that are tightly attached to the substrate, giving them a crusty appearance

**cryptococcosis** fungal pneumonia caused by the encapsulated yeast *Cryptococcus neoformans* commonly found in bird droppings

**cryptosporidiosis** intestinal infection caused by *Cryptosporidium parvum* or *C. hominis*

**culture density** the number of cells per volume of broth

**culture medium** combination of compounds in solution that supports growth

**cutaneous mycosis** any fungal infection that affects the surface of the skin, hair, or nails

**cyanobacteria** phototrophic, chlorophyll-containing bacteria that produce large amounts of gaseous oxygen

**cyclic AMP (cAMP)** intracellular signaling molecule made through the action of adenylyl cyclase from ATP when glucose levels are low, with the ability to bind to a catabolite activator protein to allow it to bind to regulatory regions and activate the transcription of operons encoding enzymes for metabolism of alternative substrates

**cyclic photophosphorylation** pathway used in photosynthetic organisms when the cell's need for ATP outweighs that for NADPH, thus bypassing NADPH production

**cyclosporiasis** intestinal infection caused by *Cyclospora cayetanensis*

**cystic echinococcosis** hydatid disease, an infection caused by the tapeworm *Echinococcus granulosus* that can cause cyst formation

**cysticerci** larval form of a tapeworm

**cystitis** inflammation of the bladder

**cysts** microbial cells surrounded by a protective outer covering; some microbial cysts are formed to help the microbe survive harsh conditions, whereas others are a normal part of the life cycle

**cytochrome oxidase** final ETS complex used in aerobic respiration that transfers energy-depleted electrons to oxygen to form  $H_2O$

**cytokine storm** an excessive release of cytokines, typically triggered by a superantigen, that results in unregulated activation of T cells

**cytokines** protein molecules that act as a chemical signals; produced by cells in response to a stimulation event

**cytomegalovirus (CMV) infection** human herpesvirus 5 infection that is typically asymptomatic but can become serious in immunocompromised patients, transplant recipients, and developing fetuses

**cytopathic effect** cell abnormality resulting from a viral infection

**cytoplasm** the gel-like material composed of water and dissolved or suspended chemicals contained within the plasma membrane of a cell

**cytoplasmic membrane** see *cell membrane*

**cytoproct** a protozoan cell structure that is specialized for excretion

**cytosine** pyrimidine nitrogenous base found in nucleotides

**cytoskeleton** a network of filaments or tubules in the eukaryotic cell that provides shape and structural support for cells; aids movement of materials throughout the cell

**cytostome** a protozoan cell structure that is specialized for phagocytosis (i.e., to take in food)

**cytotoxic T cells** effector cells of cellular immunity that target and eliminate cells infected with intracellular pathogens through induction of apoptosis

**cytotoxicity** harmful effects to host cell

**D**

**dacryocystitis** inflammation of the lacrimal sac often associated with a plugged nasolacrimal duct

**daptomycin** cyclic lipopeptide that disrupts the bacterial cell membrane

**darkfield microscope** a compound light microscope that produces a bright image on a dark background; typically a modified brightfield microscope

**death phase (decline phase)** phase of the growth curve at which the number of dying cells exceeds the number of new cells formed

**decimal reduction time (DRT) or D-value** amount of time it takes for a specific protocol to produce a one order of magnitude decrease in the number of organisms; that is, death of 90% of the population

**decolorizing agent** a substance that removes a stain, usually from some parts of the specimen

**deeply branching bacteria** bacteria that occupy the lowest branches of the phylogenetic tree of life

**definitive host** the preferred host organism for a parasite, in which the parasite reaches maturity and may reproduce sexually

**degeneracy** redundancy in the genetic code because a given amino acid is encoded by more than one nucleotide triplet codon

**degerming** protocol that significantly reduces microbial numbers by using mild chemicals (e.g., soap) and gentle scrubbing of a small area of skin or tissue to avoid the transmission of pathogenic microbes

**degranulation** release of the contents of mast cell granules in response to the cross-linking of IgE molecules on the cell surface with allergen molecules

**dehydration synthesis** chemical reaction in which monomer molecules bind end to end in a process that results in the formation of water molecules as a byproduct

**deletion** type of mutation involving the removal of one or more bases from a DNA sequence

**Deltaproteobacteria** class of Proteobacteria that includes sulfate-reducing bacteria

**denatured protein** protein that has lost its secondary and tertiary structures (and quaternary structure, if applicable) without the loss of its primary structure

**dendrites** branched extensions of the soma of a neuron that interact with other cells

**dengue fever** mosquito-borne viral hemorrhagic disease; also known as breakbone fever

**dental calculus** calcified heavy plaque on teeth, also called tartar

**dental caries** cavities formed in the teeth as a result of tooth decay caused by microbial activity

**deoxyribonucleic acid (DNA)** double-stranded nucleic acid composed of deoxyribonucleotides that serves as the genetic material of the cell

**deoxyribonucleotides** DNA nucleotides containing deoxyribose as the pentose sugar component

**dermatophyte** any fungus of the genera *Microsporum*, *Epidermophyton*, or *Trichophyton*, which feed on keratin (a protein found in skin, hair, and nails) and can cause cutaneous infections

**dermis** the second layer of human skin, found between the epidermis and the hypodermis

**descriptive epidemiology** a method of studying a disease outbreak using case histories, contact interviews, medical information, and other sources of information

**desensitization** injections of antigen that lead to production of antigen-specific IgG molecules, effectively outcompeting IgE molecules on the surface of sensitized mast cells for antigen

**desiccation** method of microbial control involving the removal of water from cells through drying or dehydration

**desquamation** peeling and shedding of outermost skin

**diapedesis** process by which leukocytes pass through capillary walls to reach infected tissue; also called extravasation

**diaphragm** a component of a microscope; typically consists of a disk under the stage with holes of various sizes; can be adjusted to allow more or less light from the light source to reach the specimen

**differential interference-contrast microscope** a microscope that uses polarized light to increase contrast

**differential media** media that contain additives that make it possible to distinguish bacterial colonies based on metabolic activities of the organisms

**differential staining** staining that uses multiple dyes to differentiate between structures or organisms

**diffraction** the changing of direction (bending or spreading) that occurs when a light wave interacts with an opening or barrier

**dikaryotic** having two separate nuclei within one cell

**dimorphic fungus** a fungus that can take the form of a yeast or a mold, depending on environmental conditions

**dioecious** refers to sexually reproducing organisms in which individuals have either male or female reproductive organs (not both)

**diphtheria** serious infection of the larynx, caused by the toxicigenic bacterium *Corynebacterium diphtheriae*

**diploid** having two copies of each chromosome

**direct agglutination assay** assay that can be used to detect the agglutination of bacteria by the action of antibodies in patient serum

**direct antihuman globulin test (DAT)** another name for a direct Coombs' test

**direct contact transmission** movement of a pathogen between hosts by physical contact or transfer in droplets at a distance less than one meter

**direct Coombs' test** assay that looks for antibodies *in vivo* against red blood cells caused by various types of infections, drug reactions, and autoimmune disorders

**direct ELISA** enzyme-linked immunoabsorbent assay in which the antigens are immobilized in the well of a microtiter plate; only a single antibody is used in the test

**direct fluorescent antibody (DFA) test** FA technique in which the labeled antibody binds to the target antigen

**direct hemagglutination assay** test that determines the titer of certain bacteria and viruses that causes clumping of red blood cells

**direct microscopic cell count** counting of cells using a calibrated slide under a light microscope

**direct repair (light repair or photoreactivation)** light-dependent mechanism for repairing pyrimidine dimers involving the enzyme photolyase

**disaccharide** one of two monosaccharides linked together by a glycosidic bond

**disease** any condition in which the normal structure or function of the body is damaged or impaired

**disinfectant** antimicrobial chemical applied to a fomite during disinfection that may be toxic to tissues

**disinfection** protocol that removes potential pathogens from a fomite

**disk-diffusion method** a technique for measuring of the effectiveness of one or more antimicrobial agents against a known bacterium; involves measuring the zone(s) of inhibition around the chemical agent(s) in a culture of the bacterium

**dispersion** the separation of light of different frequencies due to different degrees of refraction

**disulfide bridge** covalent bond between the sulfur atoms of two sulphydryl side chains

**DNA gyrase (topoisomerase II)** bacterial topoisomerase that relaxes the supercoiled chromosome to make DNA more accessible for the initiation of replication

**DNA ligase** enzyme that catalyzes the formation of covalent phosphodiester linkage between the 3'-OH end of one DNA fragment and the 5' phosphate end of another DNA fragment

**DNA packaging** process in which histones or other DNA binding proteins perform various levels of DNA wrapping and attachment to scaffolding proteins to allow the DNA to fit inside a cell

**DNA polymerase** class of enzymes that adds nucleotides to the free 3'-OH group of a growing DNA chain that are complementary to the template strand

**DNA primers** short, synthetic, single-stranded DNA fragments of known sequence that bind to specific target sequences within a sample due to complementarity between the target DNA sequence and the primer; commonly used in PCR but may be used in other hybridization techniques

**DNA probe** a single-stranded DNA fragment that is complementary to part of the gene (DNA or RNA) of interest

**DNAse** pathogen-produced nuclease that degrades extracellular DNA

**dosage** amount of medication given during a certain time interval

**double immunodiffusion** see Ouchterlony assay

**doubling time** the time it takes for the population to double; also referred to as generation time

**droplet transmission** direct contact transmission of a pathogen transferred in sneezed or coughed droplets of mucus that land on the new host within a radius of one meter

**drug resistance** ability of a microbe to persist and grow in the presence of an antimicrobial drug

**dry-heat sterilization** protocol that involves the direct application of high heat

**dura mater** tough, outermost membrane that surrounds the brain

**dynein** motor proteins that interact with microtubules in eukaryotic flagella and cilia

**dysentery** intestinal inflammation that causes diarrhea with blood and mucus

**dysuria** urination accompanied by burning, discomfort, or pain

## E

**E (exit) site** functional site of an intact ribosome that releases dissociated uncharged tRNAs so that they can be recharged with free amino acids

**East African trypanosomiasis** acute form of African trypanosomiasis caused by *Trypanosoma brucei rhodesiense*

**eastern equine encephalitis** serious, but rare, mosquito-borne viral infection of the brain that is found primarily on the Atlantic and Gulf coast states of the United States

**Ebola virus disease (EVD)** potentially fatal viral hemorrhagic fever found primarily in western Africa and transmitted through contact with body fluids

**eclipse phase** period after viral infection during which the infective virus is not detected, either intracellularly or extracellularly, and biosynthesis is occurring

**ectoplasm** outer, more gelatinous layer of cytoplasm under a protist cell membrane

**edema** swelling due to accumulation of fluid and protein in tissue as a result of increased permeability of capillary walls during an inflammatory response; chronic edema can also result from blockage of lymphatic vessels, as in the case of elephantiasis

**effector cells** activated cells of cellular immunity that are involved in the immediate immune response, primarily to defend the body against pathogens

**electron carrier** cellular molecule that accepts high-energy electrons from reduced molecules like foods and later serves as an electron donor in subsequent redox reactions

**electron microscope** a type of microscope that uses short-wavelength electron beams rather than light to increase magnification and resolution

**electron transport system (ETS)** series of membrane-associated protein complexes and associated mobile accessory electron carriers important in the generation of the proton motive force required for ATP production by chemiosmosis; the last component involved in the cellular respiration of glucose

**electroporation** a genetic engineering technique in which cells are exposed to a short electric pulse, inducing them to take up DNA molecules from their environment

**elementary bodies** metabolically and reproductively inactive, endospore-like form of intracellular bacteria that spreads infection outside of cells

**elongation in DNA replication** stage of DNA replication during which DNA polymerase adds nucleotides, complementary to the parental strand, to the 3' end of a growing DNA strand

**elongation in transcription** stage of transcription during which RNA polymerase extends the RNA molecule by adding RNA nucleotides, complementary to the template DNA strand

**elongation of translation** stage of translation during which amino acids are added one by one to the C-terminus of the growing polypeptide

**Embden-Meyerhof-Parnas (EMP) pathway** type of glycolysis found in animals and the most common in microbes

**emerging infectious disease** a disease that is new to the human population or has increased in prevalence over the previous 20 years

**enantiomers** stereoisomers that are mirror images of each other and nonsuperimposable

**encephalitis** inflammation of the tissues of the brain

**encystment** the process of forming a cyst

**endemic disease** an illness that is constantly present (often at low levels) in a population

**endergonic reaction** chemical reaction that requires energy beyond activation energy to occur

**endocarditis** inflammation of the endocardium, especially the heart valves

**endocrine function** refers to a cytokine signal released from a cell and carried by the bloodstream to a distant recipient cell

**endocytosis** the uptake of molecules through plasma membrane invagination and vacuole/vesicle formation

**endomembrane system** a series of organelles (endoplasmic reticulum, Golgi apparatuses, lysosomes, and transport vesicles) arranged as membranous tubules, sacs, and disks that synthesize many cell components

**endoplasm** inner, more fluid layer of cytoplasm under a protist cell membrane (inside of the ectoplasm)

**endoplasmic reticulum** part of the endomembrane system that is an interconnected array of tubules and flattened sacs with a single lipid bilayer that may be either rough or smooth; important in synthesizing proteins and lipids

**endospore** a cellular structure formed by some bacteria in response to adverse conditions; preserves DNA of the cell in a dormant state until conditions are favorable again

**endospore staining** a differential staining technique that uses two stains to make bacterial endospores appear distinct from the rest of the cell

**endosymbiotic theory** the theory that mitochondria and chloroplasts arose as a result of prokaryotic cells establishing a symbiotic relationship within a eukaryotic host

**endothelia** layer of epithelial cells lining blood vessels, lymphatics, the blood-brain barrier, and some other tissues

**endotoxin** lipid A component of lipopolysaccharides in the outer membrane of gram-negative bacteria

**enriched media** media that contain additional essential nutrients to support growth

**enrichment culture** media providing growth conditions that favor the expansion of an organism present in low numbers

**enteric** bacteria of the family Enterobacteriaceae, which live in the human intestinal tract

**enteritis** inflammation of the lining of the intestine

**enterobiasis** intestinal infection caused by the pinworm *Enterobius vermicularis*

**enterohemorrhagic *E. coli* (EHEC)** *E. coli* bacteria that cause severe gastrointestinal illness with potential serious complications such as hemolytic uremic syndrome

**enteroinvasive *E. coli* (EIEC)** *E. coli* bacteria that cause relatively mild gastrointestinal illness

**enteropathogenic *E. coli* (EPEC)** *E. coli* bacteria that cause serious gastrointestinal illness

**enterotoxigenic *E. coli* (ETEC)** *E. coli* bacteria that cause a relatively mild illness commonly called traveler's diarrhea

**enterotoxin** toxin that affects the intestines

**Entner-Doudoroff (ED) pathway** alternative glycolytic pathway used by some bacteria

**enveloped virus** a virus formed with a nucleic-acid packed capsid surrounded by a lipid layer

**enzyme** catalyst for biochemical reactions inside cells

**enzyme immunoassay (EIA)** type of assay wherein an enzyme is coupled to an antibody; addition of a chromogenic substrate for the antibody allows quantification or identification of the antigen bound by the antibody

**enzyme-linked immunosorbent assay (ELISA)** specialized form of EIA in which either the primary antibody or the antigen is first attached to a solid surface such as the well of a microtiter plate

**eosinophils** leukocytes with granules containing histamine and major basic protein; facilitate allergic responses and protection against parasitic protozoa and helminths

**epidemic disease** an illness with a higher-than-expected incidence in a given period within a given population

**epidemic typhus** severe and sometimes fatal infection caused by *Rickettsia prowazekii* and transmitted by body lice

**epidemiology** the study of where and when infectious diseases occur in a population and how they are transmitted and maintained in nature

**epidermis** the outermost layer of human skin

**epididymis** coiled tube that collects sperm from the testes and passes it on to the vas deferens

**epididymitis** inflammation of the epididymis caused by a bacterial infection

**epigenetic regulation** chemical modification of DNA or associated histones to influence transcription

**epiglottis** flap of cartilage that covers the larynx during swallowing; diverts food to the esophagus and prevents it from entering the respiratory tract

**epiglottitis** inflammation of the epiglottis

**epiphyte** a plant that grows on another plant

**epitope** smaller exposed region on an antigen that is recognized by B-cell and T-cell receptors and antibodies

**Epsilonproteobacteria** class of Proteobacteria that are microaerophilic

**equivalence zone** region where the antibody-antigen ratio produces the greatest amount of precipitin in a precipitin reaction

**erysipelas** a skin infection, typically caused by *Streptococcus pyogenes*, that presents as a red, large, intensely inflamed patch of skin involving the dermis, usually with clear borders, typically on the legs or face

**erythema nodosum** a condition that causes inflammation in the subcutaneous fat cells of the hypodermis resulting in red nodules

**erythema** redness at the site of inflammation, usually due to dilation of blood vessels in the area to help bring in white blood cells

**erythrocyte** red blood cell

**erythrogenic toxin** exotoxin produced by some strains of *Streptococcus pyogenes*; activity of the toxin can produce the characteristic rash of scarlet fever

**erythromycin** protein synthesis inhibitor of the macrolide class that is often used as an alternative to penicillin

**eschar** a localized mass of dead skin tissue

**Etest** simple, rapid method for determining MIC, involving commercially available plastic strips that contain a gradient of an antimicrobial and are placed on an agar plate inoculated with a bacterial lawn

**etiologic agent** the pathogen or substance responsible for causing a particular disease; causative agent

**etiology** the science of the causes of disease

**Eukarya** the domain of life that includes all unicellular and multicellular organisms with cells that contain membrane-bound nuclei and organelles

**eukaryote** an organism made up of one or more cells that contain a membrane-bound nucleus and organelles

**eukaryotic cell** has a nucleus surrounded by a complex nuclear membrane that contains multiple, rod-shaped chromosomes

**eustachian tube** small passage between the nasopharynx and the middle ear that allows pressure to equalize across the tympanic membrane

**eutrophs** microorganisms that require a copious amount of organic nutrients; also called copiotrophs

**excystment** the process of emerging from a cyst

**exergonic reaction** chemical reaction that does not require energy beyond activation energy to proceed; releases energy when the reaction occurs

**exocytosis** the release of the contents of transport vesicles to the cell's exterior by fusion of the transport vesicle's membrane with the plasma membrane

**exoenzyme** secreted enzyme that enhances the ability of microorganisms to invade host cells

**exon** protein-coding sequence of a eukaryotic gene that is transcribed into RNA and spliced together to code for a polypeptide

**exonuclease** enzymatic activity that removes RNA primers in DNA introduced by primase

**exotoxin** biologically active product that causes adverse changes in the host cells

**experimental epidemiology** the use of laboratory and clinical studies to directly study disease in a population

**experimental study** a type of scientific study that involves manipulation of the study subjects by the researcher through application of specific treatments hypothesized to affect the outcome while maintaining rigorously controlled conditions

**exposure** contact between potential pathogen and host; also called contamination or contact

**extended-spectrum  $\beta$ -lactamases (ESBLs)**  $\beta$ -lactamases carried by some gram-negative bacteria that provide resistance to all penicillins, cephalosporins, monobactams, and  $\beta$ -lactamase-inhibitor combinations, but not carbapenems

**extensively drug resistant *Mycobacterium tuberculosis* (XDR-TB)** strains of *M. tuberculosis* that are resistant to rifampin and isoniazid, and also are resistant to any fluoroquinolone and at least one of three other drugs (amikacin, kanamycin, or capreomycin)

**extracellular matrix** material composed of proteoglycans and fibrous proteins secreted by some eukaryotic cells that lack cell walls; helps multicellular structures withstand physical stresses and coordinates signaling from the external surface of the cell to the interior of the cell

**extracellular polymeric substances (EPS)** hydrated gel secreted by bacteria in a biofilm containing polysaccharides, proteins, nucleic acids, and some lipids

**extrachromosomal DNA** additional molecules of DNA distinct from the chromosomes that are also part of the cell's genome

**extravasation** process by which leukocytes pass through capillary walls to reach infected tissue; also called diapedesis

## F

**F<sup>-</sup> (recipient) cell** *E. coli* cell lacking the F plasmid and thus incapable of forming a conjugation pilus but capable of receiving the F plasmid during conjugation

**F pilus (F pili)** specialized type of pilus that aids in DNA transfer between cells; conjugation pilus of *E. coli*

**F plasmid (fertility factor)** bacterial plasmid in *E. coli* containing genes encoding the ability to conjugate, including genes encoding the formation of the conjugation pilus

**F' plasmid** integrated F plasmid imprecisely excised from the chromosome; carries with it some chromosomal DNA adjacent to the integration site

**F<sup>+</sup> (donor) cell** *E. coli* cell containing the F plasmid, capable of forming a conjugation pilus

**Fab region** arm of an antibody molecule that includes an antigen-binding site

**facultative anaerobe** organism that grows better in the presence of oxygen but can proliferate in its absence

**false negative** negative result to a test for an infection or condition (e.g., presence of antigen, antibody, or nucleic acid) when the infection or condition is actually present

**false positive** positive result to a test for an infection or condition (e.g., presence of antigen, antibody, or nucleic acid) when the infection or condition is actually absent

**fastidious organism** organism that has extensive growth requirements

**fatty acid** lipid that contains long-chain hydrocarbons terminated with a carboxylic acid functional group

**fatty acid methyl ester (FAME) analysis** technique in which the microbe's fatty acids are extracted, converted to volatile methyl esters, and analyzed by gas chromatography, yielding chromatograms that may be compared to reference data for identification purposes

**Fc region** region on the trunk of an antibody molecule involved in complement activation and opsonization

**feedback inhibition** mechanism of regulating metabolic pathway whereby the product of a metabolic pathway noncompetitively binds to an enzyme early on in the pathway, temporarily preventing the synthesis of the product

**fermentation** process that uses an organic molecule as a final electron acceptor to regenerate NAD<sup>+</sup> from NADH such that glycolysis can continue

**fever** system-wide sign of inflammation that raises the body temperature and stimulates the immune response

**fifth disease** a highly contagious illness, more commonly affecting children, marked by a distinctive "slapped-cheek" rash and caused by parvovirus B19

**fimbriae** filamentous appendages found by the hundreds on some bacterial cells; they aid adherence to host cells

**fine focusing knob** a knob on a microscope that produces relatively small movements to adjust focus

**fixation** the process by which cells are killed and attached to a slide

**flagella** long, rigid, spiral structures used by prokaryotic cells for motility in aqueous environments; composed of a filament made of flagellin, a hook, and motor (basal body) that are attached to the cell envelope

**flagella staining** a staining protocol that uses a mordant to coat the flagella with stain until they are thick enough to be seen

**flagellum (eukaryotic) (plural: flagella)** long, whip-like, filamentous external structure found on some eukaryotic cells; composed of microtubules in a 9+2 arrangement; used for locomotion

**flavin adenine dinucleotide (FAD/FADH<sub>2</sub>)** oxidized/reduced forms of an electron carrier in cells

**flocculant** visible aggregation that forms between a substance in suspension (e.g., lipid in water) and antibodies against the substance

**flow cytometry** technique analyzing cells for fluorescence intensity; specific subsets of cells are usually labeled in some way prior to the analysis

**fluconazole** antifungal drug of the imidazole class that is administered orally or intravenously for the treatment of several types of systemic yeast infections

**fluid mosaic model** refers to the ability of membrane components to move fluidly within the plane of the membrane, as well as the mosaic-like composition of the components

**flukes** any of the parasitic nonsegmented flatworms (trematodes) that have an oral sucker and sometimes a second ventral sucker; they attach to the inner walls of intestines, lungs, large blood vessels, or the liver in human hosts

**fluorescence microscope** a microscope that uses natural fluorochromes or fluorescent stains to increase contrast

**fluorescence-activated cell sorter (FACS)** technique for using a flow cytometer to physically separate cells into two populations based on fluorescence intensity

**fluorescent antibody (FA) techniques** suite of assays that use a fluorescently labeled antibody to bind to and so make an antigen easy to visualize

**fluorescent enzyme immunoassay (FEIA)** EIA in which the substrate is a fluorogen that becomes fluorescent following reaction with the enzyme

**fluorescent** the ability of certain materials to absorb energy and then immediately release that energy in the form of light

**fluorochromes** chromophores that fluoresce (absorb and then emit light)

**fluorogen** nonfluorescent molecule that becomes fluorescent on enzyme or laser activation

**fluorophore** molecule that fluoresces when excited by light

**fluoroquinolones** class of synthetic antimicrobials that inhibit the activity of DNA gyrase, preventing DNA replication

**focal infection** infection in which the pathogen causes infection in one location that then spreads to a secondary location

**focal length** the distance from the lens to the image point when the object is at a definite distance from the lens (this is also the distance to the focal point)

**focal point** a property of the lens; the image point when light entering the lens is parallel (i.e., the object is an infinite distance from the lens)

**foliose lichens** lichens that have lobes that may appear to resemble leaves

**folliculitis** a skin infection characterized by localized inflammation of hair follicles, typically producing an itchy red rash

**fomite** inanimate item that may harbor microbes and aid in disease transmission

**foodborne disease** disease that is transmitted through contaminated food

**fragmentation** newly formed cells split away from the parent filament in actinomycetes and cyanobacteria

**frameshift mutation** mutation resulting from either an insertion or a deletion in a number of nucleotides that, if not a multiple of three, changes every amino acid after the mutation

**free ribosome** eukaryotic 80S ribosome found in the cytoplasm; synthesizes water-soluble proteins

**frequency** the rate of vibration for a light wave or other electromagnetic wave

**fruticose lichens** lichens that are generally branched with a rounded appearance

**functional groups** specific groups of atoms that may occur within a molecule, conferring specific chemical properties

**fungi** (singular: fungus) any of various unicellular or multicellular eukaryotic organisms, typically having cell walls made out of chitin and lacking photosynthetic pigments, vascular tissues, and organs

**fungicide** chemical or physical treatment that kills fungi

**fungistatic** having the ability to inhibit fungal growth, generally by means of chemical or physical treatment

**furuncle** a small, purulent skin lesion; sometimes called a boil

**fusion inhibitor** antiviral drug that blocks the fusion of HIV receptors to the coreceptors required for virus entry into the cell, specifically, chemokine receptor type 5

## G

**Gammaproteobacteria** class of Proteobacteria that is very diverse and includes a number of human pathogens

**gas gangrene** rapidly spreading infection of necrotic tissues caused by the gram-positive anaerobe *Clostridium perfringens* and other *Clostridium* spp.

**gastritis** inflammation of the lining of the stomach

**gastroenteritis** inflammation of the lining of the stomach and intestine

**gene expression** production of proteins from the information contained in DNA through the processes of transcription and translation

**gene gun** an apparatus that shoots gold or tungsten particles coated with recombinant DNA molecules at high speeds into plant protoplasts

**gene silencing** a genetic engineering technique in which researchers prevent the expression of a particular gene by using small interfering RNAs (siRNAs) or microRNAs (miRNAs) to interfere with translation

**gene therapy** a form of treatment for diseases that result from genetic mutations; involves the introduction of nonmutated, functional genes into the genome of the patient, often by way of a viral vector

**generalized transduction** transfer of a random piece of bacterial chromosome DNA by the phage

**generation time** see *doubling time*

**genes** segments of DNA molecules that code for proteins or stable RNA molecules

**genetic code** correspondence between mRNA nucleotide codons and the translated amino acids

**genetic engineering** the direct alteration of an organism's genetics to achieve desirable traits

**genital herpes** an STI caused by the herpes simplex virus

**genital warts** soft, pink, irregular growths that develop in the external genitalia or anus as a result of human papillomavirus infection

**genome** entire genetic content of a cell

**genomic library** a repository of an organism's entire genome maintained as cloned fragments in the genomes of strains of a host organism

**genomics** the study and comparison of entire genomes, including the complete set of genes, their nucleotide sequence and organization, and their interactions within a species and with other species

**genotype** full collection of genes that a cell contains within its genome

**germ theory of disease** the theory that many diseases are the result of microbial infection

**germination** process of an endospore returning to the vegetative state

**Ghon complex** calcified lesion containing *Mycobacterium tuberculosis*; forms in the lungs of patients with tuberculosis

**giardiasis** intestinal infection caused by *Giardia lamblia*

**gingivitis** inflammation of the gums that can cause bleeding

**glial cell** assists in the organization of neurons, provides a scaffold for some aspects of neuron function, and aids in recovery from neural injury

**glomerulonephritis** a type of kidney infection involving the glomeruli of the nephrons

**glomerulus** capillary bed in the nephron of the kidney that filters blood to form urine

**glycocalyx** cell envelope structure (either capsules or slime layer) outside the cell wall in some bacteria; allows bacteria to adhere to surfaces, aids in biofilm formation, and provides protection from predation

**glycogen** highly branched storage polysaccharide in animal cells and bacteria

**glycolipid** complex lipid that contains a carbohydrate moiety

**glycolysis** first step in the breakdown of glucose, the most common example of which is the Embden-Meyerhoff-Parnas pathway, producing two pyruvates, two NADH molecules, and two (net yield) ATP per starting glucose molecule

**glycopeptides** class of antibiotics that inhibit cell wall synthesis by binding to peptidoglycan subunits and blocking their insertion into the cell wall backbone, as well as blocking transpeptidation

**glycoprotein** conjugated protein with a carbohydrate attached

**glycosidic bond** forms between the hydroxyl groups of two sugar molecules

**Golgi apparatus** an organelle of the endomembrane system that is composed of a series of flattened membranous disks, called dictyosomes, each having a single lipid bilayer, that are stacked together; important in the processing of lipids and proteins

**gonorrhea** a common STI of the reproductive system caused by *Neisseria gonorrhoeae*

**graft-versus-host disease** specific type of transplantation reaction in which a transplanted immune system (e.g., a bone marrow transplant) contains APCs and T cells that are activated and attack the recipient's tissue

**Gram stain procedure** a differential staining technique that distinguishes bacteria based upon their cell wall structure

**granulocytes** leukocytes found in the peripheral blood that are characterized by numerous granules in the cytoplasm; granulocytes include neutrophils, eosinophils, and basophils

**granuloma** walled-off area of chronically inflamed tissue containing microbial pathogens, macrophages, and cellular materials unable to be eliminated

**granulomatous amoebic encephalitis (GAE)** serious brain infection of immunocompromised individuals caused by *Acanthamoeba* or *Balamuthia mandrillaris*

**granzymes** proteases released from a natural killer cell that enter the cytoplasm of a target cell, inducing apoptosis

**Graves disease** hyperthyroidism caused by an autoimmune disease affecting thyroid function

**green nonsulfur bacteria** similar to green sulfur bacteria but use substrates other than sulfides for oxidation

**green sulfur bacteria** phototrophic, anaerobic bacteria that use sulfide for oxidation and produce large amounts of green bacteriochlorophyll

**growth curve** a graph modeling the number of cells in a culture over time

**guanine** purine nitrogenous base found in nucleotides

**Guillain-Barré syndrome** an autoimmune disease, often triggered by bacterial and viral infections, characterized by the destruction of myelin sheaths around neurons, resulting in flaccid paralysis

**gummas** granulomatous lesions that develop in tertiary syphilis

**H**

**hair follicle** a structure embedded in the dermis from which hair grows

**halophile** organism that depends on high concentrations of salt in the environment to grow

**halotolerant** organism that grows in the presence of high salt concentration but does not require it

**Hansen's Disease** chronic bacterial infection of peripheral nervous tissues caused by the acid-fast bacterium, *Mycobacterium leprae*; also known as leprosy

**hantavirus pulmonary syndrome** acute lung infection by a hantavirus following inhalation of aerosols from the urine or feces of infected rodents

**haploid** having one copy of each chromosome

**hapten** a molecule that is too small to be antigenic alone but becomes antigenic when conjugated to a larger protein molecule

**hard chancre** a generally painless ulcer that develops at the site of infection in primary syphilis

**Hashimoto thyroiditis** hypothyroidism caused by an autoimmune disease affecting thyroid function

**healthcare-associated infection (HAI)** an infection acquired in a hospital or other health-care facility unrelated to the reason for which the patient was initially admitted; nosocomial infection

**heavy chains** longest identical peptide chains in antibody molecules (two per antibody monomer), composed of variable and constant region segments

**helical virus** cylindrical or rod shaped

**helicase** enzyme that unwinds DNA by breaking the hydrogen bonds between the nitrogenous base pairs, using ATP

**helminth** a multicellular parasitic worm

**helper T cells** class of T cells that is the central orchestrator of the cellular and humoral defenses of adaptive immunity and the cellular defenses of innate immunity

**hemagglutination** visible clumping of red blood cells that can be caused by some viruses, bacteria, and certain diseases in which antibodies are produced that bind to self-red blood cells

**hematopoiesis** formation, development, and differentiation of blood cells from pluripotent hematopoietic stem cells

**hematuria** condition in which there is blood in the urine

**hemolysin** class of exotoxin that targets and lyses red blood cells, as well as other cells

**hemolytic disease of the newborn (HDN)** type II hypersensitivity reaction that occurs when maternal anti-Rh antibodies cross the placenta and target fetal Rh<sup>+</sup> red blood cells for lysis

**hemolytic transfusion reaction (HTR)** condition resulting after an incompatible blood transfusion; caused by type II hypersensitivity reaction and destruction of red blood cells

**hemorrhagic fever with renal syndrome** serious hemorrhagic fever caused by hantavirus infection

**HEPA filter** high-efficiency particulate air filter with an effective pore size that captures bacterial cells, endospores, and viruses as air passes through, removing them from the air

**hepatitis** inflammation of the liver

**herd immunity** a reduction in disease prevalence brought about when few individuals in a population are susceptible to an infectious agent

**herpes keratitis** eye infection caused by herpes simplex virus

**herpes simplex virus type 2 (HSV-2)** the type of herpesvirus most commonly associated with genital herpes

**herpetic gingivostomatitis** inflammation of the mouth and gums often caused by the HSV-1 virus

**heterolactic fermentation** process producing a mixture of lactic acid, ethanol and/or acetic acid, and CO<sub>2</sub> as fermentation products; the microbes that do this use pentose phosphate pathway glycolysis, which is why they generate multiple fermentation products

**heterotroph** organism that uses fixed organic carbon compounds as its carbon source

**hexose monophosphate shunt** see *pentose phosphate pathway*

**Hfr cell** *E. coli* cell in which an F plasmid has integrated into the host cell's chromosome

**high G+C gram-positive bacteria** bacteria that have more than 50% guanine and cytosine nucleotides in their DNA

**high-energy phosphate bond** bond between the negatively charged phosphate groups that holds a lot of potential energy

**histamine** proinflammatory molecule released by basophils and mast cells in response to stimulation by other cytokines and chemical mediators

**histones** DNA-binding proteins found in eukaryotes and archaea that aid in orderly packaging of chromosomal DNA

**histoplasmosis** fungal disease caused by the dimorphic fungus *Histoplasma capsulatum*

**holoenzyme** enzyme with a bound cofactor or coenzyme

**holozoic** refers to protozoans that consume food particles through phagocytosis

**homolactic fermentation** process producing only lactic acid as a fermentation product; the microbes that do this use Embden-Meyerhof-Parnas glycolysis

**hookworm infection** soil-transmitted intestinal infection caused by the nematodes *Necator americanus* and *Ancylostoma duodenale*

**horizontal direct transmission** movement of a pathogen from one host to another (excluding mother to embryo, fetus, or infant) in a population through physical contact or through droplet transmission

**horizontal gene transfer** introduction of genetic material from one organism to another organism within the same generation

**host range** the types of host cells that a particular virus is able to infect

**HTST** high-temperature short-time pasteurization is a method of pasteurization commonly used for milk in which the milk is exposed to a temperature of 72 °C for 15 seconds

**human African trypanosomiasis** serious infection caused by *Trypanosoma brucei* and spread by the bite of the tsetse fly

**human granulocytic anaplasmosis** zoonotic tickborne disease caused by the obligate intracellular pathogen *Anaplasma phagocytophilum*

**human immunodeficiency virus (HIV)** retrovirus responsible for acquired immune deficiency syndrome (AIDS) in humans

**human papillomavirus (HPV)** a group of common sexually transmitted viruses that may be associated with genital warts or cervical cancer

**humanized monoclonal antibodies** chimeric antibodies with mouse variable regions and human constant regions

**humoral immunity** adaptive immunity mediated by antibodies produced by B cells

**hyaluronidase** enzyme produced by pathogens that degrades hyaluronic acid between adjacent cells in connective tissue

**hybridization** the joining of two complementary single-stranded DNA molecules

**hybridoma** clones of cell produced by fusing a normal B cell with a myeloma cell that is capable of producing monoclonal antibodies indefinitely

**hydatid disease** cystic echinococcosis, an infection caused by the tapeworm *Echinococcus granulosus*

**hydrophilic** “water loving”; refers to a polar molecule or portion of a molecule capable of strong attraction to water molecules

**hydrophobic** “water fearing”; refers to a nonpolar molecule or portion of a molecule not capable of strong attraction to water molecules

**hypersensitivity pneumonitis (HP)** type III and IV hypersensitivities in the lungs that are caused by environmental or occupational exposure to allergens such as mold and dust

**hypersensitivity** potentially damaging immune response against an antigen

**hyperthermophile** a microorganism that has an optimum growth temperature close to the temperature of boiling water

**hypertonic medium** an environment in which the solute concentration outside a cell exceeds that inside the cell, causing water molecules to move out of the cell, resulting in crenation (shriveling) or plasmolysis.

**hyphae** tubular, filamentous structures that makes up most fungi

**hypodermis** the layer of tissue under the dermis, consisting primarily of fibrous and adipose connective tissue

**hypotonic medium** an environment in which the solute concentration inside a cell exceeds that outside the cell, causing water molecules to move into the cell, possibly leading to swelling and possibly lysis

**in vivo** inside the organism

**inactivated vaccine** vaccine composed of whole pathogen cells or viruses that have been killed or inactivated through treatment with heat, radiation, or chemicals

**incidence** the number of individuals with new infections of a particular disease in a given period of time

**inclusion conjunctivitis** inflammation of the conjunctiva in newborns caused by *Chlamydia trachomatis* transmitted during childbirth

**inclusions** prokaryotic cell cytoplasmic structures for storing specific nutrients and other resources needed by cells

**incubation period** the first stage of acute disease, during which the pathogen begins multiplying in the host and signs and symptoms are not observable

**indirect agglutination assay** assay that can be used to detect the agglutination of small latex beads; beads may be coated with antigen when looking for the presence of specific antibodies, or with antibody when looking for the presence of antigen

**indirect antiglobulin test (IAT)** see indirect Coombs' test

**indirect contact transmission** transfer of an infectious agent between hosts through contact with a fomite

**indirect Coombs' test** assay, performed *in vitro* prior to blood transfusions, that looks for antibodies against red blood cell antigens (other than the A and B antigens) that are unbound in a patient's serum

**indirect ELISA** EIA in which an antigen from a pathogen is first attached to the wells of a microtiter plate; the antigen then captures antibodies from patient serum to determine whether the patient currently has or previously had the disease

**indirect fluorescent antibody test** assay for antigen-specific antibodies wherein the antigen captures the antibody, which is subsequently detected using a labeled anti-immunoglobulin mAb

**induced mutation** mutation caused by a mutagen

**inducer** small molecule that either activates or represses transcription

**inducible operon** bacterial operon, typically containing genes encoding enzymes in a degradative pathway, whose expression is induced by the substrate to be degraded when the substrate is available for the cell to use, but that is otherwise repressed in the absence of the substrate

**induction** prophage DNA is excised from the bacterial genome

**infection** the successful colonization of a microorganism within a host

**infectious arthritis (septic arthritis)** inflammation of joint tissues in response to a microbial infection

**infectious disease** disease caused by a pathogen

**infectious mononucleosis** common and mild infection caused by Epstein-Barr virus (HHV-4) or cytomegalovirus (HHV-5); transmitted by direct contact with body fluids such as saliva

**inflammation** innate nonspecific immune response characterized by erythema, edema, heat, pain, and altered function, typically at the site of injury or infection but sometimes becoming systemic.

**influenza** highly contagious and acute viral disease of the respiratory tract caused by the influenza virus

**initiation factors** proteins that participate in ribosome assembly during initiation

**initiation of DNA replication** stage of replication during which various proteins bind to the origin of replication to begin the replication process

**initiation of transcription** stage of transcription during which RNA polymerase binds to a promoter and transcription begins

**initiation of translation** stage of translation during which an initiation complex composed of the small ribosomal subunit, the mRNA template, initiation factors, GTP, and a special initiator tRNA forms, and the large ribosomal subunit then binds to the initiation complex

**inoculum** small number of cells added to medium to start a culture

**inorganic phosphate (P<sub>i</sub>)** single phosphate group in solution

**in vitro** outside the organism in a test tube or artificial environment

**insertion** type of mutation involving the addition of one or more bases into a DNA sequence

**integrase inhibitors** antiviral drugs that block the activity of the HIV integrase responsible for recombination of a DNA copy of the viral genome into the host cell chromosome

**intercalating agent** molecule that slides between the stacked nitrogenous bases of the DNA double helix, potentially resulting in a frameshift mutation

**interference** distortion of a light wave due to interaction with another wave

**interferon** cytokines released by cells that have been infected with a virus; stimulate antiviral responses in nearby cells as well as the cells secreting the interferon

**interleukins** cytokines largely produced by immune system cells that help coordinate efforts against invading pathogens

**intermediate filament** one of a diverse group of cytoskeletal fibers that act as cables within the cell and anchor the nucleus, comprise the nuclear lamina, or contribute to the formation of desmosomes

**intermediate host** a host in which a parasite goes through some stages of its life cycle before migrating to the definitive host

**intermittent common source spread** a mode of disease transmission in which every infection originates from the same source and that source produces infections for a period before stopping and then starting again

**intertrigo** a rash that occurs in a skin fold

**intestinal fluke** a trematode worm that infects the intestine, often caused by *Fasciolopsis buski*

**intracellular targeting toxin** see *A-B exotoxin*

**intrinsic growth rate** genetically determined generation time under specific conditions for a bacterial strain

**intron** intervening sequence of a eukaryotic gene that does not code for protein and whose corresponding RNA sequences are removed from the primary transcript during splicing

**intubation** placement of a tube into the trachea, generally to open the airway or to administer drugs or oxygen

**in-use test** a technique for monitoring the correct use of disinfectants in a clinical setting; involves placing used, diluted disinfectant onto an agar plate to see if microbial colonies will grow

**invasion** dissemination of a pathogen through local tissues or throughout the body

**iodophor** compound in which iodine is complexed to an organic molecule, increasing the stability and efficacy of iodine as a disinfectant

**ionizing radiation** high-energy form of radiation that is able to penetrate surfaces and sterilize materials by damaging microbial cell components and DNA

**ischemia** condition marked by the inadequate flow of blood to the tissues

**isograft** tissue grafted from one monozygotic twin to another

**isohemagglutinins** IgM class antibodies produced against A or B red blood cell antigens

**isomers** molecules that have the same atomic makeup but differ in the structural arrangement of the atoms

**isoniazid** antimetabolite that inhibits biosynthesis of mycolic acid; used for the treatment of mycobacterial infections

**isoprenoid** branched lipid derived from five-carbon isoprene molecules

**isotonic medium** a solution in which the solute concentrations inside and outside the cell are approximately equal, thereby creating no net movement of water molecules across the cell membrane

**ivermectin** antihelminthic drug of the avermectin class that binds to invertebrate glutamate-gated chloride channels to block neuronal transmission in helminths

## J

**Japanese encephalitis** arboviral disease caused by the Japanese encephalitis virus (JEV) and endemic to Asia

**jaundice** yellowish color of the skin and mucous membranes caused by excessive bilirubin caused by a failure of the liver to effectively process the breakdown of hemoglobin

## K

**keratin** a fibrous protein found in hair, nails, and skin

**keratitis** inflammation of the cornea

**keratoconjunctivitis** inflammation of both the cornea and the conjunctiva

**kidney** organ that filters the blood, producing urine

**Kinyoun technique** a method of acid-fast staining that does not use heat to infuse the primary stain, carbolfuchsin, into acid-fast cells

**Kirby-Bauer disk diffusion test** simple, rapid method for determining susceptibility and resistance of a bacterial pathogen to antibacterial drugs. The test involves drug-impregnated disks placed on an agar plate inoculated with a bacterial lawn.

**Koplik's spots** white spots that form on the inner lining of the cheek of patients with measles

**Krebs cycle** cyclic pathway during which each two-carbon unit entering the cycle is further oxidized, producing three NADH, one FADH<sub>2</sub>, and one ATP by substrate-level phosphorylation, releasing two CO<sub>2</sub> molecules and regenerating the molecule used in the first step; also called the *citric acid cycle* or the *tricarboxylic acid cycle*

**kuru** rare form of transmissible spongiform encephalopathy endemic to Papua New Guinea

## L

**lacrimal duct** connects the lacrimal gland to the lacrimal sac

**lacrimal gland** a gland situated above the eye that secretes tears

**lacrimal punctum** opening in each upper and lower eyelid

**lacrimal sac** a reservoir for tears; also known as the dacrocyt or tear sac

**lag period** the time between antigen exposure and production of antibodies

**lag phase** interval before exponential growth of a microbial population during which cells adjust to a new environment

**lagging strand** strand of DNA made discontinuously by DNA polymerase

**laryngitis** inflammation of the larynx

**laryngopharynx** lower portion of the pharynx that connects to the larynx

**larynx** region of the respiratory tract containing the vocal cords; also referred to as the voice box

**latent disease** disease that goes into a dormant nonreplicative state after the acute disease and can persist in this state for years, with the risk of reactivation back into acute disease

**latent virus** virus that remains dormant in the host genome

**lateral flow test** see immunochromatographic assays

**leading strand** strand of DNA made continuously in the 5' to 3' direction by DNA polymerase

**Legionnaires disease** atypical pneumonia occurring in older individuals; caused by the inhalation of *Legionella pneumophila* aerosolized in water

**leishmaniasis** protozoan infection caused by *Leishmania* spp. and transmitted by sand flies

**leprosy** see *Hansen's disease*

**leptospirosis** bacterial infection of the kidney caused by *Leptospira* spp.; may spread to the liver, lungs, brain, and other organs

**leukocidin** class of exotoxin that targets and lyses leukocytes

**leukocytes** white blood cells of various types, including granulocytes, lymphocytes, and monocytes

**leukotrienes** lipid-based chemical mediators produced by leukocytes and other tissue cells; promote inflammation and allergic responses

**lichen** symbiotic association of a fungus with an alga or cyanobacterium

**ligation** repair of the sugar-phosphate backbone of the DNA, making the DNA molecule continuous

**light chains** the shorter identical peptide chains of an antibody molecule (two per antibody monomer), composed of variable and constant region segments

**light-dependent reaction** process by which energy from sunlight is absorbed by pigment molecules in photosynthetic membranes and converted into stored chemical energy in the forms of ATP and NADPH

**light-harvesting complex** group of multiple proteins and associated pigments that each may absorb light energy to become excited, and transfer this energy from one pigment molecule to another until the energy is delivered to a reaction center pigment

**light-independent reaction** process by which chemical energy, in the form of ATP and NADPH produced by the light-dependent reactions, is used to fix inorganic CO<sub>2</sub> into organic sugar; usually referred to as the Calvin-Benson cycle

**lincomycin** naturally produced protein synthesis inhibitor of the lincosamide class that binds to the 50S subunit, inhibiting peptide bond formation

**lincosamides** class of protein synthesis inhibitors that are similar to macrolides

**linked recognition** a mechanism whereby a B cell and the helper T cell with which it interacts recognize the same antigen

**lipase** extracellular enzyme that degrades triglycerides

**lipid bilayer** biological membranes composed of two layers of phospholipid molecules with the nonpolar tails associating to form a hydrophobic barrier between the polar heads; also called unit membrane

**lipid** macromolecule composed primarily of carbon and hydrogen; source of nutrients for organisms, a storage form for carbon and energy, a part of the structure of membranes, and may function as hormones, pharmaceuticals, fragrances, and pigments

**lipopolysaccharide (LPS)** lipid molecules with attached sugars that are found as components of gram-negative outer membranes

**lipoprotein** conjugated protein attached to a lipid

**listeriosis** bacterial disease caused from the ingestion of the microbe *Listeria monocytogenes*

**lithotroph** chemotroph that uses inorganic chemicals as its electron source; also known as chemoaerotroph

**live attenuated vaccine** vaccine with live pathogen that has been attenuated to become less virulent in order to produce an active but subclinical infection

**liver fluke** a trematode worm that affects the bile duct of the liver, including *Fasciola hepatica* and *F. gigantica*

**local infection** infection in one limited area

**log phase** interval of growth when cells divide exponentially; also known as the exponential growth phase

**loiasis** a disease caused by the parasitic *Loa loa* worm, which is transmitted by deerflies; adult worms live in the subcutaneous tissue and cause inflammation, swelling, and eye pain as they migrate through the skin and the conjunctiva of the eye

**lophotrichous** having a single tuft of flagella located at one end of a bacterial cell

**low G+C gram-positive bacteria** bacteria that have less than 50% of guanine and cytosine nucleotides in their DNA

**lumen** space inside the cisternae of the endoplasmic reticulum in eukaryotic cells

**Lyme disease** tickborne disease caused by the spirochete *Borrelia burgdorferi*

**lymph nodes** bean-shaped organs situated throughout the body that contain areas called germinal centers, which are rich in B and T lymphocytes; also contain macrophages and dendritic cells for antigen presentation

**lymphadenitis** inflammation of the lymph nodes

**lymphangitis** inflammation of the lymphatic vessels

**lymphogranuloma venereum** infection caused by *Chlamydia trachomatis* in tropical regions

**lyophilization** rapid freezing, followed by placement under a vacuum, of a material so that water is lost by sublimation, thereby inhibiting microbial growth

**lysis** destruction of the host cell

**lysogen** bacterium carrying the prophage

**lysogenic conversion (phage conversion)** alteration of host characteristics or phenotypes due to the presence of phage

**lysogenic cycle** life cycle of some phages in which the genome of the infecting phage is integrated into the bacterial chromosome and replicated during bacterial reproduction until it excises and enters a lytic phase of the life cycle

**lysogeny** process of integrating the phage into the host genome

**lysosome** an organelle of the endomembrane system that contains digestive enzymes that break down engulfed material such as foodstuffs, infectious particles, or damaged cellular components

**lytic cycle** infection process that leads to the lysis of host cells

## M

**M protein** a streptococcal cell wall protein that protects the bacteria from being phagocytized. It is associated with virulence and stimulates a strong immune response

**macrolides** class of protein synthesis inhibitors containing a large, complex ring structure that binds to the 50S subunit, inhibiting peptide bond formation

**macromolecule** polymer assembled from of individual units, monomers, that bind together like building blocks

**macronucleus** larger nucleus in ciliate protists that have two nuclei; polyploid with a reduced genome of metabolic genes and derived from the micronucleus

**macronutrient** element required in abundance in cells; account for approximately 99% of the cell's dry weight

**macrophages** monocytes that have left the bloodstream and differentiated into tissue-specific phagocytes

**mad cow disease** form of transmissible spongiform encephalopathy primarily affecting cattle; can be transmitted to humans by consumption of contaminated cattle products

**magnetosomes** inclusions in certain bacterial cells containing magnetic iron oxide or iron sulfide, which allows bacteria to align along a magnetic field by magnetotaxis

**magnetotaxis** directional movement of bacterial cells using flagella in response to a magnetic field

**magnification** the power of a microscope (or lens) to produce an image that appears larger than the actual specimen, expressed as a factor of the actual size

**major histocompatibility complex (MHC)** collection of genes that code for MHC glycoproteins expressed on the surface of all nucleated cells

**malaise** a general feeling of being unwell

**malaria** potentially fatal, mosquito-borne protozoan infection caused by several species of *Plasmodium* and characterized by a relapsing fever, nausea, vomiting, and fatigue

**mast cells** granulocytes similar in origin and function to basophils, but residing in tissues

**matrix assisted laser desorption/ionization time of flight mass spectrometry (MALDI-TOF)** technique in which the sample (e.g., a microbe colony) is mixed with a special matrix and irradiated with a high-energy laser to generate characteristic gaseous ions that are subjected to mass spectral analysis, yielding mass spectra that may be compared to reference data for identification purposes

**maturation** assembly of viral components to produce a functional virus

**mature naïve T cell** a T cell that has exited the thymus after thymic selection but has not yet been activated

**maximum growth pH** highest pH value that an organism can tolerate for growth

**maximum growth temperature** highest temperature at which a microorganism will divide or survive

**maximum permissible oxygen concentration** highest concentration of oxygen at which an organism will grow

**measles** highly contagious respiratory disease caused by the measles virus (MeV); marked by an intense macular rash and high fever; also known as rubella

**mebendazole** antihelminthic drug of the benzimidazole class that binds to helminthic  $\beta$ -tubulin, preventing microtubule formation

**mechanical transmission** transfer of a pathogen between hosts by a mechanical vector

**mechanical vector** an animal that transfers a pathogen from one host to another or from a reservoir to a host without being infected by the pathogen itself

**median infectious dose (ID<sub>50</sub>)** concentration of pathogen that will produce active infection in 50% of test animals inoculated

**median lethal dose (LD<sub>50</sub>)** concentration of pathogen that kills 50% of infected test animals

**medulla** loosely packed layer of fungal filaments located underneath the cortex of a lichen

**membrane attack complex (MAC)** ring structure formed from complement proteins C6 through C9 that penetrates the membranes of a targeted cell, causing cell lysis and death

**membrane filtration** method to remove bacteria from liquid, typically heat-sensitive solutions, using filters with an effective pore size of 0.2  $\mu\text{m}$  or smaller, depending on need

**membrane filtration technique** known volumes are vacuum filtered aseptically through a membrane with a pore size small enough to trap microorganisms, which are counted after growth on plates

**membrane-bound ribosome** 80S eukaryotic ribosome attached to rough endoplasmic reticulum

**membrane-disrupting toxin** toxin that affects cell membrane function by either forming pores or disrupting the phospholipid bilayer

**memory B cell** an activated and differentiated B cell that is programmed to respond to secondary exposures to a specific antigen

**memory helper T cell** a long-lived T cell programmed to recognize and quickly mount a secondary response to a specific pathogen upon re-exposure

**memory** the ability of the specific adaptive immune system to quickly respond to pathogens to which it has previously been exposed

**meninges** membranes that surround the brain

**meningitis** inflammation of the meningeal membranes that surround the brain

**meningococcal meningitis** bacterial infection caused by *Neisseria meningitidis* that results in an inflammation of the meninges

**meningoencephalitis** inflammatory response that involves both the brain and the membranes that surround it

**MERS** Middle East respiratory syndrome; first described in Saudi Arabia in 2013; caused by a zoonotic coronavirus that results in flu-like symptoms

**mesophile** a microorganism that grows best at moderate temperatures, typically between about 20  $^{\circ}\text{C}$  and 45  $^{\circ}\text{C}$

**metabolism** all of the chemical reactions inside of cells

**metachromatic granule** a type of inclusion containing volutin, a polymerized inorganic phosphate that appears red when stained with methylene blue

**metagenomics** the sequencing of genomic fragments from microbial communities, allowing researchers to study genes from a collection of multiple species

**metatranscriptomics** the science of studying a collection of mRNA molecules produced from microbial communities; involves studying gene expression patterns from a collection of multiple species

**methanogen** microorganism that produces gaseous methane

**methicillin-resistant *Staphylococcus aureus* (MRSA)** pathogen resistant to all  $\beta$ -lactams through acquisition of a new low-affinity penicillin-binding protein, and often resistant to many other drug classes

**metronidazole** antibacterial and antiprotozoan drug of the nitroimidazole class that is activated in anaerobic target cell and introduces DNA strand breakage, thus interfering with DNA replication in target cells

**MHC I molecule** glycoprotein expressed on the surface of all nucleated cells and involved in the presentation of normal "self" antigens and foreign antigens from intracellular pathogens

**MHC II molecule** glycoprotein expressed only on the surface of antigen-presenting cells and involved in the presentation of foreign antigens from pathogens ingested by phagocytosis

**micelle** simple spherical arrangement of amphipathic lipid molecules with nonpolar tails aggregated within the interior and polar heads forming the outer surface

**microaerophile** organism that requires oxygen at levels lower than atmospheric concentration

**microarray analysis** a technique used to compare two samples of genomic DNA or cDNA; the DNA or cDNA fragments are immobilized on a chip and labeled with different fluorescent dyes, allowing for comparison of sequences or gene-expression patterns

**microbe** generally, an organism that is too small to be seen without a microscope; also known as a microorganism

**microbial death curve** graphical representation of the progress of a particular microbial control protocol

**microbial ecology** study of the interactions between microbial populations microbiology the study of microorganisms

**microbiome** all prokaryotic and eukaryotic microorganisms that are associated with a certain organism

**microfilament** cytoskeletal fiber composed of actin filaments

**microinjection** the direct injection of DNA into the cytoplasm of a eukaryotic cell using a glass micropipette

**micronucleus** smaller nucleus in ciliate protists that have two nuclei; diploid, somatic, and used for sexual reproduction through conjugation

**micronutrient** indispensable element present in cells in lower amounts than macronutrients; also called *trace element*

**microorganism** generally, an organism that is too small to be seen without a microscope; also known as a microbe

**microsporidia** fungi that lack mitochondria, centrioles, and peroxisomes; some can be human pathogens

**microtiter plates** plastic dishes with multiple small wells

**microtubule** hollow tube composed of tubulin dimers ( $\alpha$  and  $\beta$  tubulin); the structural component of the cytoskeleton, centrioles, flagella, and cilia

**miliary tuberculosis** hematogenous dissemination and spread of *Mycobacterium tuberculosis* from tubercles

**minimal bactericidal concentration (MBC)** lowest antibacterial drug concentration that kills  $\geq 99.9\%$  of a starting inoculum of bacteria

**minimal inhibitory concentration (MIC)** lowest concentration of an antibacterial drug that inhibits visible growth of a bacterial strain

**minimum growth pH** lowest pH value that an organism can tolerate for growth

**minimum growth temperature** lowest temperature at which a microorganism will divide or survive

**minimum permissible oxygen concentration** lowest concentration of oxygen at which an organism will grow

**missense mutation** point mutation that results in a different amino acid being incorporated into the resulting polypeptide

**mitochondrial matrix** the innermost space of the mitochondrion enclosed by two membranes; the location of many metabolic enzymes as well as the mitochondrial DNA and 70S ribosomes

**mitochondrion (plural: mitochondria)** large, complex organelle that is the site of cellular respiration in eukaryotic cells

**mode of action** way in which a drug affects a microbe at the cellular level

**moist-heat sterilization** protocol that involves steam under pressure in an autoclave, allowing the steam to reach temperatures higher than the boiling point of water

**mold** a multicellular fungus, typically made up of long filaments

**molecular cloning** the purposeful fragmentation of DNA followed by attachment to another piece of DNA to produce a recombinant molecule, followed by introduction of this recombinant molecule into an easily manipulated host to allow for the creation of multiple copies of a gene of interest

**monoclonal antibodies (mAbs)** antibodies produced *in vitro* that only bind to a single epitope

**monocular** having a single eyepiece

**monocytes** large, agranular, mononuclear leukocytes found in the peripheral blood; responsible for phagocytosis of pathogens and damaged cells

**monoecious** refers to sexually reproducing organisms in which individuals have both male and female reproductive organs

**monomer** small organic molecule that binds with like molecules, forming a polymer or macromolecule

**monosaccharide** monomer for the synthesis of carbohydrate polymers; the simplest carbohydrate, called a *simple sugar*

**monotrichous** having one flagellum, typically located on one end of the bacterial cell

**morbidity** a state of illness

**Morbidity and Mortality Weekly Report (MMWR)** the trade/industry publication for epidemiologists, reporting US public health data compiled by the CDC

**morbidity rate** the number of cases of a disease expressed as a percentage of the population or number per standard part of the population, such as 100,000

**mordant** a chemical added to a specimen that sets a stain

**mortality** death

**mortality rate** the number of deaths from a disease expressed as a percentage of the population or number per standard part of the population, such as 100,000

**most probable number (MPN)** statistical value representing the viable bacterial population in a sample obtained after a series of dilutions and multiple tube inoculations

**mRNA** short-lived type of RNA that serves as the intermediary between DNA and the synthesis of protein products

**mucociliary escalator** system by which mucus and debris are propelled up and out of the respiratory tract by the beating of respiratory cilia and the mechanical actions of coughing or swallowing

**mucormycosis** rare form of pneumonia that can be caused by an invasive infection of different fungi in the order Mucorales, such as *Rhizopus* or *Mucor*

**mucous membrane** moist layer of epithelial cells and interspersed goblet cells that lines the inner surfaces of the body, usually bathed in antimicrobial secretions from the cells of the membrane

**mucus** viscous secretion produced by cells and glands in various mucous membranes throughout the body; helps trap and remove microbes and debris from the body

**multidrug-resistant microbes (MDR)** group of pathogens that carry one or more resistance mechanisms, making them resistant to multiple antimicrobials; also called superbugs

**multidrug-resistant *Mycobacterium tuberculosis* (MDR-TB)** strains of *M. tuberculosis* that are resistant to both rifampin and isoniazid, the drug combination typically prescribed for the treatment of tuberculosis

**multiple sclerosis** autoimmune attack on the myelin sheaths and nerve cells in the central nervous system

**mumps** a viral illness that causes swelling of the parotid glands; rare in the United States because of effective vaccination

**murine typhus** fleaborne infection caused by *Rickettsia typhi* and characterized by fever, rash, and pneumonia

**mutagen** type of chemical agent or radiation that can induce mutations

**mutant** organism harboring a mutation that often has a recognizable change in phenotype compared to the wild type

**mutation** heritable change in the DNA sequence of an organism

**mutualism** type of symbiosis in which two populations benefit from, and depend on, each other

**myasthenia gravis** autoimmune disease affecting the acetylcholine receptors in the neuromuscular junction, resulting in weakened muscle contraction capability

**mycelium** vegetative network of branched, tubular hyphae

**mycolic acids** waxy molecules associated with peptidoglycan in some gram-positive, acid-fast bacteria, chiefly mycobacteria

**mycology** the study of fungi

**Mycoplasma pneumonia** also known as walking pneumonia; a milder form of atypical pneumonia caused by *Mycoplasma pneumoniae*

**mycoses (mycosis, sing.)** refers to diseases caused by fungi

**mycotoxin** biologically active product of pathogenic fungi that causes adverse changes in the host cells

**myelin sheath** insulating layer that surrounds the axon of some neurons and helps to promote signal propagation

**myocarditis** inflammation of the heart muscle tissues

## N

**naïve mature B cell** a B cell that has not yet been activated

**naked virus** virus composed of a nucleic acid core, either DNA or RNA, surrounded by a capsid

**nalidixic acid** member of the quinolone family that functions by inhibiting the activity of DNA gyrase, blocking DNA replication

**narrow-spectrum antimicrobial** drug that targets only a specific subset of microbes

**nasal cavity** air-filled space in the skull immediately behind the nose

**nasolacrimal duct** tear duct connecting the lacrimal glands to the nasal cavity

**nasolacrimal duct** tear fluid flows from each eye through this duct to the inner nose

**nasopharynx** part of the upper throat (pharynx) extending from the posterior nasal cavity; carries air inhaled through the nose

**native structure** three-dimensional structure of folded fully functional proteins

**natural active immunity** immunity that develops as a result of natural infection with a pathogen

**natural antibiotic** antimicrobial compound that is produced naturally by microorganisms in nature

**natural killer cells (NK cells)** lymphoid cells that recognize and destroy abnormal target cells by inducing apoptosis

**natural passive immunity** transfer of maternal antibodies from mother to fetus (transplacentally) or infant (via breastmilk)

**necrotizing fascitis** a serious infection, also known as flesh-eating disease, that leads to rapid destruction of tissue through the action of exotoxin A; it can be caused by *S. pyogenes* or several other bacterial species

**negative (–) single-strand RNA (–ssRNA)** a viral RNA strand that cannot be translated until it is replicated into positive single-strand RNA by viral RNA-dependent RNA polymerase

**negative stain** a stain that produces color around the structure of interest while not coloring the structure itself

**Nematoda** phylum comprising roundworms

**neonatal herpes** herpes infection of the newborn, generally caused by infection during birth

**neonatal meningitis** meningitis caused by Group B streptococcus and occurring primarily in neonates (less than 2 months old)

**neonatal tetanus** tetanus acquired through infection of the cut umbilical cord

**neurocysticercosis** parasitic invasion of brain tissues by the larvae of the pork tapeworm, *Taenia solium*

**neuromycosis** any fungal infection of the nervous system

**neuron** specialized cell found throughout the nervous system that transmits signals through the nervous system using electrochemical processes

**neuropathy** numbness or tingling sensation caused by damage to peripheral nerves

**neurotoxoplasmosis** disease caused by the invasion of brain tissues by the protozoan *Toxoplasma gondii*; typically only affects immunocompromised patients

**neurotransmitter** compound that is released at the synapse of neurons to stimulate or suppress the actions of other cells

**neutralism** type of symbiosis that does not affect either of the two populations

**neutralization** binding of an antibody to a pathogen or toxin, preventing attachment to target cells

**neutrophile** organism that grows best at a near a neutral pH of 6.5–7.5

**neutrophils** leukocytes with a multilobed nucleus found in large numbers in peripheral blood; able to leave the bloodstream to phagocytose pathogens in infected tissues; also called polymorphonuclear neutrophils (PMNs)

**next generation sequencing** a group of automated techniques used for rapid DNA sequencing

**nicotine adenine dinucleotide (NAD<sup>+</sup>/NADH)** oxidized/reduced forms of an electron carrier in cells

**nicotine adenine dinucleotide phosphate (NADP<sup>+</sup>/NADPH)** oxidized/reduced forms of an electron carrier in cells

**nitrogen fixation** bacterial biochemical pathways that incorporate inorganic nitrogen gas into organic forms more easily used by other organisms

**nitrogenous base** nitrogen-containing ring structure within a nucleotide that is responsible for complementary base pairing between nucleic acid strands

**noncoding DNA** regions of an organism's genome that, unlike genes, do not encode proteins

**noncommunicable disease** disease that is not transmitted from one person to another

**noncompetitive (allosteric) inhibitor** molecule that binds to allosteric sites, inducing a conformational change in the enzyme's structure that prevents it from functioning

**noncritical item** object that may contact intact skin but does not penetrate it; requires cleanliness but not a high level of disinfection

**noncyclic photophosphorylation** pathway used in photosynthetic organisms when both ATP and NADPH are required by the cell

**nonenveloped virus** naked virus

**nongonococcal urethritis (NGU)** a nonspecific infection of the urethra that is not caused by *Neisseria gonorrhoeae*

**noninfectious disease** disease caused by something other than an infectious agent (e.g., genetics, environment, nutritional deficiencies)

**nonionizing radiation** low-energy radiation, like ultraviolet light, that can induce dimer formation between two adjacent pyrimidine bases, resulting in DNA polymerase stalling and possible formation of a frameshift mutation

**nonsense mutation** point mutation that converts a codon encoding an amino acid (a sense codon) into a stop codon (a nonsense codon)

**nontreponemal serologic tests** qualitative and quantitative indirect diagnostic tests for syphilis

**northern blot** a technique in molecular genetics used to detect the amount of RNA made by gene expression within a tissue or organism sample; RNA fragments within a sample are separated by agarose gel electrophoresis, immobilized on a membrane, and then exposed to a specific DNA probe labeled with a radioactive or fluorescent molecular beacon to aid in detection

**nosocomial disease** disease acquired in a hospital setting

**notifiable disease** a disease for which all cases must legally be reported to regional, state, and/or federal public health agencies

**nuclear envelope** (also called the nuclear membrane) a structure defining the boundary of the nucleus; composed of two distinct lipid bilayers that are contiguous with each other and with the endoplasmic reticulum

**nuclear lamina** a meshwork of intermediate filaments (mainly lamins) found just inside the nuclear envelope; provides structural support to the nucleus

**nucleic acid** class of macromolecules composed of nucleotide monomers polymerized into strands

**nucleoid** concentrated area of DNA genome and associated proteins found in a prokaryotic cell that is not surrounded by a membrane

**nucleoid-associated protein (NAP)** protein that assists in the organization and packaging of the chromosome in prokaryotic cells

**nucleolus** a dense region within the nucleus where ribosomal RNA biosynthesis occurs and preribosomal complexes are made

**nucleoside analog** chemical that is structurally similar to a normal nucleotide base that can be incorporated into DNA instead of normal bases during replication but that has different base pairing rules than the normal base for which it was substituted, inducing mutation

**nucleotide excision repair (dark repair)** enzymatic mechanism to repair pyrimidine dimers by cutting the dimer-containing DNA strand on both sides of dimer, removing the intervening strand and replacing the bases with the correct ones

**nucleotide** nucleic acid monomer composed of a pentose sugar, a phosphate group, and a nitrogenous base

**nucleus** a membrane-bound structure of eukaryotic cells that houses the DNA genome

**numerical aperture** a measure of a lens's ability to gather light

## O

**objective lenses** on a light microscope, the lenses closest to the specimen, typically located at the ends of turrets

**obligate aerobe** organism that requires oxygen for growth

**obligate anaerobe** organism that dies in the presence of oxygen

**obligate intracellular pathogen** microorganism that cannot synthesize its own ATP and, therefore, must rely on a host cell for energy; behaves like a parasite when inside a host cell, but is metabolically inactive outside of a host cell

**observational study** a type of scientific study that involves measurement of study subjects on variables hypothesized to be associated with the outcome of interest, but without any manipulation of the subjects

**ocular lens** on a microscope, the lens closest to the eye (also called an eyepiece)

**oil immersion lens** a special objective lens on a microscope designed to be used with immersion oil to improve resolution

**Okazaki fragment** short fragment of DNA made during lagging strand synthesis

**oligopeptide** peptide having up to approximately 20 amino acids

**oligotroph** organism capable of living in low-nutrient environments

**opacity** the property of absorbing or blocking light

**operator** DNA sequence located between the promoter region and the first coding gene to which a repressor protein can bind

**operon** a group of genes with related functions often found clustered together within the prokaryotic chromosome and transcribed under the control of a single promoter and operator repression sequence

**ophthalmia neonatorum** inflammation of the conjunctiva in newborns caused by *Neisseria gonorrhoeae* transmitted during childbirth

**opisthotonus** characteristic symptom of tetanus that results in uncontrolled muscular spasms and backward arching of the neck and spine

**opportunistic pathogen** microorganism that can cause disease in individuals with compromised host defenses

**opsonin** any molecule that binds to and coats the outside of a pathogen, identifying it for destruction by phagocytes (examples include antibodies and the complement proteins C3b and C4b)

**opsonization** process of coating a pathogen with a chemical substance (an opsonin) that allows phagocytic cells to recognize, engulf, and destroy the pathogen more easily

**optimum growth pH** the pH at which an organism grows best

**optimum growth temperature** the temperature at which a microorganism's growth rate is highest

**optimum oxygen concentration** the ideal concentration of oxygen for a particular microorganism

**oral herpes** an infection caused by herpes simplex virus that results in cold sores, most commonly on and around the lips

**oral thrush** *Candida* infection of the mouth

**orchitis** inflammation of one or both of the testes

**organic molecule** composed primarily of carbon; typically contains at least one carbon atom bound to one or more hydrogen atoms

**organotroph** chemotroph that uses organic molecules as its electron source; also known as chemoheterotroph

**origin of replication** specific nucleotide sequence where replication begins

**opharynx** area where air entering mouth enters the pharynx

**osmosis** diffusion of water across a semipermeable membrane

**osmotic pressure** the force or pressure generated by water diffusing across a semipermeable membrane, driven by differences in solute concentration across the membrane

**osteomyelitis** inflammation of bone tissue

**otitis externa** an infection of the external ear canal, most commonly caused by *Pseudomonas aeruginosa*; often called swimmer's ear

**otitis** inflammation of the ear

**otitis media with effusion** accumulation of fluid inside the middle ear with or without infection

**Ouchterlony assay** test in which antigen and antisera are added to neighboring wells in an agar gel, allowing visualization of precipitin arcs

**outer membrane** a phospholipid bilayer external to the peptidoglycan layer found in gram-negative cell walls

**oxazolidinones** class of synthetic protein synthesis inhibitors that interfere with formation of the initiation complex for translation and prevent translocation of the growing protein from the ribosomal A site to the P site

**oxidation reaction** chemical reaction that removes electrons (often as part of H atoms) from donor molecules, leaving them oxidized

**oxidative phosphorylation** mechanism for making ATP that uses the potential energy stored within an electrochemical gradient to add  $\bar{P}_i$  to ADP

**oxygenic photosynthesis** type of photosynthesis found in plants, algae, and cyanobacteria, and in which  $H_2O$  is used as the electron donor to replace an electron lost by a reaction center pigment, resulting in oxygen as a byproduct

## P

**P (peptidyl) site** functional site of an intact ribosome that binds charged tRNAs carrying amino acids that have formed peptide bonds with the growing polypeptide chain but have not yet dissociated from their corresponding tRNA

**palatine tonsil** lymphoid tissue located near the oropharynx

**pandemic disease** an epidemic that is worldwide as opposed to regional

**papilloma** growth on the skin associated with infection by any of the human papilloma viruses (HPV); commonly known as a wart

**paracrine function** refers to a cytokine signal released from a cell to a receptor on a nearby cell

**parasitism** type of symbiosis in which one population benefits while harming the other

**parasitology** the study of parasites

**parenteral route** means of entry by a pathogen through skin or mucous membranes when these barriers are breached

**paroxysmal stage** most serious stage of pertussis (whooping cough), characterized by severe and prolonged coughing spells

**passive carrier** an individual capable of transmitting a pathogen to another individual without becoming infected

**passive immunity** adaptive immune defenses received from another individual or animal

**pasteurization** form of microbial control using heat that is applied to foods; kills pathogens and reduces the number of spoilage-causing microbes while maintaining food quality

**pathogen** a disease-causing microorganism

**pathogen-associated molecular patterns (PAMPs)** common molecular motifs found on pathogens

**pathogenicity** ability of a microbial agent to cause disease

**pattern recognition receptors (PRRs)** receptors on the surface or in the interior of phagocytic cells that bind to pathogen-associated molecular patterns (PAMPs)

**pellicle** structure that underlies the plasma membrane in protists, providing additional support

**pelvic inflammatory disease (PID)** infection of the female reproductive organs that may spread from the vagina to the cervix, uterus, fallopian tubes, and ovaries

**penetration** entry of phage or virus into a host cell through injection, endocytosis, or membrane fusion

**penicillin**  $\beta$ -lactam antibacterial that was the first cell wall synthesis inhibitor developed

**penis** external genital organ in males through which urine and semen are discharged

**pentamidine** antiprotozoan drug that appears to degrade kDNA in target cells, as well as inhibit protein synthesis

**pentose phosphate pathway (PPP)** alternative glycolytic pathway that produces intermediates used for the biosynthesis of nucleotides and amino acids; also called the *phosphogluconate pathway* or the *hexose monophosphate shunt*

**peptic ulcer** an ulcer in the lining of the stomach or duodenum, often associated with *Helicobacter pylori*

**peptide bond** bond between the carboxyl group of one amino acid and the amine group of another; formed with the loss of a water molecule

**peptidoglycan (murein)** the polymer of alternating N-acetylglucosamine (NAG) and N-acetylmuramic acid (NAM) subunits linked together by peptide chains; a major constituent of bacterial cell walls

**peptidyl transferase** RNA-based ribozyme that is part of the 50S ribosomal subunit and catalyzes formation of the peptide bond between the amino acid bound to a tRNA and the growing polypeptide chain

**perforin** compound released from a natural killer cell that creates pores in the target cell through which other toxins (particularly granzymes) can gain access to the cytoplasm

**pericarditis** inflammation of the sac that surrounds the heart

**period of convalescence** fifth stage of acute disease, during which the patient returns to normal function

**period of decline** fourth stage of disease, during which the number of pathogens present in the host decreases, along with signs and symptoms of disease

**period of illness** third stage of acute disease, during which the number of pathogens present in the host is greatest and the signs and symptoms of disease are most severe

**periodontal disease** a condition in which the gums are inflamed and may erode

**periodontitis** inflammation of the gums that is more severe than gingivitis, spreading deeper into the tissues

**peripheral nervous system** network of neurons that connects the CNS with organs, sensory organs, and muscles throughout the body

**peripheral tolerance** mechanism by which regulatory T cells inhibit self-reactive immune responses in T cells that have already exited the thymus

**periplasmic space** the space between the cell wall and the plasma membrane, primarily in gram-negative bacteria

**peristalsis** muscular contractions of the gastrointestinal tract that propel ingested material through the stomach, intestines, and, eventually, through the rectum and out of the body

**peritrichous** having numerous flagella covering the entire surface of a bacterial cell

**peroxidase** enzyme that catalyzes the detoxification of peroxides

**peroxisome** in eukaryotic cells, a membrane-bound organelle (not part of the endomembrane system) that produces hydrogen peroxide to break down various types of molecules; also plays a role in lipid biosynthesis

**peroxygent** type of strong oxidizing agent that causes free radical formation in cells; can be used as a disinfectant or antiseptic

**persister** dormant cell that survives in the death phase and is resistant to most antibiotics

**pertussis** contagious illness caused by *Bordetella pertussis* that causes severe coughing fits followed by a whooping sound during inhalation; commonly known as whooping cough

**pertussis toxin** main virulence factor accounting for the symptoms of whooping cough

**petechiae** small red or purple spots on the skin that result from blood leaking out of damaged vessels

**Petroff-Hausser counting chamber** calibrated slide that allows counting of bacteria in a specific volume under a microscope

**Peyer's patches** lymphoid tissue in the ileum that monitors and fights infections

**phagemid** a plasmid capable of being replicated as a plasmid and also incorporated into a phage head

**phagocytosis** a type of endocytosis in which large particles are engulfed by membrane invagination, after which the particles are enclosed in a pocket, which is pinched off from the membrane to form a vacuole

**phagolysosome** compartment in a phagocytic cell that results when the phagosome is fused with the lysosome, leading to the destruction of the pathogens inside

**phagosome** compartment in the cytoplasm of a phagocytic cell that contains the phagocytosed pathogen enclosed by part of the cell membrane

**pharmacogenomics (toxicogenomics)** the evaluation of the effectiveness and safety of drugs on the basis of information from an individual's genomic sequence as well as examination of changes in gene expression in response to the drug

**pharyngitis** inflammation of the pharynx

**pharynx** region connecting the nose and mouth to the larynx: the throat

**phase-contrast microscope** a light microscope that uses an annular stop and annular plate to increase contrast

**phenol coefficient** measure of the effectiveness of a chemical agent through comparison with that of phenol on *Staphylococcus aureus* and *Salmonella enterica* serovar Typhi

**phenolics** class of chemical disinfectants and antiseptics characterized by a phenol group that denatures proteins and disrupts membranes

**phenotype** observable characteristics of a cell or organism

**phosphodiester bonds** linkage whereby the phosphate group attached to the 5' carbon of the sugar of one nucleotide bonds to the hydroxyl group of the 3' carbon of the sugar of the next nucleotide

**phosphogluconate pathway** see *pentose phosphate pathway*

**phospholipase** enzyme that degrades phospholipids

**phospholipid** complex lipid that contains a phosphate group

**phospholipid-derived fatty acids (PLFA) analysis** technique in which membrane phospholipids are saponified to release the fatty acids of the phospholipids, which can be subjected to FAME analysis for identification purposes

**phosphorescence** the ability of certain materials to absorb energy and then release that energy as light after a delay

**photosynthesis** process whereby phototrophic organisms convert solar energy into chemical energy that can then be used to build carbohydrates

**photosynthetic pigment** pigment molecule used by a cell to absorb solar energy; each one appears the color of light that it transmits or reflects

**photosystem** organized unit of pigments found within a photosynthetic membrane, containing both a light-harvesting complex and a reaction center

**phototaxis** directional movement using flagella in response to light

**phototroph** organism that gets its energy from light

**phototrophic bacteria** nontaxonomic group of bacteria that use sunlight as their primary source of energy

**phylogeny** the evolutionary history of a group of organisms

**phytoplankton** photosynthetic plankton

**pia mater** fragile and innermost membrane layer surrounding the brain

**pili** long protein extensions on the surface of some bacterial cells; specialized F or sex pilus aids in DNA transfer between cells

**pinocytosis** a type of endocytosis in which small dissolved materials are endocytosed into smaller vesicles

**plague** infectious epidemic disease caused by *Yersinia pestis*

**plankton** microscopic organisms that float in the water and are carried by currents; they may be autotrophic (phytoplankton) or heterotrophic (zooplankton)

**planktonic** free-floating or drifting in suspension

**plantibodies** monoclonal antibodies produced in plants that are genetically engineered to express mouse or human antibodies

**plaque** clear area on bacterial lawn caused by viral lysis of host cells

**plasma cell** activated and differentiated B cell that produces and secretes antibodies

**plasma** fluid portion of the blood that contains all clotting factors

**plasma membrane** (also called the cell membrane or cytoplasmic membrane) lipid bilayer with embedded proteins that defines the boundary of the cell

**plasmalemma** protist plasma membrane

**plasmid** small, circular, double-stranded DNA molecule that is typically independent from the bacterial chromosome

**plasmolysis** the separation of the plasma membrane away from the cell wall when a cell is exposed to a hypertonic environment

**platelets** cell fragments in the peripheral blood that originate from megakaryocyte cells in the bone marrow; also called thrombocytes

**Platyhelminthes** phylum comprising flatworms

**pleconaril** an antiviral drug targeting picornaviruses that prevents the uncoating of virus particles upon their infection of host cells

**pleomorphic** able to change shape

**pneumococcal meningitis** bacterial infection caused by *Streptococcus pneumoniae* that results in an inflammation of the meninges

**Pneumocystis pneumonia** common pulmonary infection in patients with AIDS; caused by *P. jirovecii*

**pneumonia** pulmonary inflammation that causes the lungs to fill with fluids

**pneumonic plague** rare form of plague that causes massive hemorrhages in the lungs and is communicable through aerosols

**point mutation** mutation, most commonly a base substitution, that affects a single base pair

**point source spread** a form of common source spread in which the transmission of a disease from the source occurs for a brief period that is less than the pathogen's incubation period

**polar tubule** a tube-like structure produced by spores of parasitic Microsporidia fungi that pierces host cell membranes

**poliomyelitis (polio)** disease caused by an infection of the enteric polio virus characterized by inflammation of the motor neurons of the brain stem and spinal cord; can result in paralysis

**poly-A tail** string of approximately 200 adenine nucleotides added to the 3' end of a eukaryotic primary mRNA transcript to stabilize it

**polyacrylamide gel electrophoresis (PAGE)** a method for separating populations of proteins and DNA fragments during Sanger sequencing of varying sizes by differential migration rates caused by a voltage gradient through a vertical gel matrix

**polycistronic mRNA** single mRNA molecule commonly produced during prokaryotic transcription that carries information encoding multiple polypeptides

**polyclonal antibodies** antibodies produced in a normal immune response, in which multiple clones of B cells respond to many different epitopes on an antigen

**polyenes** class of antifungal drugs that bind to ergosterol to form membrane pores, disrupting fungal cell membrane integrity

**polyhedral virus** virus with a three-dimensional shape with many facets

**polyhydroxybutyrate (PHB)** a type of cellular inclusion surrounded by a phospholipid monolayer embedded with protein

**polylinker site or multiple cloning site (MCS)** a short sequence containing multiple unique restriction enzyme recognition sites that are used for inserting foreign DNA into the plasmid after restriction digestion of both the foreign DNA and the plasmid

**polymer** macromolecule composed of individual units, monomers, that bind together like building blocks.

**polymerase chain reaction (PCR)** an *in vitro* molecular technique that rapidly amplifies the number of copies of specific DNA sequences to make the amplified DNA available for other analyses

**polymorphonuclear neutrophil (PMN)** see *neutrophils*

**polymyxins** lipophilic polypeptide antibiotics that target the lipopolysaccharide component of gram-negative bacteria and ultimately disrupt the integrity of their outer and inner membranes

**polypeptide** polymer having from approximately 20 to 50 amino acids

**polypyletic** refers to a grouping of organisms that is not descended from a single common ancestor

**polysome (polysome)** structure including an mRNA molecule that is being translated by multiple ribosomes concurrently

**polysaccharide** polymer composed of hundreds of monosaccharides linked together by glycosidic bonds; also called *glycans*

**portal of entry** anatomical feature of the body through which pathogens can enter host tissue

**portal of exit** anatomical feature of the body through which pathogens can leave diseased individual

**positive (+) strand** viral RNA strand that acts like messenger RNA and can be directly translated inside the host cell

**positive stain** a stain that colors the structure of interest

**pour plate method** a technique used for inoculating plates with diluted bacterial samples for the purpose of cell counting; cells are mixed with warm liquid agar before being poured into Petri dishes

**praziquantel** antihelminthic drug that induces a calcium influx into tapeworms, leading to spasm and paralysis

**precipitin** complex lattice of antibody and antigen that becomes too large to stay in solution

**precipitin ring test** assay in which layers of antisera and antigen in a test tube form precipitin at the interface of the two solutions

**prevalence** the total number or proportion of individuals in a population ill with a specific disease

**primary amoebic meningoencephalitis (PAM)** acute and deadly parasitic infection of brain tissues by the amoeba *Naegleria fowleri*

**primary antibody** in a sandwich ELISA, the antibody that is attached to wells of a microtiter plate to capture antigen from a solution, or in an indirect ELISA, the antigen-specific antibody present in a patient's serum

**primary cell culture** cells taken directly from an animal or plant and cultured *in vitro*

**primary immunodeficiency** genetic condition that results in impaired immune function

**primary infection** initial infection produced by a pathogen

**primary lymphoid tissue** one of two types of lymphatic tissue; comprises bone marrow and the thymus

**primary pathogen** microorganism that can cause disease in the host regardless of the effectiveness of the host's immune system

**primary response** the adaptive immune response produced upon first exposure to a specific antigen

**primary stain** refers, in differential staining techniques, to the first dye added to the specimen

**primary structure** bonding sequence of amino acids in a polypeptide chain **protein** macromolecule that results when the number of amino acids linked together becomes very large, or when multiple polypeptides are used as building subunits

**primary transcript** RNA molecule directly synthesized by RNA polymerase in eukaryotes before undergoing the additional processing required to become a mature mRNA molecule

**primase** RNA polymerase enzyme that synthesizes the RNA primer required to initiate DNA synthesis

**primer** short complementary sequence of five to 10 RNA nucleotides synthesized on the template strand by primase that provides a free 3'-OH group to which DNA polymerase can add DNA nucleotides

**prion** acellular infectious particle consisting of just proteins that can cause progressive diseases in animals and humans

**prodromal period** second stage of acute disease, during which the pathogen continues to multiply in the host and nonspecific signs and symptoms become observable

**progeny virus** newly assembled virions ready for release outside the cell

**proglottid** body segment of a cestode (tapeworm)

**prokaryote** an organism whose cell structure does not include a membrane-bound nucleus

**prokaryotic cell** a cell lacking a nucleus bound by a complex nuclear membrane

**promoter** DNA sequence onto which the transcription machinery binds to initiate transcription

**propagated spread** the progression of an infectious disease from person to person, either indirectly or directly, through a population of susceptible individuals as one infected individual transmits the agent to others, who transmit it to others yet again

**prophage** phage genome that has incorporated into the host genome

**prospective study** a research design that follows cases from the beginning of the study through time to associate measured variables with outcomes

**prostate gland** gland that contributes fluid to semen

**prostatitis** inflammation of the prostate gland

**protease** enzyme involved in protein catabolism that removes individual amino acids from the ends of peptide chains

**protease inhibitor** class of antiviral drugs, used in HIV therapy and hepatitis C therapy, that inhibits viral-specific proteases, preventing viral maturation

**protein signature** an array of proteins expressed by a cell or tissue under a specific condition

**Proteobacteria** phylum of gram-negative bacteria

**proteomic analysis** study of all accumulated proteins of an organism

**proteomics** the study of the entire complement of proteins in an organism; involves monitoring differences in gene expression patterns between cells at the protein level

**protists** informal name for diverse group of eukaryotic organisms, including unicellular, colonial, and multicellular types that lack specialized tissues

**proton motive force** electrochemical gradient formed by the accumulation of hydrogen ions (also known as protons) on one side of a membrane relative to the other protozoan (plural: protozoa) a unicellular eukaryotic organism, usually motile

**protozoans** informal term for some protists, generally those that are nonphotosynthetic, unicellular, and motile; protozoology the study of protozoa

**provirus** animal virus genome that has integrated into the host chromosome

**pseudohyphae** short chains of yeast cells stuck together

**pseudomembrane** grayish layer of dead cells, pus, fibrin, red blood cells, and bacteria that forms on mucous membranes of the nasal cavity, tonsils, pharynx, and larynx of individuals with diphtheria

**pseudomembranous colitis** inflammation of the large intestine with the formation of a pseudomembrane; caused by *C. difficile*

**pseudopodia** temporary projections involved in amoeboid movement; these "false feet" form by gel-sol cycling of actin polymerization/depolymerization

**psittacosis** zoonotic *Chlamydophila* infection from birds that causes a rare form of pneumonia

**psoriasis** autoimmune disease involving inflammatory reactions in and thickening of skin

**psychrophile** a microorganism that grows best at cold temperatures; most have an optimum growth temperature of about 15 °C and can survive temperatures below 0 °C; most cannot survive temperatures above 20 °C

**psychrotroph** a microorganism that grows best at cool temperatures, typically between about 4 °C and 25 °C, with optimum growth at about 20 °C

**puerperal sepsis** sepsis associated with a bacterial infection incurred by a woman during or after childbirth

**purines** nitrogenous bases containing a double-ring structure with a six-carbon ring fused to a five-carbon ring; includes adenine and guanine

**purple nonsulfur bacteria** phototrophic bacteria that are similar to purple sulfur bacteria except they use hydrogen rather than hydrogen sulfide for oxidation

**purple sulfur bacteria** phototrophic bacteria that oxidize hydrogen sulfide into elemental sulfur and sulfuric acid; their purple color is due to the pigments bacteriochlorophylls and carotenoids

**purulent** an infection that produces pus; suppurative **pus** accumulation of dead pathogens, neutrophils, tissue fluid, and other bystander cells that may have been killed by phagocytes at the site of an infection

**pyelonephritis** an infection of one or both kidneys **pyocyanin** blue pigments produced by some strains of *Pseudomonas aeruginosa*

**pyoderma** any suppurative (pus-producing) infection of the skin

**pyoverdin** a water-soluble, yellow-green or yellow-brown pigment produced by some strains of *Pseudomonas aeruginosa*

**pyrimidines** nitrogenous bases containing a single six-carbon ring; includes cytosine and thymine in DNA

**pyrophosphate (PPI)** two connected phosphate groups in solution

**pyuria** pus or white blood cells in the urine

## Q

**Q fever** highly infectious zoonotic disease caused by *Coxiella burnetii* that farmers can contract from their animals by inhalation

**quarantine** the isolation of an individual for the purpose of preventing the spread of disease

**quaternary ammonium salts (quats)** group of cationic detergents, named for the characteristic quaternary nitrogen atom that confers a positive charge, that make up an important class of disinfectants and antiseptics

**quaternary structure** structure of protein complexes formed by the combination of several separate polypeptides or subunits

**quinolines** class of antiprotozoan drugs long used for the treatment of malaria; interferes with heme detoxification

**quorum sensing** cell-to-cell communication in bacteria; enables a coordinated response from cells when the population reaches a threshold density

## R

**R plasmid** plasmid containing genes encoding proteins that make a bacterial cell resistant to one or more antibiotics

**rabies** contagious viral disease primarily transmitted by the bite of infected mammals that can cause acute encephalitis resulting in madness, aggressiveness, coma, and death

**radial immunodiffusion** precipitin reaction in which antigen added to a well in an antiserum-impregnated gel diffuses, producing a precipitin ring whose diameter squared is directly proportional to antigen concentration

**rat-bite fever** relapsing fever caused by either *Bacillus moniliformis* or *Spirillum minor*; can be transmitted by the bite of a rat or through contact with rat feces or urine

**reaction center** protein complex in a photosystem, containing a pigment molecule that can undergo oxidation upon excitation by a light-harvesting pigment, actually giving up an electron

**reactivation tuberculosis** secondary infection by *Mycobacterium tuberculosis* that forms later in life; occurs when the bacteria escape from the Ghon complexes and establish focal infections at other sites in immunocompromised individuals

**reactive oxygen species (ROS)** unstable and toxic ions and molecules derived from partial reduction of oxygen

**reading frame** way nucleotides in mRNA are grouped into codons

**real-time PCR (quantitative PCR, qPCR)** a variant of PCR involving the use of fluorescence to allow for the monitoring of the increase in double-stranded template during a PCR reaction as it occurs, allowing for the quantitation of the original target sequence

**receptor-mediated endocytosis** a type of endocytosis in which extracellular ligands are targeted to specific cells through their binding to specific cell surface receptors

**recognition site** a specific, often palindromic, DNA sequence recognized by a restriction enzyme that is typically four to six base pairs long and reads the same in the 5' to 3' direction on one strand as it does in the 5' to 3' direction on the complementary strand

**recombinant DNA molecule** a DNA molecule resulting from the cutting and insertion of DNA from one organism into the DNA of another organism, resulting in a new combination of genetic material

**recombinant DNA pharmaceuticals** pharmaceuticals produced as a result of genetic engineering

**recombinant DNA technology** the process by which DNA from one organism is cut and new pieces of foreign DNA from a second organism are inserted, artificially creating new combinations of genetic material within the organism

**redox potential** tendency for a molecule to acquire electrons and become reduced; electrons flow from molecules with lower redox potentials to those with higher redox potentials

**redox reaction** pairing of an oxidation reaction with a reduction reaction

**reduction reaction** chemical reaction that adds electrons to acceptor molecules, leaving them reduced

**reemerging infectious disease** a disease that was once under control or largely eradicated that has begun causing new outbreaks due to changes in susceptible populations, the environment, or the pathogen itself

**reflection** when light bounces back from a surface

**refraction** bending of light waves, which occurs when a light wave passes from one medium to another

**refractive index** a measure of the magnitude of slowing of light waves by a particular medium

**regulatory T cells** class of T cells that are activated by self-antigens and serve to inhibit peripheral self-reacting T cells from causing damage and autoimmunity

**rejection** process by which adaptive immune responses recognize transplanted tissue as non-self, mounting a response that destroys the tissue or leads to the death of the individual

**relapsing fever** louse- or tickborne disease caused by *Borrelia recurrentis* or *B. hermsii* and characterized by a recurrent fever

**replica plating** plating technique in which cells from colonies growing on a complete medium are inoculated onto various types of minimal media using a piece of sterile velvet, ensuring that the orientation of cells deposited on all plates is the same so that growth (or absence thereof) can be compared between plates

**replication bubble** circular structure formed when the DNA strands are separated for replication

**replication fork** Y-shaped structure that forms during the process of replication as DNA unwinds and opens up to separate the DNA strands

**replication process** by which DNA is copied

**reporter genes** genes that encode easily observable characteristics, allowing for their expression to be easily monitored

**repressible operon** bacterial operon, that typically containing genes encoding enzymes required for a biosynthetic pathway and that is expressed when the product of the pathway continues to be required but is repressed when the product of the pathway accumulates, removing the need for continued expression

**repressor** protein that suppresses transcription of a gene or operon in response to an external stimulus

**reservoir** a living host or nonliving site in which a pathogenic organism can survive or multiply

**resident microbiota** microorganisms that constantly live in the human body

**resolution** the ability to distinguish between two points in an image

**restriction endonuclease (restriction enzyme)** bacterial enzyme that cuts DNA fragments at a unique, often palindromic, recognition site; used in genetic engineering for splicing DNA fragments together into recombinant molecules

**restriction fragment length polymorphism (RFLP)** a genetic variant identified by differing numbers or sizes of DNA fragments generated after digestion of a DNA sample with a restriction endonuclease; the variants are caused by the loss or gain of restriction sites, or the insertion or deletion of sequences between restriction sites.

**retort** large industrial autoclave used for moist heat sterilization on a large scale

**retrospective study** a research design that associates historical data with present cases

**retrovirus** positive ssRNA virus that produces and uses reverse transcriptase to make an ssDNA copy of the retroviral genome that can then be made into dsDNA and integrate into the host cell chromosome to form a provirus within the host chromosome.

**reverse transcriptase** enzyme found in retroviruses that can make a copy of ssDNA from ssRNA

**reverse transcriptase inhibitor** classes of antiviral drugs that involve nucleoside analog competitive inhibition and non-nucleoside noncompetitive inhibition of the HIV reverse transcriptase

**reverse transcriptase PCR (RT-PCR)** a variation of PCR used to obtain DNA copies of a specific mRNA molecule that begins with the conversion of mRNA molecules to cDNA by the enzyme reverse transcriptase

**Reye syndrome** potentially life-threatening sequelae to some viral infections that result in the swelling of the liver and brain; aspirin use has also been linked to this syndrome

**Rh factor** red blood cell surface antigen that can trigger type II hypersensitivity reactions

**rheostat** a dimmer switch that controls the intensity of the illuminator on a light microscope

**rheumatic fever** serious clinical sequela of an infection with *Streptococcus pyogenes* that can result in damage to joints or the valves of the heart

**rheumatoid arthritis** systemic autoimmune disease in which immune complexes form and deposit in the joints and their linings, leading to inflammation and destruction

**rhinitis** inflammation of the nasal cavity

**rhizines** structures made of hyphae found on some lichens; aid in attachment to a surface

**ribonucleic acid (RNA)** single-stranded nucleic acid composed of ribonucleotides; important in transcription and translation (protein synthesis)

**ribonucleotides** RNA nucleotides containing ribose as the pentose sugar component and a nitrogenous base

**ribosome** a complex intracellular structure that synthesizes proteins

**riboswitch** small region of noncoding RNA found within the 5' end of some prokaryotic mRNA molecules that may bind to a small intracellular molecule, influencing the completion of transcription and/or translation

**ribulose bisphosphate carboxylase (RuBisCO)** first enzyme of the Calvin cycle responsible for adding a CO<sub>2</sub> molecule onto a five-carbon ribulose bisphosphate (RuBP) molecule

**rifampin** semisynthetic member of the rifamycin class that blocks bacterial RNA polymerase activity, inhibiting transcription

**rimantadine** antiviral drug that targets the influenza virus by preventing viral escape from endosomes upon host cell uptake, preventing viral RNA release and subsequent viral replication

**ringworm** a tinea (cutaneous mycosis of the skin), typically characterized by a round, red, slightly raised lesion that heals outward from the center, giving it the appearance of a round worm

**RNA interference (RNAi)** process by which antisense RNAs or small interfering RNAs (siRNAs) interfere with gene expression by binding to mRNA, preventing translation and protein synthesis

**RNA polymerase** enzyme that adds nucleotides to the 3'-OH group of the growing mRNA molecule that are complementary to the template strand, forming covalent phosphodiester bonds between the nucleotides in the RNA

**RNA splicing** process of removing intron-encoded RNA sequences from eukaryotic primary transcripts and reconnecting those encoded by exons

**RNA transcript** mRNA produced during transcription

**Rocky Mountain spotted fever** potentially fatal tickborne disease caused by *Rickettsia rickettsii* characterized by fever, body aches, and a rash

**rogue form** misfolded form of the PrP protein that is normally found in the cell membrane and has the tendency to aggregate in neurons, causing extensive cell death and brain damage

**rolling circle replication** type of rapid unidirectional DNA synthesis of a circular DNA molecule

**roseola** a rash-causing illness, most commonly affecting children, associated with human herpesvirus 6 (HHV-6)

**rough endoplasmic reticulum** a type of endoplasmic reticulum containing bound 80S ribosomes for the synthesis of proteins destined for the plasma membrane

**route of administration** method used to introduce a drug into the body

**rRNA** type of stable RNA that is a major constituent of ribosomes, ensuring proper alignment of the mRNA and the ribosomes as well as catalyzing the formation of the peptide bonds between two aligned amino acids during protein synthesis

**rubella** German measles, caused by the rubella virus

**runs (running)** purposeful, directional movement of a prokaryotic cell propelled by counterclockwise flagellar rotation

## S

**σ factor** subunit of bacterial RNA polymerase conferring promoter specificity that can be substituted with a different version in response to an environmental condition, allowing for a quick and global change of the regulon transcribed

**saccharide** carbohydrate

**salmonellosis** gastrointestinal illness caused by *Salmonella* bacteria

**salpingitis** inflammation of the fallopian tubes

**sandwich ELISA** EIA in which the primary antibody is first attached to the wells of a microtiter plate, allowing it to capture antigen from an unknown solution to be quantified

**Sanger DNA sequencing (dideoxy method, chain termination method)** the original DNA sequencing technique in which dideoxy nucleotides, each labeled with a molecular beacon, are used to terminate chain elongation; the resulting incrementally sized fragments are then separated by electrophoresis to determine the sequence of the DNA molecule

**sanitization** protocol that reduces microbial load on inanimate surfaces to levels deemed safe for public health

**saprozoic** refers to protozoans that ingest small, soluble food molecules

**SARS** severe acute respiratory syndrome; caused by a zoonotic coronavirus that results in flu-like symptoms

**saturated fatty acid** lipid with hydrocarbon chains containing only single bonds, which results in the maximum number of hydrogen atoms per chain

**scanning electron microscope (SEM)** a type of electron microscope that bounces electrons off of the specimen, forming an image of the surface

**scanning probe microscope** a microscope that uses a probe that travels across the surface of a specimen at a constant distance while the current, which is sensitive to the size of the gap, is measured

**scanning tunneling microscope** a microscope that uses a probe that is passed just above the specimen as a constant voltage bias creates the potential for an electric current between the probe and the specimen

**scarlet fever** bacterial infection caused by *Streptococcus pyogenes*, marked by a high fever and a disseminated scarlet rash

**schistosomiasis** helminthic infection caused by *Schistosoma* spp.; transmitted from a snail intermediate host to human swimmers or bathers in freshwater

**schizogony** asexual reproduction in protozoans that is characterized by multiple cell divisions (one cell dividing to form many smaller cells)

**scolex** the head region of a cestode (tapeworm), which typically has suckers and/or hooks for attachment to the host

**scrappie** form of transmissible spongiform encephalopathy that primarily affects sheep

**sebaceous gland** a gland located in hair follicles that secretes sebum

**sebum** lipid-rich substance secreted by the sebaceous glands of the skin

**secondary antibody** antibody to which an enzyme is attached for use in ELISA assays; in direct and sandwich ELISAs, it is specific for the antigen being quantified, whereas in indirect ELISA, it is specific for the primary antibody

**secondary immunodeficiency** impaired immune response due to infection, metabolic disturbance, poor diet, stress, or other acquired factors

**secondary infection** second infection that develops after a primary infection as a result of the primary disease compromising immune defenses or antibiotics, thus eliminating protective microbiota

**secondary lymphoid tissue** one of two types of lymphatic tissue; comprises the spleen, lymph nodes, Peyer's patches, and mucosa associated lymphoid tissue (MALT)

**secondary response** the adaptive immune response produced in response to a specific antigen to which the body has previously been exposed

**secondary structure** structure stabilized by hydrogen bonds between the carbonyl and amine groups of a polypeptide chain; may be an  $\alpha$ -helix or a  $\beta$ -pleated sheet, or both

**secretory vesicle** membranous sac that carries molecules through the plasma membrane to be released (secreted) from the cell

**selective IgA deficiency** primary immunodeficiency in which individuals produce normal levels of IgG and IgM, but are unable to produce secretory IgA

**selective media** media that contain additives that encourage the growth of some bacteria while inhibiting others

**selective toxicity** desirable quality of an antimicrobial drug indicating that it preferentially kills or inhibits the growth of the target microbe while causing minimal or no harm to the host

**semiconservative DNA replication** pattern of DNA replication process whereby each of the two parental DNA strands acts as a template for new DNA to be synthesized, producing hybrid old- and new-strand daughter molecules

**semicritical item** object that contacts mucous membranes or nonintact skin but does not penetrate tissues; requires a high level of disinfection

**seminal vesicles** glands that contribute fluid to semen

**semisynthetic antimicrobial** chemically modified derivative of a natural antibiotic

**sense strand** strand of DNA that is not transcribed for gene expression; it is complementary to the antisense strand

**sepsis** systemic inflammatory response to an infection that results in high fever and edema, causing organ damage and possibly leading to shock and death

**septate hyphae** hyphae that contain walls between individual cells; characteristic of some fungi

**septic arthritis** see *infectious arthritis*

**septic shock** serious condition marked by the loss of blood pressure resulting from an inflammatory response against a systemic infection

**septic** the condition of being septicemic; having an infection in the blood

**septicemia** condition in which pathogens are multiplying in blood

**septicemic plague** form of plague that occurs when the bacterial pathogen gains access to the bloodstream

**septum** separating structure that forms during cell division; also describes the separating wall between cells in a filament

**sequela (plural: sequelae)** condition that arises as a consequence of a prior disease

**serial dilution** sequential transfer of known volumes of culture samples from one tube to another to perform a several-fold dilution of the original culture

**seroconversion** point in an infection at which antibody to a pathogen is detectable using an immunoassay

**serotype** strain or variation of the same species of bacteria; also called serovar

**serovar** specific strain of bacteria identified by agglutination using strain-specific antisera

**serum** fluid portion of the blood after clotting has occurred; generally lacks clotting factors

**serum sickness** systemic type III hypersensitivity reaction

**sessile** attached to a surface

**severe combined immunodeficiency disease (SCID)** genetic disorder resulting in impaired function of B cells and T cells

**sex pilus** specialized type of pilus that aids in DNA transfer between some prokaryotic cells

**sheath** part of the tail on a bacteriophage that contracts to introduce the viral DNA into the bacterium

**shigellosis** gastrointestinal illness caused by *Shigella* bacteria, also called bacillary dysentery

**shingles** acute and painful rash that forms following the reactivation of a latent chickenpox infection

**shock** extreme drop in blood pressure that, among other causes, can result from a strong immune response to the activity of toxins or response to bacterial products and can result in death

**shuttle vector** a plasmid that can move between bacterial and eukaryotic cells

**side chain** the variable functional group, *R*, attached to the  $\alpha$  carbon of an amino acid

**sign** objective and measurable indication of a disease

**silent mutation** point mutation that results in the same amino acid being incorporated into the resulting polypeptide

**simple microscope** a type of microscope with only one lens to focus light from the specimen

**simple staining** a staining technique that uses a single dye

**single-stranded binding protein** protein that coats the single strands of DNA near each replication fork to prevent the single-stranded DNA from rewinding into a double helix

**sinusitis** inflammation of the sinuses

**S-layer** cell envelope layer composed of protein covering the cell walls of some bacteria and archaea; in some archaea, may function as the cell wall

**slime layer** a type of glycocalyx with unorganized layers of polysaccharides that aid bacterial adherence to surfaces

**smear** a thin layer of a specimen on a slide

**smooth endoplasmic reticulum** a type of endoplasmic reticulum that lacks ribosomes, is involved in the biosynthesis of lipids and in carbohydrate metabolism, and serves as the site of detoxification of toxic compounds within the cell

**soft chancres** soft, painful ulcers associated with the STI chancroid

**soma** cell body of a neuron

**sonication** method of microbial control that involves application of ultrasound waves to form cavitation within a solution, including inside cells, disrupting cell components as a result

**Southern blot** a technique in molecular genetics used to detect the presence of certain DNA sequences within a given DNA sample; DNA fragments within the sample are separated by agarose gel electrophoresis, immobilized on a membrane, and then exposed to a specific DNA probe labeled with a radioactive or fluorescent molecular beacon to aid in detection

**specialized transduction** transfer of a specific piece of bacterial chromosomal DNA near the site of integration by the phage

**specificity** the ability of the specific adaptive immune system to target specific pathogens or toxins

**spike** viral glycoprotein embedded within the viral capsid or envelope used for attachment to host cells

**spirochetes** a group of long, thin, spiral-shaped fastidious bacteria that includes the human pathogens that cause syphilis, Lyme disease, and leptospirosis

**spleen** abdominal organ consisting of secondary lymphoid tissue that filters blood and captures pathogens and antigens that pass into it; also contains specialized macrophages and dendritic cells that are crucial for antigen presentation

**spliceosome** protein complex containing small nuclear ribonucleoproteins that catalyzes the splicing out of intron-encoded RNA sequences from the primary transcript during RNA maturation in eukaryotes

**spontaneous generation** the now-disproven theory that life can arise from nonliving matter

**spontaneous mutation** mutation not caused by a mutagen that occurs through DNA replication errors

**sporadic disease** an illness that occurs at relatively low levels with no discernible pattern or trend, frequently with no geographic focus

**spores** specialized cells that may be used for reproduction or may be specialized to withstand harsh conditions

**sporotrichosis** subcutaneous infection caused by the fungus *Sporothrix schenckii*, which causes skin lesions and can potentially spread to the lymphatic system; also known as rose gardener's disease or rose thorn disease

**sporulation** the process by which a vegetative cell produces a dormant endospore

**spread plate method** a technique used for inoculating plates with diluted bacterial samples for the purpose of cell counting; the liquid sample is pipetted onto solid medium and spread uniformly across the plate

**St. Louis encephalitis** mosquito-borne viral infection of the brain that occurs primarily in the central and southern United States

**stage** the platform of a microscope on which slides are placed

**staining** the addition of stains or dyes to a microscopic specimen for the purpose of enhancing contrast

**staphylococcal food poisoning** gastrointestinal illness caused by toxins produced by *Staphylococcus aureus*

**staphylococcal** a class of staphylococcal exotoxins that are cytotoxic to skin cells and white blood cells

**starch** energy-storage polysaccharide in plants; composed of two types of glucose polymers: amylose and amylopectin

**start codon** AUG codon, specifying methionine, which is typically the codon that initiates translation

**stationary phase** interval during which the number of cells formed by cell division is equal to the number of cells dying

**stereoisomers** isomers that differ in the spatial arrangements of atoms

**sterilant** strong chemical that effectively kills all microbes and viruses in or on an inanimate item

**sterile field** specified area that is free of all vegetative microbes, endospores, and viruses

**sterilization** protocol that completely removes all vegetative cells, endospores, and viruses from an item

**steroid** lipid with complex, ringed structures found in cell membranes and hormones

**sterol** the most common type of steroid; contains an OH group at one specific position on one of the molecule's carbon rings

**sticky ends** short, single-stranded complementary overhangs that may be produced when many restriction enzymes cut DNA

**stigma** light-sensing eyespot found in *Euglena*

**stop codon (nonsense codon)** one of three codons for which there is no tRNA with a complementary anticodon; a signal within the mRNA for termination of translation

**stratum corneum** a layer of dead, keratinized cells that forms the uppermost layer of the epidermis

**strep throat (streptococcal pharyngitis)** bacterial pharyngitis caused by *Streptococcus pyogenes*

**streptococcal toxic shock-like syndrome (STSS)** condition similar to staphylococcal toxic shock syndrome but with greater likelihood of bacteremia, necrotizing fasciitis, and acute respiratory distress syndrome

**stroma** a gel-like fluid that makes up much of a chloroplast's volume, and in which the thylakoids floats

**strongyloidiasis** soil-transmitted intestinal infection caused by the helminth *Strongyloides stercoralis*

**structural formula** graphic representation of the molecular structure showing how the atoms are arranged

**structural isomers** molecules composed of the same numbers and types of atoms but with different bonding sequences

**subacute bacterial endocarditis** form of endocarditis in which damage to the valves of the heart occurs over months as a result of blood clot formation and immune-response-induced fibrosis of the valves

**subclinical disease** disease that does not present any signs or symptoms

**subcutaneous mycosis** any fungal infection that penetrates the epidermis and dermis to enter deeper tissues

**substrate** chemical reactants of an enzymatic reaction

**substrate-level phosphorylation** direct method of ATP production in which a high-energy phosphate group is removed from an organic molecule and added to an ADP molecule

**subunit vaccine** vaccine that contains only key antigens as opposed to whole pathogens

**sugar-phosphate backbone** alternating sugar-phosphate structure composing the framework of a nucleic acid strand that results from phosphodiester bond formation between nucleotides

**sulfonamides (sulfa drugs)** group of structurally related synthetic antimicrobial compounds that function as antimetabolites, competitively inhibiting an enzyme in the bacterial folic acid synthesis pathway

**superantigen** class of exotoxin that triggers a strong nonspecific immune response with excessive production of cytokines (cytokine storm) causing inflammation, high fever, shock, and, potentially, death

**supercoiled** extensive wrapping and twisting of a DNA molecule, allowing the DNA to fit within a small space

**supercoiling** process in which DNA is underwound or overwound to fit inside a cell

**supercritical fluid** molecule, commonly carbon dioxide, brought to high pressures to reach a state that has physical properties between those of liquids and gases, allowing it to effectively penetrate surfaces and cells to form carbonic acid, which lowers the pH of cells considerably, leading to sterilization

**superinfection** secondary infection that may develop as a result of long-term, broad-spectrum antimicrobial use

**superoxide dismutase** enzyme that catalyzes the breakdown of superoxide anions

**suppurative** producing pus; purulent

**surfactant** group of chemical compounds used for degerming; lower the surface tension of water, creating emulsions that mechanically carry away microorganisms

**sweat gland** one of numerous tubular glands embedded in the dermis that secretes the watery substance known as perspiration

**symbiosis** any interaction between different species that are associated with each other within a community

**symptom** subjective experience of disease felt by the patient

**synapse** junction between a neuron and another cell

**syncytia** multinucleated cells that form from the fusion of normal cells during infections or other processes

**syndrome** group of signs and symptoms characteristic of a particular disease

**syngamy** process in which haploid gametes fuse

**synthetic antimicrobial** antimicrobial developed from a chemical not found in nature

**syphilis** an STI caused by the bacterium *Treponema pallidum*

**systemic autoimmune disease** autoimmune disease that affect the organism as a whole, rather than a single organ

**systemic infection** infection that has spread to multiple locations or body systems

**systemic inflammatory response syndrome (SIRS)** severe inflammatory response to the presence of microbes in the blood; can lead to sepsis

**systemic lupus erythematosus (SLE)** systemic autoimmune disease producing inflammatory type III hypersensitivities as antibodies form immune complexes with nuclear and cytoplasmic antigens

**systemic mycosis** a fungal infection that spreads throughout the body

## T

**T-cell receptors (TCR)** molecules on T cells involved in the recognition of processed foreign epitopes presented with MHC I or MHC II

**T lymphocyte** lymphocyte that serves as the central orchestrator, bridging humoral, cellular, and innate immunity, and serves as the effector cells of cellular immunity; T cell

**taeniasis** infection caused by *Taenia* or *Diphyllobothrium*

**tail fiber** long protein component on the lower part of a phage used for specific attachment to bacterial cell

**tail pins** points extended at the base of a bacteriophage sheath that, along with tail fibers, lead to phage attachment to a bacterial cell

**tapeworms** segmented, hermaphroditic, parasitic flatworms (Platyhelminthes)

**tartar** calcified heavy plaque on teeth, also called dental calculus taxonomy the classification, description, identification, and naming of living organisms

**T-dependent antigen** a protein antigen that is only capable of activating a B cell with the cooperation of a helper T cell

**TDP** thermal death point is the lowest temperature at which all microorganisms are killed in a 10-minute exposure

**TDT** thermal death time is the length of time needed to kill all microorganisms in a sample at a given temperature

**telomerase** enzyme that attaches to the end of a linear chromosome and adds nucleotides to the 3' end of one of the DNA strands, maintaining the telomere sequence, thus preventing loss of DNA from the end of the chromosome

**telomere** repetitive, noncoding sequence found at the end of a linear eukaryotic chromosome that protects the genes near the end of the chromosome from deletion as the DNA molecule is repeatedly replicated

**temperate phage** bacteriophage that can incorporate viral genome into the host cell chromosome and replicate with the host cell until new viruses are produced; a phage that undergoes the lysogenic cycle

**teratogenic** able to disrupt the normal development of a fetus in utero

**terbinafine** antifungal drug of the allylamine class that is used topically for the treatment of dermatophytic skin infections

**termination of DNA replication** stage of replication during which DNA replication is halted once the chromosome has been fully replicated

**termination of transcription** stage of transcription that occurs when RNA polymerase has reached specific DNA sequences, leading to release of the enzyme from the DNA template, freeing the RNA transcript and, thus, halting transcription

**termination of translation** stage of translation during which a nonsense codon aligns with the A site, signaling release factors to release of the polypeptide, leading to the dissociation of the small and large ribosomal subunits from the mRNA and from each other

**tertiary structure** large-scale, three-dimensional structure of a polypeptide

**test sensitivity** probability that a diagnostic test will find evidence of the targeted disease when the pathogen is present

**test specificity** probability that a diagnostic test will not find evidence of the targeted disease when the pathogen is absent

**testes** (singular *testis*) pair of glands located in the scrotum of males that produce sperm and testosterone

**tetanus** bacterial disease caused by exotoxin produced by *Clostridium tetani* that causes a rigid paralysis

**tetracyclines** class of protein synthesis inhibitors that bind to the 30S subunit, blocking the association of tRNAs with the ribosome during translation

**T<sub>H</sub>1 cells** subtype of T cells that stimulate cytotoxic T cells, macrophages, neutrophils, and NK cells

**T<sub>H</sub>17 cells** subtype of T cell that are essential for defense against specific pathogens and infections, such as chronic mucocutaneous infections with *C. albicans*

**T<sub>H</sub>2 cells** subtype of T cells that stimulate B cells and direct their differentiation; also involved in directing antibody class switching

**thallus** body of fleshy fungi (more generally, a body without a root, stem, or leaf) that commonly co-occurs with HIV infection; the microbes move to the lymphatic system in the groin

**thermophile** a microorganism that grows best at warm temperatures, typically between 50 °C and 80 °C

**thin sections** thin slices of tissue for examination under a TEM

**thioglycolate medium** medium designed to test the aerotolerance of bacteria; it contains a low concentration of agar to allow motile bacteria to move throughout the medium

**thioglycolate tube culture** contains reducing medium through which oxygen diffuses from the tube opening, producing a range of oxygen environments down the length of the tube

**thrombocytes** see *platelets*

**thylakoids** a highly dynamic collection of membranous sacs found in the stroma of chloroplasts; site of photosynthesis

**thymic selection** a three-step process of negative and positive selection of T cells in the thymus

**thymine dimer** covalent linkage between two adjacent thymine bases on exposure to ultraviolet radiation

**thymine** pyrimidine nitrogenous base found only in DNA nucleotides

**tincture** solution of an antiseptic compound dissolved in alcohol

**T-independent antigen** a nonprotein antigen that can activate a B cell without cooperation from a helper T cell

**tinea** any cutaneous fungal infection caused by dermatophytes, such as *tinea corporis*, *tinea capitis*, *tinea cruris*, and *tinea pedis*

**tinea capitis** cutaneous mycosis of the scalp; also known as ringworm of the scalp

**tinea corporis** cutaneous mycosis of the body; also known as ringworm of the body

**tinea cruris** cutaneous mycosis of the groin region; also known as jock itch

**tinea pedis** cutaneous mycosis of the feet; also known as athlete's foot

**tissue tropism** tendency of most viruses to infect only certain tissue types within a host

**titer** concentration obtained by titration; the reciprocal of a measurement of biological activity determined by finding the dilution of an unknown (e.g., antigen-specific antibody in an antiserum) that shows the defined end-point; always expressed as a whole number

**tolerance** lack of an anti-self immune response

**toll-like receptors (TLRs)** pathogen recognition receptors (PRRs) that may be found on the external surface of phagocytes or facing inward in interior compartments

**tonsillitis** inflammation of the tonsils

**topoisomerase** type of enzyme that helps maintain the structure of supercoiled chromosomes, preventing overwinding of DNA during certain cellular processes like DNA replication

**topoisomerase II** enzyme responsible for facilitating topological transitions of DNA, relaxing it from its supercoiled state

**total magnification** in a light microscope is a value calculated by multiplying the magnification of the ocular by the magnification of the objective lenses

**toxemia** presence of toxins in the blood

**toxic shock syndrome** severe condition marked by the loss of blood pressure and blood clot formation caused by a bacterial superantigen, toxic shock syndrome toxin

**toxicogenicity** ability of a pathogen to produce toxins to cause damage to host cells

**toxin** poison produced by a pathogen

**toxoid vaccine** vaccine that contains inactivated bacterial toxins

**toxoplasmosis** typically asymptomatic protozoan infection caused by *Toxoplasma* spp. and transmitted through contact with cysts in cat feces; infections in pregnant women may cause birth defects or miscarriage

**trace element** indispensable element present in cells in lower amounts than macronutrients; also called *micronutrient*

**trachea** also known as the windpipe, this is a stiffened tube of cartilage that runs from the larynx to the bronchi

**trachoma** a type of conjunctivitis, caused by *Chlamydia trachomatis*, that is a major cause of preventable blindness

**transcription bubble** region of unwinding of the DNA double helix during transcription

**transcription factors** proteins encoded by regulatory genes that function by influencing the binding of RNA polymerase to the promoter and allowing its progression to transcribe structural genes

**transcription** process of synthesizing RNA using the information encoded in DNA

**transcriptomics** the study of the entire collection of mRNA molecules produced by cells; involves monitoring differences in gene expression patterns between cells at the mRNA level

**transduction** mechanism of horizontal gene transfer in bacteria in which genes are transferred through viral infection

**transendothelial migration** process by which circulating leukocytes exit the bloodstream via the microvascular endothelium

**transfection** the introduction of recombinant DNA molecules into eukaryotic hosts

**transformation** mechanism of horizontal gene transfer in bacteria in which naked environmental DNA is taken up by a bacterial cell

**transgenic** describing an organism into which foreign DNA from a different species has been introduced

**transient microbiota** microorganisms, sometimes pathogenic, that are only temporarily found in the human body

**transition reaction** reaction linking glycolysis to the Krebs cycle, during which each pyruvate is decarboxylated and oxidized (forming NADH), and the resulting two-carbon acetyl group is attached to a large carrier molecule called coenzyme A, resulting in the formation of acetyl-CoA and CO; also called the *bridge reaction*

**translation (protein synthesis)** process of protein synthesis whereby a ribosome decodes an mRNA message into a polypeptide product

**transmissible spongiform encephalopathy** degenerative disease caused by prions; leads to the death of neurons in the brain

**transmission electron microscope (TEM)** a type of electron microscope that uses an electron beam, focused with magnets, that passes through a thin specimen

**transmittance** the amount of light that passes through a medium

**transparency** the property of allowing light to pass through

**transport vesicle** membranous sac that carries molecules between various components of the endomembrane system

**transposition** process whereby a DNA sequence known as a transposon independently excises from one location in a DNA molecule and integrates elsewhere

**transposon (transposable element)** molecule of DNA that can independently excise from one location in a DNA molecule and integrate into the DNA elsewhere

**trench fever** louseborne disease caused by *Bartonella quintana* and characterized by high fever, body aches, conjunctivitis, ocular pain, severe headaches, and severe bone pain

**trench mouth** a severe form of gingivitis, also called acute necrotizing ulcerative gingivitis

**treponemal serologic tests** tests for syphilis that measure the amount of antibody directed against antigens associated with *Treponema pallidum*

**triacylglycerol** three fatty acids chemically linked to a glycerol molecule; also called a triglyceride

**triazoles** ergosterol biosynthesis inhibitors used to treat several types of systemic yeast infections; exhibit more selective toxicity than the imidazoles and are associated with fewer side effects

**tricarboxylic acid cycle** see *Krebs cycle*

**trichinosis** soil-transmitted intestinal infection caused by the nematode *Trichinella spiralis*; associated with cyst formation

**trichomoniasis** a common STI caused by *Trichomonas vaginalis*

**trichuriasis** intestinal infection caused by the whipworm *Trichuris trichiura*

**triglyceride** three fatty acids chemically linked to a glycerol molecule; also called a triacylglycerol

**trimethoprim** synthetic antimicrobial compound that functions as an antimetabolite to an enzyme in the bacterial folic acid synthesis pathway

**tRNA** small type of stable RNA that carries the correct amino acid to the site of protein synthesis in the ribosome and base pairs with the mRNA to allow the amino acid it carries to be inserted in the polypeptide chain being synthesized

**trophozoite** a life cycle phase in which protists are actively feeding and growing

**tubercle** small, rounded lesion

**tuberculosis** life-threatening form of microbial infection marked by the presence of acid-fast bacteria growing in nodules (especially in the lungs)

**tularemia** infection of the lymphatic system by *Francisella tularensis*; also known as rabbit fever

**tumble (tumbling)** random, circuitous movement of a bacterial cell, propelled by clockwise flagellar rotation

**tumor** collection or aggregate of cells; can be benign (noncancerous) or malignant (cancerous)

**tumor-inducing (Ti) plasmid** a naturally occurring plasmid of the bacterium *Agrobacterium tumefaciens* that researchers use as a shuttle vector to introduce a desired DNA fragment into plant cells

**turbidity** cloudiness of a culture due to refraction of light by cells and particles

**two-photon microscope** a microscope that uses long-wavelength or infrared light to fluoresce fluorochromes in the specimen

**tympanic membrane** also referred to as the ear drum, this structure separates the outer and middle ear

**type 1 diabetes mellitus** hyperglycemia caused by an autoimmune disease affecting insulin production by  $\beta$  cells of the pancreas

**type I hypersensitivity** rapid-onset allergic reaction due to cross-linking of antigen-specific IgE on the outside of mast cells, resulting in release of inflammatory mediators

**type II hypersensitivity** cytotoxic reaction triggered by IgG and IgM antibodies binding to antigens on cell surfaces

**type III hypersensitivity** inflammatory reaction induced by formation of immune complexes and their deposition in tissues and blood vessels

**type IV hypersensitivity** delayed T-cell-mediated inflammatory reaction that takes longer to manifest than the first three hypersensitivity types, due to the need for activation of antigen-presenting cell and T-cell subsets

**typhoid fever** serious illness caused by infection with certain serotypes of *Salmonella*

## U

**UHT pasteurization** method of pasteurization that exposes milk to ultra-high temperatures (near 140 °C) for a few seconds, effectively sterilizing it so that it can be sealed and stored for long periods without refrigeration

**ulcer** open sore

**ultramicrotome** a device that cuts thin sections for electron microscopy

**unit membrane** biological membrane composed of two layers of phospholipid molecules with the nonpolar tails associating to form a hydrophobic barrier between the polar heads; also called lipid bilayer

**unsaturated fatty acid** lipid with hydrocarbon chains containing one or more carbon-carbon double bonds and subsequently fewer than the maximum number of hydrogen atoms per chain

**uracil** pyrimidine nitrogenous base found only in RNA nucleotides

**ureter** duct that transports urine from the kidneys to the urinary bladder

**ureteritis** inflammation of the ureter

**urethra** duct through which urine passes from the urinary bladder to leave the body through the urinary meatus

**urethritis** inflammation of the urethra

**urinary bladder** an organ that stores urine until it is ready to be excreted

**urinary meatus** the opening through which urine leaves the body

**use-dilution test** a technique for determining the effectiveness of a chemical disinfectant on a surface; involves dipping a surface in a culture of the targeted microorganism, disinfecting the surface, and then transferring the surface to a fresh medium to see if bacteria will grow

**uterus** female reproductive organ in which a fertilized egg implants and develops

## V

**vaccination** inoculation of a patient with attenuated pathogens or antigens to activate adaptive immunity and protect against infection

**vagina** female reproductive organ that extends from the vulva to the cervix

**vaginitis** inflammation of the vagina

**vaginosis** an infection of the vagina caused by overgrowth of resident bacteria

**vancomycin** cell wall synthesis inhibitor of the glycopeptide class

**vancomycin-intermediate *Staphylococcus aureus* (VISA)** pathogen with intermediate vancomycin resistance due to increased targets for and trapping of vancomycin in the outer cell wall

**vancomycin-resistant enterococci (VRE)** pathogens resistant to vancomycin through a target modification of peptidoglycan subunit peptides that inhibit binding by vancomycin

**vancomycin-resistant *Staphylococcus aureus* (VRSA)** pathogen with resistance to vancomycin that has arisen as a result of the horizontal gene transfer of vancomycin resistance genes from VRE

**variolation** the historical practice of inoculating a healthy patient with infectious material from a person infected with smallpox in order to promote immunity to the disease

**vas deferens** pair of ducts in the male reproductive system that conduct sperm from the testes and seminal fluid to the ejaculatory duct

**vasculitis** inflammation affecting blood vessels (either arteries or veins)

**VDRL (Venereal Disease Research Laboratory) test** test for syphilis that detects anti-treponemal antibodies to the phospholipids produced due to the tissue destruction by *Treponema pallidum*; antibodies are detected through a flocculation reaction with cardiolipin extracted from beef heart tissue

**vector** animal (typically an arthropod) that transmits a pathogen from one host to another host; DNA molecules that carry DNA fragments from one organism to another

**vegetative cell** a cell that is actively growing and dividing, and does not contain an endospore

**vehicle transmission** transfer of a pathogen between hosts via contaminated food, water, or air

**vein** blood vessel that returns blood from the tissues to the heart for recirculation

**vertical direct transmission** transfer of a pathogen from mother to child during pregnancy, birth, or breastfeeding

**vertical gene transfer** transfer of genes from parent to offspring

**viable cell** live cell; live cells are usually detected as colony-forming units

**viable plate count** direct method of measuring microbial growth in a culture; the number of viable or live cells is usually expressed in CFU/mL

**viral conjunctivitis** inflammation of the conjunctiva caused by a viral infection

**viral envelope** lipid membrane obtained from phospholipid membranes of the cell that surrounds the capsid

**viral hemagglutination inhibition assay** assay used to quantify the amount of neutralizing antibody against a virus by showing a decrease in hemagglutination caused by a standardized amount of virus

**viral titer** number of virions per unit volume

**viremia** presence of virus in blood

**viricide** chemical or physical treatment that destroys or inactivates viruses

**virion** inert particle that is the reproductive form of a virus

**viroid** infectious plant pathogen composed of RNA

**virology** the study of viruses

**virulence** degree to which an organism is pathogenic; severity of disease signs and symptoms

**virulence factor** product of a pathogen that assists in its ability to cause infection and disease

**virulent phage** bacteriophage for which infection leads to the death of the host cell; a phage that undergoes the lytic cycle

**virus** an acellular microorganism, consisting of proteins and genetic material (DNA or RNA), that can replicate itself by infecting a host cell

**virusoid** small piece of RNA associated with larger RNA of some infectious plant viruses

**volutin** inclusions of polymerized inorganic phosphate; also called metachromatic granules

**vulva** the female external genitalia

## W

**water activity** water content of foods or other materials

**wavelength** the distance between one peak of a wave and the next peak

**Weil's disease** advanced stage of leptospirosis in which the kidney and liver become seriously infected

**West African trypanosomiasis** chronic form of African trypanosomiasis caused by *Trypanosoma brucei gambiense*

**West Nile encephalitis** mosquito-borne disease caused by the West Nile virus (WNV) that can result in swelling of the brain and death in severe cases

**western blot** technique used to detect the presence of a certain protein within a given protein sample in which proteins within the sample are separated by PAGE, immobilized on a membrane, and then exposed first to an antibody that binds to the protein of interest and then second to an antibody equipped with a molecular beacon that will bind to the first antibody

**western equine encephalitis** serious but rare mosquito-borne viral infection of the brain that is found primarily in the central and western United States

**wet mount** a slide preparation technique in which a specimen is placed on the slide in a drop of liquid

**wheel-flare reaction** localized type I hypersensitivity reaction, involving a raised, itchy bump (wheel) and redness (flare), to injected allergen

**whooping cough** common name for pertussis

**wild type** phenotype of an organism that is most commonly observed in nature

**Winterbottom's sign** acute swelling of lymph nodes at the back of the neck that is an early sign of African trypanosomiasis

**wobble position** third position of a codon that, when changed, typically results in the incorporation of the same amino acid because of the degeneracy of the genetic code

**World Health Organization (WHO)** international public health organization within the United Nations; monitors and communicates international public health information and coordinates international public health programs and emergency interventions

## X

**xenobiotic** compound synthesized by humans and introduced to an environment in much higher concentrations than expected in nature

**xenograft** transplanted tissue from a donor that is of a different species than the recipient

**X-linked agammaglobulinemia** genetic disorder resulting in an inability to produce antibodies

**x-y mechanical stage knobs** knobs on a microscope that are used to adjust the position of the specimen on the stage surface, generally to center it directly above the light

## Y

**yeast** any unicellular fungus

**yeast infection** fungal infection of the vagina typically caused by an overgrowth of resident *Candida* spp.

**yellow fever** mild to potentially fatal mosquito-borne viral disease caused by the yellow fever virus

## Z

**Ziehl-Neelsen technique** a method of acid-fast staining that uses heat to infuse the primary stain, carbolfuchsin, into acid-fast cells

**zone of inhibition** clear zone around a filter disk impregnated with an antimicrobial drug, indicating growth inhibition due to the antimicrobial drug

**zoonosis** see *zoonotic disease*

**zoonotic disease** any disease that is transmitted to humans by animals

**zooplankton** heterotrophic plankton

**Z-scheme** electron flow seen in noncyclic photophosphorylation in plants, algae, and cyanobacteria due to the use of both PSI and PSII

**zygospores** spores used by Zygomycetes for sexual reproduction; they have hard walls formed from the fusion of reproductive cells from two individuals