

Glossary

- abiotic factors** Elements of the nonliving, physical environment that affect a particular organism. Compare with *biotic factors*.
- abscisic acid** (ab-sis'ik) A plant hormone involved in dormancy and responses to stress.
- abscission** (ab-sizh'en) The normal (usually seasonal) fall of leaves or other plant parts, such as fruits or flowers.
- abscission layer** The area at the base of the petiole where the leaf will break away from the stem. Also known as *abscission zone*.
- absorption** (ab-sorp'shun) (1) The movement of nutrients and other substances through the wall of the digestive tract and into the blood or lymph. (2) The process by which chlorophyll takes up light for photosynthesis.
- absorption spectrum** A graph of the amount of light at specific wavelengths that is absorbed as light passes through a substance. Each type of molecule has a characteristic absorption spectrum. Compare with *action spectrum*.
- accessory fruit** A fruit consisting primarily of tissue other than ovary tissue, e.g., apple, pear. Compare with *aggregate, simple, and multiple fruits*.
- acclimatization** Adjustment to seasonal changes.
- acetyl coenzyme A (acetyl CoA)** (as'uh-teel) A key intermediate compound in metabolism; consists of a two-carbon acetyl group covalently bonded to coenzyme A.
- acetyl group** A two-carbon group derived from acetic acid (acetate).
- acetylcholine** (ah'see-til-koh'leen) A common neurotransmitter released by cholinergic neurons, including motor neurons.
- achene** (a-keen') A simple, dry fruit with one seed in which the fruit wall is separate from the seed coat, e.g., sunflower fruit.
- acid** A substance that is a hydrogen ion (proton) donor; acids unite with bases to form salts. Compare with *base*.
- acid precipitation** Precipitation that is acidic as a result of both sulfur and nitrogen oxides forming acids when they react with water in the atmosphere.
- acidic solution** A solution in which the concentration of hydrogen ions $[H^+]$ exceeds the concentration of hydroxide ions $[OH^-]$. An acidic solution has a pH less than 7. Compare with *basic solution* and *neutral solution*.
- acoelomate** (a-seel'oh-mate) An animal lacking a body cavity (coelom). Compare with *coelomate* and *pseudocoelomate*.
- acquired immune responses** See *specific immune responses*.
- acquired immunodeficiency syndrome (AIDS)** A serious, potentially fatal disease caused by the human immunodeficiency virus (HIV).
- acromegaly** (ak'roh-meg'ah-lee) A condition characterized by overgrowth of the extremities of the skeleton, fingers, toes, jaws, and nose. It may be produced by excessive secretion of growth hormone by the anterior pituitary gland.
- acrosome reaction** (ak'roh-sohm) A series of events in which the acrosome, a caplike structure covering the head of a sperm cell, releases proteolytic (protein-digesting) enzymes and undergoes other changes that permit the sperm to penetrate the outer covering of the egg.
- actin** (ak'tin) The protein of which microfilaments consist. Actin, together with the protein myosin, is responsible for muscle contraction.
- actin filaments** Thin filaments consisting mainly of the protein actin; actin and myosin filaments make up the myofibrils of muscle fibers.
- actinopods** (ak-tin'o-podz) Protozoa characterized by axopods that protrude through pores in their shells. See *radiolarians*.
- action potential** An electrical signal resulting from depolarization of the plasma membrane in a neuron or muscle cell. Compare with *resting potential*.
- action spectrum** A graph of the effectiveness of light at specific wavelengths in promoting a light-requiring reaction. Compare with *absorption spectrum*.
- activation energy (E_A)** The kinetic energy required to initiate a chemical reaction.
- activator protein** A positive regulatory protein that stimulates transcription when bound to DNA. Compare with *repressor protein*.
- active immunity** Immunity that develops as a result of exposure to antigens; it can occur naturally after recovery from a disease or can be artificially induced by immunization with a vaccine. Compare with *passive immunity*.
- active site** A specific region of an enzyme (generally near the surface) that accepts one or more substrates and catalyzes a chemical reaction. Compare with *allosteric site*.
- active transport** Transport of a substance across a membrane that does not rely on the potential energy of a concentration gradient for the substance being transported and therefore requires an additional energy source (often ATP); includes carrier-mediated active transport, endocytosis, and exocytosis. Compare with *diffusion* and *facilitated diffusion*.
- adaptation** (1) An evolutionary modification that improves an organism's chances of survival and reproductive success. (2) A decline in the response of a receptor subjected to repeated or prolonged stimulation.
- adaptive immune responses** See *specific immune responses*.
- adaptive radiation** The evolution of a large number of related species from an unspecialized ancestral organism.
- adaptive zone** A new ecological opportunity that was not exploited by an ancestral organism; used by evolutionary biologists to explain the ecological paths along which different taxa evolve.
- addiction** Physical dependence on a drug, generally based on physiological changes that take place in response to the drug; when the drug is withheld, the addict may suffer characteristic withdrawal symptoms.
- adenine** (ad'eh-noon) A nitrogenous purine base that is a component of nucleic acids and ATP.
- adenosine triphosphate (ATP)** (a-den'oh-seen) An organic compound containing adenine, ribose, and three phosphate groups; of prime importance for energy transfers in cells.
- adhering junction** A type of anchoring junction between cells; connects epithelial cells.

- adhesion** The property of sticking to some other substance. Compare with *cohesion*.
- adipose tissue** (ad'i-pohs) Tissue in which fat is stored.
- adrenal cortex** (ah-dree'nul kor'teks) The outer region of each adrenal gland; secretes steroid hormones, including mineralocorticoids and glucocorticoids.
- adrenal glands** (ah-dree'nul) Paired endocrine glands, one located just superior to each kidney; secrete hormones that help regulate metabolism and help the body cope with stress.
- adrenal medulla** (ah-dree'nul meh-dull'uh) The inner region of each adrenal gland; secretes epinephrine and norepinephrine.
- adrenergic neuron** (ad-ren-er'jik) A neuron that releases norepinephrine or epinephrine as a neurotransmitter. Compare with *cholinergic neuron*.
- adventitious** (ad'ven-tish'us) Of plant organs, such as roots or buds, that arise in an unusual position on a plant.
- aerobe** Organism that grows or metabolizes only in the presence of molecular oxygen. Compare with *anaerobe*.
- aerobic** (air-oh'bik) Growing or metabolizing only in the presence of molecular oxygen. Compare with *anaerobic*.
- aerobic respiration** See *respiration*.
- afferent** (af'fer-ent) Leading toward some point of reference. Compare with *efferent*.
- afferent neurons** Neurons that transmit action potentials from sensory receptors to the brain or spinal cord. Compare with *efferent neurons*.
- age structure** The number and proportion of people at each age in a population. Age structure diagrams represent the number of males and females at each age, from birth to death, in the population.
- aggregate fruit** A fruit that develops from a single flower with many separate carpels, e.g., raspberry. Compare with *simple*, *accessory*, and *multiple fruits*.
- aggregated distribution** See *clumped dispersion*.
- aging** Progressive changes in development in an adult organism.
- agnathans** (ag-na'thanz) Jawless fishes; historical class of vertebrates, including lampreys, hagfishes, and many extinct forms.
- AIDS** See *acquired immunodeficiency syndrome*.
- albinism** (al'bih-niz-em) A hereditary inability to form melanin pigment, resulting in light coloration.
- albumin** (al-bew'min) A class of protein found in most animal tissues; a fraction of plasma proteins.
- aldehyde** An organic molecule containing a carbonyl group bonded to at least one hydrogen atom. Compare with *ketone*.
- aldosterone** (al-dos'tur-ohn) A steroid hormone produced by the vertebrate adrenal cortex; stimulates sodium reabsorption. See *mineralocorticoids*.
- algae** (al'gee) (sing., *alga*) An informal group of unicellular, or simple multicellular, photosynthetic protists that are important producers in aquatic ecosystems.
- allantois** (a-lan'toe-iss) An extraembryonic membrane of reptiles, birds, and mammals that stores the embryo's nitrogenous wastes; most of the allantois is detached at hatching or birth.
- allele frequency** The proportion of a specific allele in the population.
- alleles** (al-leelz') Genes governing variation of the same character that occupy corresponding positions (loci) on homologous chromosomes; alternative forms of a gene.
- allelopathy** (uh-leel'uh-path'ee) An adaptation in which toxic substances secreted by roots or shed leaves inhibit the establishment of competing plants nearby.
- allergen** A substance that stimulates an allergic reaction.
- allergy** A hypersensitivity to some substance in the environment, manifested as hay fever, skin rash, asthma, food allergies, etc.
- allometric growth** Variation in the relative rates of growth for different parts of the body during development.
- allopatric speciation** (al-oh-pa'trik) Speciation that occurs when one population becomes geographically separated from the rest of the species and subsequently evolves. Compare with *sympatric speciation*.
- allopolyploid** (al'oh-pol'ee-ployd) A polyploid whose chromosomes are derived from two species. Compare with *autopolyploid*.
- all-or-none law** The principle that neurons transmit an impulse in a similar way no matter how weak or strong the stimulus; the neuron either transmits an action potential (all) or does not (none).
- allosteric regulators** Substances that affect protein function by binding to allosteric sites.
- allosteric site** (al-oh-steer'ik) A site on an enzyme other than the active site, to which a specific substance binds, thereby changing the shape and activity of the enzyme. Compare with *active site*.
- alpha (α) helix** A regular, coiled type of secondary structure of a polypeptide chain, maintained by hydrogen bonds. Compare with *beta (β)-pleated sheet*.
- alpine tundra** An ecosystem located in the higher elevations of mountains, above the tree line and below the snow line. Compare with *tundra*.
- alternation of generations** A type of life cycle characteristic of plants and a few algae and fungi in which they spend part of their life in a multicellular *n* gametophyte stage and part in a multicellular *2n* sporophyte stage.
- altruistic behavior** Behavior in which one individual helps another, seemingly at its own risk or expense.
- alveolus** (al-vee'o-lus) (pl., *alveoli*) (1) An air sac of the lung through which gas exchange with the blood takes place. (2) Saclike unit of some glands, e.g., mammary glands. (3) One of several flattened vesicles located just inside the plasma membrane in certain protists.
- Alzheimer's disease (AD)** A progressive, degenerative brain disorder characterized by amyloid plaques and neurofibrillary tangles.
- amino acid** (uh-mee'no) An organic compound containing an amino group ($-\text{NH}_2$) and a carboxyl group ($-\text{COOH}$); may be joined by peptide bonds to form a polypeptide chain.
- amino group** A weakly basic functional group; abbreviated $-\text{NH}_2$.
- aminoacyl-tRNA** (uh-mee'no-ace'seel) Molecule consisting of an amino acid covalently linked to a transfer RNA.
- aminoacyl-tRNA synthetase** One of a family of enzymes, each responsible for covalently linking an amino acid to its specific transfer RNA.
- ammonification** (uh-moe'nuh-fah-kay'shun) The conversion of nitrogen-containing organic compounds to ammonia (NH_3) by certain soil bacteria (ammonifying bacteria); part of the nitrogen cycle.
- amniocentesis** (am'nee-oh-sen-tee'sis) Sampling of the amniotic fluid surrounding a fetus to obtain information about its development and genetic makeup. Compare with *chorionic villus sampling*.
- amnion** (am'nee-on) In terrestrial vertebrates, an extraembryonic membrane that forms a fluid-filled sac for the protection of the developing embryo.
- amniotes** Terrestrial vertebrates: reptiles, birds, and mammals; animals whose embryos are enclosed by an amnion.
- amoeba** (a-mee'ba) (pl., *amoebas*) A unicellular protozoon that moves by means of pseudopodia.
- amphibians** Members of vertebrate class that includes salamanders, frogs, and caecilians.
- amphipathic molecule** (am'fih-pa'thik) A molecule containing both hydrophobic and hydrophilic regions.

- ampulla** Any small, saclike extension, e.g., the expanded structure at the end of each semicircular canal of the ear.
- amylase** (am'-uh-laze) Starch-digesting enzyme, e.g., human salivary amylase or pancreatic amylase.
- amyloplasts** See *leukoplasts*.
- anabolic steroids** Synthetic androgens that increase muscle mass, physical strength, endurance, and aggressiveness but cause serious side effects; these drugs are often abused.
- anabolism** (an-ab'oh-lizm) The aspect of metabolism in which simpler substances are combined to form more complex substances, resulting in the storage of energy, the production of new cell materials, and growth. Compare with *catabolism*.
- anaerobe** Organism that grows or metabolizes only in the absence of molecular oxygen. See *facultative anaerobe* and *obligate anaerobe*. Compare with *aerobe*.
- anaerobic** (an'air-oh'bik) Growing or metabolizing only in the absence of molecular oxygen. Compare with *aerobic*.
- anaerobic respiration** See *respiration*.
- anaphase** (an'uh-faze) Stage of mitosis in which the chromosomes move to opposite poles of the cell; anaphase occurs after metaphase and before telophase.
- anaphylaxis** (an'uh-fih-lak'sis) An acute allergic reaction following sensitization to a foreign substance or other substance.
- ancestral characters** See *shared ancestral characters*.
- androgen** (an'dro-jen) Any substance that has masculinizing properties, such as a sex hormone. See *testosterone*.
- androgen-binding protein (ABP)** A protein produced by Sertoli cells in the testes; binds and concentrates testosterone.
- anemia** (uh-nee'mee-uh) A deficiency of hemoglobin or red blood cells.
- aneuploidy** (an'yoo-ploy-dee) Any chromosomal aberration in which there are either extra or missing copies of certain chromosomes.
- angiosperms** (an'jee-oh-spermz") The traditional name for flowering plants, a very large (more than 300,000 species), diverse phylum of plants that form flowers for sexual reproduction and produce seeds enclosed in fruits; include monocots and eudicots.
- angiotensin I** (an-jee-o-ten'sin) A polypeptide produced by the action of renin on a plasma protein (angiotensinogen).
- angiotensin II** A peptide hormone formed by the action of angiotensin-converting enzyme on angiotensin I; stimulates aldosterone secretion by the adrenal cortex.
- animal pole** The nonyolky, metabolically active pole of a vertebrate or echinoderm egg. Compare with *vegetal pole*.
- anion** (an'eye-on) A particle with one or more units of negative charge, such as a chloride ion (Cl⁻) or hydroxide ion (OH⁻). Compare with *cation*.
- anisogamy** (an'eye-sog'uh-me) Sexual reproduction involving motile gametes of similar form but dissimilar size. Compare with *isogamy* and *oogamy*.
- annelid** (an'eh-lid) A member of phylum Annelida; segmented worm such as earthworm.
- annual plant** A plant that completes its entire life cycle in 1 year or less. Compare with *perennial* and *biennial*.
- antenna complex** The arrangement of chlorophyll, accessory pigments, and pigment-binding proteins into light-gathering units in the thylakoid membranes of photoautotrophic eukaryotes. See *reaction center* and *photosystem*.
- antennae** (sing., *antenna*) Sensory structures characteristic of some arthropod groups.
- anterior** Toward the head end of a bilaterally symmetrical animal. Compare with *posterior*.
- anther** (an'thur) The part of the stamen in flowers that produces microspores and, ultimately, pollen grains.
- antheridium** (an'thur-id'ee-im) (pl., *antheridia*) In plants, the multicellular male gametangium (sex organ) that produces sperm cells. Compare with *archegonium*.
- anthropoid** (an'thra-poid) A member of a suborder of primates that includes monkeys, apes, and humans.
- antibody** (an'tee-bod'ee) A specific protein (immunoglobulin) that recognizes and binds to specific antigens; produced by plasma cells.
- antibody-mediated immunity** A type of specific immune response in which B cells differentiate into plasma cells and produce antibodies that bind with foreign antigens, leading to the destruction of pathogens. Compare with *cell-mediated immunity*.
- anticodon** (an'tee-koh'don) A sequence of three nucleotides in transfer RNA that is complementary to, and combines with, the three-nucleotide codon.
- antidiuretic hormone (ADH)** (an'ty-dy-uh-ret'ik) A hormone secreted by the posterior lobe of the pituitary that controls the rate of water reabsorption by the kidney.
- antigen** (an'tih-jen) Any molecule, usually a protein or large carbohydrate, that is specifically recognized as foreign by cells of the immune system.
- antigen-antibody complex** The combination of antigen and antibody molecules.
- antigen-presenting cell (APC)** A cell that displays foreign antigens as well as its own surface proteins. Dendritic cells, macrophages, and B cells are APCs.
- antimicrobial peptides** Soluble molecules that destroy pathogens.
- anti-oncogene** See *tumor suppressor gene*.
- antioxidants** Certain enzymes (e.g., catalase and peroxidase), vitamins, and other substances that destroy free radicals and other reactive molecules. Compare with *oxidants*.
- antiparallel** Said of a double-stranded nucleic acid in which the 5' to 3' direction of the sugar-phosphate backbone of one strand is reversed in the other strand.
- anus** (ay'nus) The distal end and outlet of the digestive tract.
- aorta** (ay-or'tah) The largest and main systemic artery of the vertebrate body; arises from the left ventricle and branches to distribute blood to all parts of the body except the lungs.
- aphotic region** (ay-fote'ik) The lower layer of the ocean (deeper than 100 m or so) where light does not penetrate.
- apical dominance** (ape'ih-kl) The inhibition of lateral buds by a shoot tip.
- apical meristem** (mehr'ih-stem) An area of dividing tissue, located at the tip of a shoot or root, that gives rise to primary tissues; apical meristems cause an increase in the length of the plant body. Compare with *lateral meristems*.
- apicomplexans** A group of parasitic protozoa that lack structures for locomotion and that produce sporozoites as infective agents; malaria is caused by an apicomplexan. Also called *sporozoa*.
- apoenzyme** (ap'oh-en'zime) Protein portion of an enzyme; requires the presence of a specific coenzyme to become a complete functional enzyme.
- apomixis** (ap'uh-mix'us) A type of reproduction in which fruits and seeds are formed asexually.
- apoplast** A continuum consisting of the interconnected, porous plant cell walls, along which water moves freely. Compare with *symplast*.
- apoptosis** (ap-uh-toe'sis) Programmed cell death; apoptosis is a normal part of an organism's development and maintenance. Compare with *necrosis*.

- aposematic coloration** The conspicuous coloring of a poisonous or distasteful organism that enables potential predators to easily see and recognize it. Also called *warning coloration*. Compare with *cryptic coloration*.
- aquaporin** One of a family of transport proteins located in the plasma membrane that facilitate the rapid movement of water molecules into or out of cells.
- arachnids** (ah-rack'nidz) Eight-legged arthropods, such as spiders, scorpions, ticks, and mites.
- arachnoid** The middle of the three meningeal layers that cover and protect the brain and spinal cord; see *pia mater* and *dura mater*.
- archaea** (ar'key-ah) Prokaryotic organisms with a number of features, such as the absence of peptidoglycan in their cell walls, that set them apart from the bacteria. Archaea is the name of one of the two prokaryotic domains. Compare with *bacteria*.
- Archaean eon** The period of Earth's history from its beginnings approximately 4.6 billion up to 2.5 billion years ago; life originated during the Archaean.
- archaic *Homo sapiens*** Regionally diverse descendants of *H. erectus* or *H. ergaster* that lived in Africa, Asia, and Europe from about 400,000 to 200,000 years ago.
- archegonium** (ar'ke-go'nee-um) (pl., *archegonia*) In plants, the multicellular female gametangium (sex organ) that contains an egg. Compare with *antheridium*.
- archenteron** (ark-en'ter-on) The central cavity of the gastrula stage of embryonic development that is lined with endoderm; primitive digestive system.
- arctic tundra** See *tundra*.
- arterial pulse** See *pulse, arterial*.
- arteriole** (ar-teer'ee-ole) A very small artery. Vasoconstriction and vasodilation of arterioles help regulate blood pressure.
- artery** A thick-walled blood vessel that carries blood away from a heart chamber and toward the body organs. Compare with *vein*.
- arthropod** (ar'throh-pod) An invertebrate that belongs to phylum Arthropoda; characterized by a hard exoskeleton; a segmented body; and paired, jointed appendages.
- artificial insemination** The impregnation of a female by artificially introducing sperm from a male.
- artificial selection** The selection by humans of traits that are desirable in plants or animals and breeding only those individuals that have the desired traits.
- ascocarp** (ass'koh-karp) The fruiting body of an ascomycete.
- ascomycete** (ass'koh-my'seat) Member of a phylum of fungi characterized by the production of nonmotile asexual conidia and sexual ascospores.
- ascospore** (ass'koh-spor) One of a set of sexual spores, usually eight, contained in a special spore case (an ascus) of an ascomycete.
- ascus** (ass'kus) A saclike spore case in ascomycetes that contains sexual spores called *ascospores*.
- asexual reproduction** Reproduction in which there is no fusion of gametes and in which the genetic makeup of parent and of offspring is usually identical. Compare with *sexual reproduction*.
- assimilation (of nitrogen)** The conversion of inorganic nitrogen (nitrate, NO_3^- , or ammonia, NH_3) to the organic molecules of living things; part of the nitrogen cycle.
- association areas** Areas of the brain that link sensory and motor areas; responsible for thought, learning, memory, language abilities, judgment, and personality.
- association neuron** See *interneuron*.
- assortative mating** Sexual reproduction in which individuals pair nonrandomly, i.e., select mates on the basis of phenotype.
- asters** Clusters of microtubules radiating out from the poles in dividing cells that have centrioles.
- astrocyte** A type of glial cell; some are phagocytic; others regulate the composition of the extracellular fluid in the central nervous system.
- atherosclerosis** (ath'ur-oh-skle-row'sis) A progressive disease in which lipid deposits accumulate in the inner lining of arteries, leading eventually to impaired circulation and heart disease.
- atom** The smallest quantity of an element that retains the chemical properties of that element.
- atomic mass** The total number of protons and neutrons in an atom; expressed in atomic mass units or daltons.
- atomic mass unit (amu)** The approximate mass of a proton or neutron; also called a *dalton*.
- atomic number** The number of protons in the atomic nucleus of an atom, which uniquely identifies the element to which the atom corresponds.
- ATP** See *adenosine triphosphate*.
- ATP synthase** Large enzyme complex that catalyzes the formation of ATP from ADP and inorganic phosphate by chemiosmosis; located in the inner mitochondrial membrane, the thylakoid membrane of chloroplasts, and the plasma membrane of bacteria.
- atrial natriuretic peptide (ANP)** A hormone released by the atrium of the heart; helps regulate sodium excretion and lowers blood pressure.
- atrioventricular (AV) node** (ay'tree-oh-ven-trik'you-lur) Mass of specialized cardiac tissue that receives an impulse from the sinoatrial node (pacemaker) and conducts it to the ventricles.
- atrioventricular (AV) valve (of the heart)** A valve between each atrium and its ventricle that prevents backflow of blood. The right AV valve is the tricuspid valve; the left AV valve is the mitral valve.
- atrium (of the heart)** (ay'tree-um) A heart chamber that receives blood from the veins.
- australopithecines** Early hominids that lived between about 4 mya and 1 mya, based on fossil evidence. Includes several species in two genera, *Ardipithecus* and *Australopithecus*.
- autocrine regulation** A type of regulation in which a signaling molecule (e.g., a hormone) is secreted into interstitial fluid and then acts on the cells that produce it. Compare with *paracrine regulation*.
- autoimmune disease** (aw'toh-ih-mune') A disease in which the body produces antibodies against its own cells or tissues. Also called *autoimmunity*.
- autonomic nervous system** (aw-tuh-nom'ik) The portion of the peripheral nervous system that controls the visceral functions of the body, e.g., regulates smooth muscle, cardiac muscle, and glands. Its divisions are the sympathetic and parasympathetic nervous systems. Compare with *somatic nervous system*.
- autopolyploid** A polyploid whose chromosomes are derived from a single species. Compare with *allopolyploid*.
- autoradiography** Method for detecting radioactive decay; radiation causes the appearance of dark silver grains in special X-ray film.
- autosome** (aw'toh-sohm) A chromosome other than the sex (X and Y) chromosomes.
- autotroph** (aw'toh-trof) An organism that synthesizes complex organic compounds from simple inorganic raw materials; also called *producer* or *primary producer*. Compare with *heterotroph*. See *chemoautotroph* and *photoautotroph*.
- auxin** (awk'sin) A plant hormone involved in various aspects of growth and development, such as stem elongation, apical dominance, and root formation on cuttings, e.g., indole acetic acid (IAA).

- avirulence** Properties that render an infectious agent nonlethal, i.e., unable to cause disease in its host. Compare with *virulence*.
- Avogadro's number** The number of units (6.02×10^{23}) present in one mole of any substance.
- axillary bud** A bud in the axil of a leaf. Compare with *terminal bud*.
- axon** (aks'on) The long extension of the neuron that transmits nerve impulses away from the cell body. Compare with *dendrite*.
- axopods** (aks'o-podz) Long, filamentous, cytoplasmic projections characteristic of actinopods.
- B cell (B lymphocyte)** The type of white blood cell responsible for antibody-mediated immunity. When stimulated, B cells differentiate to become plasma cells that produce antibodies. Compare with *T cell*.
- bacillus** (bah-sill'us) (pl., *bacilli*) A rod-shaped bacterium. Compare with *coccus*, *spirillum*, *vibrio*, and *spirochete*.
- background extinction** The continuous, low-level extinction of species that has occurred throughout much of the history of life. Compare with *mass extinction*.
- bacteria** (bak-teer'ee-ah) Prokaryotic organisms that have peptidoglycan in their cell walls; most are decomposers, but some are parasites and others are autotrophs. Bacteria is the name of one of the two prokaryotic domains. Compare with *archaea*.
- bacterial artificial chromosome (BAC)** Genetically engineered segments of chromosomal DNA with the ability to carry large segments of foreign DNA.
- bacteriophage** (bak-teer'ee-oh-fayj) A virus that infects a bacterium (literally, "bacteria eater"). Also called *phage*.
- balanced polymorphism** (pol"ee-mor'fizm) The presence in a population of two or more genetic variants that are maintained in a stable frequency over several generations.
- bark** The outermost covering over woody stems and roots; consists of all plant tissues located outside the vascular cambium.
- baroreceptors** (bare"oh-ree-sep'torz) Receptors within certain blood vessels that are stimulated by changes in blood pressure.
- Barr body** A condensed and inactivated X chromosome appearing as a distinctive dense spot in the interphase nucleus of certain cells of female mammals.
- basal angiosperms** (bay'sl) Three clades of angiosperms that are thought to be ancestral to all other flowering plants. Compare with *core angiosperms*.
- basal body** Structure involved in the organization and anchorage of a cilium or flagellum. Structurally similar to a centriole; each is in the form of a cylinder composed of nine triplets of microtubules (9×3 structure).
- basal metabolic rate (BMR)** The amount of energy expended by the body at resting conditions, when no food is being digested and no voluntary muscular work is being performed.
- base** (1) A substance that is a hydrogen ion (proton) acceptor; bases unite with acids to form salts. Compare with *acid*. (2) A nitrogenous base in a nucleotide or nucleic acid. See *purines* and *pyrimidines*.
- basement membrane** The thin, noncell layer of an epithelial membrane that attaches to the underlying tissues; consists of tiny fibers and polysaccharides produced by the epithelial cells.
- base-substitution mutation** A change in one base pair in DNA. See *missense mutation* and *nonsense mutation*.
- basic solution** A solution in which the concentration of hydroxide ions [OH^-] exceeds the concentration of hydrogen ions [H^+]. A basic solution has pH greater than 7. Compare with *acidic solution* and *neutral solution*.
- basidiocarp** (ba-sid'ee-o-karp) The fruiting body of a basidiomycete, e.g., a mushroom.
- basidiomycete** (ba-sid'ee-o-my'seat) Member of a phylum of fungi characterized by the production of sexual basidiospores.
- basidiospore** (ba-sid'ee-o-spor) One of a set of sexual spores, usually four, borne on a basidium of a basidiomycete.
- basidium** (ba-sid'ee-um) The clublike spore-producing organ of basidiomycetes that bears sexual spores called *basidiospores*.
- basilar membrane** The multicellular tissue in the inner ear that separates the cochlear duct from the tympanic canal; the sensory cells of the organ of Corti rest on this membrane.
- Batesian mimicry** (bate'see-un mim'ih-kree) The resemblance of a harmless or palatable species to one that is dangerous, unpalatable, or poisonous so that predators are more likely to avoid them. Compare with *Müllerian mimicry*.
- behavioral ecology** The scientific study of behavior in natural environments from the evolutionary perspective.
- behavioral isolation** A prezygotic reproductive isolating mechanism in which reproduction between similar species is prevented because each group exhibits its own characteristic courtship behavior; also called *sexual isolation*.
- bellwether species** An organism that provides an early warning of environmental damage. Examples include lichens, which are very sensitive to air pollution, and amphibians, which are sensitive to a wide variety of environmental stressors.
- benthos** (ben'thos) Bottom-dwelling sea organisms that fix themselves to one spot, burrow into the sediment, or simply walk about on the ocean floor.
- berry** A simple, fleshy fruit in which the fruit wall is soft throughout, e.g., tomato, banana, grape.
- beta (β) oxidation** Process by which fatty acids are converted to acetyl CoA before entry into the citric acid cycle.
- beta (β)-pleated sheet** A regular, folded, sheetlike type of protein secondary structure, resulting from hydrogen bonding between two different polypeptide chains or two regions of the same polypeptide chain. Compare with *alpha (α) helix*.
- biennial plant** (by-en'ee-ul) A plant that takes 2 years to complete its life cycle. Compare with *annual* and *perennial*.
- bilateral symmetry** A body shape with right and left halves that are approximately mirror images of each other. Compare with *radial symmetry*.
- bile** The fluid secreted by the liver; emulsifies fats.
- binary fission** (by'nare-ee fish'un) Equal division of a prokaryotic cell into two; a type of asexual reproduction.
- binomial system of nomenclature** (by-nome'ee-ul) System of naming a species by the combination of the genus name and a specific epithet.
- bioaccumulation** The buildup of a persistent toxic substance, such as certain pesticides, in an organism's body.
- biodiversity** See *biological diversity*.
- biofilm** An irregular layer of microorganisms embedded in the slime they secrete and concentrated at a solid or liquid surface.
- biogenic amines** A class of neurotransmitters that includes norepinephrine, serotonin, and dopamine.
- biogeochemical cycle** (bye"o-jee"o-kem'ee-kl) Process by which matter cycles from the living world to the nonliving, physical environment and back again, e.g., the carbon cycle, the nitrogen cycle, and the phosphorus cycle.
- biogeography** The study of the past and present geographic distributions of organisms.
- bioinformatics** The storage, retrieval, and comparison of biological information, particularly DNA or protein sequences within a given species and among different species.

- biological clocks** Mechanisms by which activities of organisms are adapted to regularly recurring changes in the environment. See *circadian rhythm*.
- biological diversity** The variety of living organisms considered at three levels: genetic diversity, species diversity, and ecosystem diversity. Also called *biodiversity*.
- biological magnification** The increased concentration of toxic chemicals, such as PCBs, heavy metals, and certain pesticides, in the tissues of organisms at higher trophic levels in food webs.
- biological species concept** See *species*.
- biomass** (bye'ō-mas) A quantitative estimate of the total mass, or amount, of living material in a particular ecosystem.
- biome** (by'ohm) A large, relatively distinct terrestrial region characterized by a similar climate, soil, plants, and animals, regardless of where it occurs on Earth.
- bioremediation** A method to clean up a hazardous waste site that uses microorganisms to break down toxic pollutants, or plants to selectively accumulate toxins.
- biosphere** All of Earth's living organisms, collectively.
- biotic factors** Elements of the living world that affect a particular organism, i.e., its relationships with other organisms. Compare with *abiotic factors*.
- biotic potential** See *intrinsic rate of increase*.
- bipedal** Walking on two feet.
- bipolar cell** A type of neuron in the retina of the eye; receives input from the photoreceptors (rods and cones) and synapses on ganglion cells.
- biramous appendages** Appendages with two jointed branches at their ends; characteristic of crustaceans.
- bivalent** (by-vale'ent or biv'ah-lent) See *tetrad*.
- blade** (1) The thin, expanded part of a leaf. (2) The flat, leaflike structure of certain multicellular algae.
- blastocoel** (blas'toh-seel) The fluid-filled cavity of a blastula.
- blastocyst** The mammalian blastula. See *blastula*.
- blastodisc** A small disc of cytoplasm at the animal pole of a reptile or bird egg; cleavage is restricted to the blastodisc (meroblastic cleavage).
- blastomere** A cell of an early embryo.
- blastopore** (blas'toh-pore) The primitive opening into the body cavity of an early embryo that may become the mouth (in proto-stomes) or anus (in deuterostomes) of the adult organism.
- blastula** (blas'tew-lah) In animal development, a hollow ball of cells produced by cleavage of a fertilized ovum. In mammalian development, known as a *blastocyst*.
- blood** A fluid, circulating connective tissue that transports nutrients and other materials through the bodies of many types of animals.
- blood pressure** The force exerted by blood against the inner walls of the blood vessels.
- bloom** The sporadic occurrence of huge numbers of algae in freshwater and marine ecosystems.
- body mass index (BMI)** An index of weight in relation to height; calculated by dividing the square of the weight (square kilograms) by height (meters).
- Bohr effect** Increased oxyhemoglobin dissociation due to lowered pH; occurs as carbon dioxide concentration increases.
- bolting** The production of a tall flower stalk by a plant that grows vegetatively as a rosette (growth habit with a short stem and a circular cluster of leaves).
- bond energy** The energy required to break a particular chemical bond.
- bone tissue** Principal vertebrate skeletal tissue; a type of connective tissue.
- boreal forest** (bor'ee-uhl) The northern coniferous forest biome found primarily in Canada, northern Europe, and Siberia; also called *taiga*.
- bottleneck** A sudden decrease in a population size caused by adverse environmental factors; may result in genetic drift; also called *genetic bottleneck* or *population bottleneck*.
- bottom-up processes** Control of ecosystem function by nutrient cycles and other parts of the abiotic environment. Compare with *top-down processes*.
- Bowman's capsule** A double-walled sac of cells that surrounds the glomerulus of each nephron.
- brachiopods** (bray'kee-oh-podz) The phylum of solitary marine invertebrates having a pair of shells and, internally, a pair of coiled arms with ciliated tentacles; one of the lophophorate phyla.
- brain** A concentration of nervous tissue that controls neural function; in vertebrates, the anterior, enlarged portion of the central nervous system.
- brain stem** The part of the vertebrate brain that includes the medulla, pons, and midbrain.
- branchial** Pertaining to the gills or gill region.
- brassinosteroid (BR)** One of a group of steroids that function as plant hormones and are involved in several aspects of growth and development.
- bronchiole** (brank'ee-ole) Air duct in the lung that branches from a bronchus; divides to form air sacs (alveoli).
- bronchus** (brank'us) (pl., *bronchi*) One branch of the trachea and its immediate branches within the lung.
- brown alga** One of a phylum of predominantly marine algae that are multicellular and contain the pigments chlorophyll *a* and *c*, and carotenoids, including fucoxanthin.
- bryophytes** (bry'oh-fites) Nonvascular plants including mosses, liverworts, and hornworts.
- bryozoans** Animals belonging to phylum Bryozoa, one of the three lophophorate phyla; form sessile colonies by asexual budding.
- bud** An undeveloped shoot that develops into flowers, stems, or leaves. Buds are enclosed in bud scales.
- bud scale** A modified leaf that covers and protects a dormant bud.
- bud scale scar** Scar on a twig left when a bud scale abscises from the terminal bud.
- budding** Asexual reproduction in which a small part of the parent's body separates from the rest and develops into a new individual; characteristic of yeasts and certain other organisms.
- buffer** A substance in a solution that tends to lessen the change in hydrogen ion concentration (pH) that otherwise would be produced by adding an acid or base.
- bulb** A globose, fleshy, underground bud that consists of a short stem with fleshy leaves, e.g., onion.
- bundle scar** Marks on a leaf scar left when vascular bundles of the petiole break during leaf abscission.
- bundle sheath cells** Tightly packed cells that form a sheath around the veins of a leaf.
- bundle sheath extension** Support cells that extend from the bundle sheath of a leaf vein toward the upper and/or lower epidermis.
- buttress root** A bracelike root at the base of certain trees that provides upright support.
- C₃ plant** Plant that carries out carbon fixation solely by the Calvin cycle. Compare with *C₄ plant* and *CAM plant*.
- C₄ plant** Plant that fixes carbon initially by a pathway, in which the reaction of CO₂ with phosphoenolpyruvate is catalyzed by PEP carboxylase in leaf mesophyll cells; the products are transferred to the bundle sheath cells, where the Calvin cycle takes place. Compare with *C₃ plant* and *CAM plant*.

- calcitonin** (kal-sih-toh'nin) A hormone secreted by the thyroid gland that rapidly lowers the calcium content in the blood.
- callus** (kal'us) Undifferentiated tissue formed on an explant (excised tissue or organ) in plant tissue culture.
- calmodulin** A calcium-binding protein; when bound, it alters the activity of certain enzymes or transport proteins.
- calorie** The amount of heat energy required to raise the temperature of 1g of water 1°C; equivalent to 4.184 joules. Compare with *kilocalorie*.
- Calvin cycle** Cyclic series of reactions in the chloroplast stroma in photosynthesis; fixes carbon dioxide and produces carbohydrate. See *C₃ plant*.
- calyx** (kay'liks) The collective term for the sepals of a flower.
- CAM plant** Plant that carries out crassulacean acid metabolism; carbon is initially fixed into organic acids at night in the reaction of CO₂ and phosphoenolpyruvate, catalyzed by PEP carboxylase; during the day the acids break down to yield CO₂, which enters the Calvin cycle. Compare with *C₃ plant* and *C₄ plant*.
- cambium** See *lateral meristems*.
- Cambrian Radiation** A span of 40 million years, beginning about 542 mya, during which many new animal groups appeared in the fossil record.
- cAMP** See *cyclic AMP*.
- cancer cells** See *malignant cells*.
- CAP** See *catabolite activator protein*.
- capillaries** (kap'i-lare-eez) Microscopic blood vessels in the tissues that permit exchange of materials between cells and blood.
- capillary action** The ability of water to move in small-diameter tubes as a consequence of its cohesive and adhesive properties.
- capping** See *mRNA cap*.
- capsid** Protein coat surrounding the nucleic acid of a virus.
- capsule** (1) The portion of the moss sporophyte that contains spores. (2) A simple, dry, dehiscent fruit that develops from two or more fused carpels and opens along many sutures or pores to release seeds. (3) A gelatinous coat that surrounds some bacteria.
- carbohydrate** Compound containing carbon, hydrogen, and oxygen, in the approximate ratio of C:2H:O, e.g., sugars, starch, and cellulose.
- carbon cycle** The worldwide circulation of carbon from the abiotic environment into living things and back into the abiotic environment.
- carbon fixation reactions** Reduction reactions of photosynthesis in which carbon from carbon dioxide becomes incorporated into organic molecules, leading to the production of carbohydrate. See *Calvin cycle*.
- carbonyl group** A polar functional group consisting of a carbon attached to an oxygen by a double bond; found in aldehydes and ketones.
- carboxyl group** A weakly acidic functional group; abbreviated —COOH.
- carcinogen** (kar-sin'oh-jen) An agent that causes cancer or accelerates its development.
- cardiac cycle** One complete heartbeat.
- cardiac muscle** Involuntary, striated type of muscle found in the vertebrate heart. Compare with *smooth muscle* and *skeletal muscle*.
- cardiac output** The volume of blood pumped by the left ventricle into the aorta in 1 minute.
- cardiovascular disease** Disease of the heart or blood vessels; the leading cause of death in most industrial societies.
- carnivore** (kar'ni-vor) An animal that feeds on other animals; flesh eater; also called *secondary* or *tertiary consumer*. Secondary consumers eat primary consumers (herbivores), whereas tertiary consumers eat secondary consumers.
- carotenoids** (ka-rot'n-oidz) A group of yellow to orange plant pigments synthesized from isoprene subunits; include carotenes and xanthophylls.
- carpel** (kar'pul) The female reproductive unit of a flower; carpels bear ovules. Compare with *pistil*.
- carrier-mediated active transport** Transport across a membrane of a substance from a region of low concentration to a region of high concentration; requires both a transport protein with a binding site for the specific substance and an energy source (often ATP).
- carrier-mediated transport** Any form of transport across a membrane that uses a membrane-bound transport protein with a binding site for a specific substance; includes both facilitated diffusion and carrier-mediated active transport.
- carrying capacity** The largest population that a particular habitat can support and sustain for an indefinite period, assuming there are no changes in the environment.
- cartilage** A flexible skeletal tissue of vertebrates; a type of connective tissue.
- caryopsis** See *grain*.
- Casparian strip** (kas-pare'ee-un) A band of waterproof material around the radial and transverse walls of endodermal root cells.
- caspase** Any of a group of proteolytic enzymes that are active in the early stages of apoptosis.
- catabolism** The aspect of metabolism in which complex substances are broken down to form simpler substances; catabolic reactions are particularly important in releasing chemical energy stored by the cell. Compare with *anabolism*.
- catabolite activator protein (CAP)** A positively acting regulator that becomes active when bound to cAMP; active CAP stimulates transcription of the *lac* operon and other operons that code for enzymes used in catabolic pathways.
- catalyst** (kat'ah-list) A substance that increases the speed at which a chemical reaction occurs without being used up in the reaction. Enzymes are biological catalysts.
- catecholamine** (cat'eh-kole'-ah-meen) A class of compounds including dopamine, epinephrine, and norepinephrine; these compounds serve as neurotransmitters and hormones.
- cation** A particle with one or more units of positive charge, such as a hydrogen ion (H⁺) or calcium ion (Ca²⁺). Compare with *anion*.
- CD4 T cell** See *T helper cell*.
- CD8 T cell** See *T cytotoxic cell*.
- cDNA library** A collection of recombinant plasmids that contain complementary DNA (cDNA) copies of mRNA templates. The cDNA, which lacks introns, is synthesized by reverse transcriptase. Compare with *genomic DNA library*.
- cell** The basic structural and functional unit of life, which consists of living material enclosed by a membrane.
- cell cycle** Cyclic series of events in the life of a dividing eukaryotic cell; consists of mitosis, cytokinesis, and the stages of interphase.
- cell-cycle control system** Regulatory molecules that control key events in the cell cycle; common to all eukaryotes.
- cell determination** See *determination*.
- cell differentiation** See *differentiation*.
- cell fractionation** The technique used to separate the components of cells by subjecting them to centrifugal force. See *differential centrifugation* and *density gradient centrifugation*.
- cell-mediated immunity** A type of specific immune response carried out by T cells. Compare with *antibody-mediated immunity*.

- cell plate** The structure that forms during cytokinesis in plants, separating the two daughter cells produced by mitosis.
- cell signaling** Mechanisms of communication between cells. Cells signal one another with secreted signaling molecules, or a signaling molecule on one cell combines with a receptor on another cell. See *signal transduction*.
- cell theory** The theory that the cell is the basic unit of life, of which all living things are composed, and that all cells are derived from pre-existing cells.
- cell wall** The structure outside the plasma membrane of certain cells; may contain cellulose (plant cells), chitin (most fungal cells), peptidoglycan and/or lipopolysaccharide (most bacterial cells), or other material.
- cellular respiration** See *respiration*.
- cellular slime mold** A phylum of funguslike protists whose feeding stage consists of unicellular, amoeboid organisms that aggregate to form a pseudoplasmodium during reproduction.
- cellulose** (sel'yoo-lohs) A structural polysaccharide consisting of beta glucose subunits; the main constituent of plant primary cell walls.
- Cenozoic era** A geologic era that began about 66 million years ago and extends to the present.
- center of origin** The geographic area where a given species originated.
- central nervous system (CNS)** In vertebrates, the brain and spinal cord. Compare with *peripheral nervous system*.
- centrifuge** A device used to separate cells or their components by subjecting them to centrifugal force.
- centriole** (sen'tree-ohl) One of a pair of small, cylindrical organelles lying at right angles to each other near the nucleus in the cytoplasm of animal cells and certain protist and plant cells; each centriole is in the form of a cylinder composed of nine triplets of microtubules (9×3 structure).
- centromere** (sen'tro-meer) A specialized constricted region of a chromatid; contains the kinetochore. In cells at prophase and metaphase, sister chromatids are joined in the vicinity of their centromeres.
- centrosome** (sen'tro-sowm) An organelle in animal cells that is the main microtubule-organizing center; typically contains a pair of centrioles and is important in cell division.
- cephalization** The evolution of a head; the concentration of nervous tissue and sense organs at the front end of the animal.
- cephalochordates** Members of the chordate subphylum that includes the lancelets.
- cerebellum** (ser-eh-bel'um) A convoluted subdivision of the vertebrate brain concerned with coordination of muscular movements, muscle tone, and balance.
- cerebral cortex** (ser-ee'brul kor'teks) The outer layer of the cerebrum composed of gray matter and consisting mainly of nerve cell bodies.
- cerebrospinal fluid (CSF)** The fluid that bathes the central nervous system of vertebrates.
- cerebrum** (ser-ee'brum) A large, convoluted subdivision of the vertebrate brain; in humans, it functions as the center for learning, voluntary movement, and interpretation of sensation.
- chaos** The tendency of a simple system to exhibit complex, erratic dynamics; used by some ecologists to model the state of flux displayed by some populations.
- chaparral** (shap'uh-ral') A biome with a Mediterranean climate (mild, moist winters and hot, dry summers). Chaparral vegetation is characterized by drought-resistant, small-leaved evergreen shrubs and small trees.
- chaperones** See *molecular chaperones*.
- character displacement** The tendency for two similar species to diverge (become more different) in areas where their ranges overlap; reduces interspecific competition.
- Chargaff's rules** A relationship in DNA molecules based on nucleotide composition data; the number of adenines equals the number of thymines, and the number of guanines equals the number of cytosines.
- chelicerae** (keh-lis'er-ee) The first pair of appendages in certain arthropods; clawlike appendages located immediately anterior to the mouth and used to manipulate food into the mouth.
- chemical bond** A force of attraction between atoms in a compound. See *covalent bond*, *hydrogen bond*, and *ionic bond*.
- chemical compound** Two or more elements combined in a fixed ratio.
- chemical evolution** The origin of life from nonliving matter.
- chemical formula** A representation of the composition of a compound; the elements are indicated by chemical symbols with subscripts to indicate their ratios. See *molecular formula*, *structural formula*, and *simplest formula*.
- chemical symbol** The abbreviation for an element; usually the first letter (or first and second letters) of the English or Latin name.
- chemiosmosis** Process by which phosphorylation of ADP to form ATP is coupled to the transfer of electrons down an electron transport chain; the electron transport chain powers proton pumps that produce a proton gradient across the membrane; ATP is formed as protons diffuse through transmembrane channels in ATP synthase.
- chemoautotroph** (kee'moh-aw'toh-trof) Organism that obtains energy from inorganic compounds and synthesizes organic compounds from inorganic raw materials; includes some bacteria. Compare with *photoautotroph*, *photoheterotroph*, and *chemoheterotroph*.
- chemoheterotroph** (kee'moh-het'ur-oh-trof) Organism that uses organic compounds as a source of energy and carbon; includes animals, fungi, and many bacteria. Compare with *photoautotroph*, *photoheterotroph*, and *chemoautotroph*.
- chemoreceptor** (kee'moh-ree-sep'tor) A sensory receptor that responds to chemical stimuli.
- chemotroph** (kee'moh-trof) Organism that uses organic compounds or inorganic substances, such as iron, nitrate, ammonia, or sulfur, as sources of energy. Compare with *phototroph*. See *chemoautotroph* and *chemoheterotroph*.
- chiasma** (ky-az'muh) (pl., *chiasmata*) An X-shaped site in a tetrad (bivalent) usually marking the location where homologous (non-sister) chromatids previously crossed over.
- chimera** (ky-meer'uh) An organism consisting of two or more kinds of genetically dissimilar cells.
- chitin** (ky'tin) A nitrogen-containing structural polysaccharide that forms the exoskeleton of insects and the cell walls of many fungi.
- chlorophyll** (klor'oh-fil) A group of light-trapping green pigments found in most photosynthetic organisms.
- chlorophyll-binding proteins** About 15 different proteins associated with chlorophyll molecules in the thylakoid membrane.
- chloroplasts** (klor'oh-plastz) Membranous organelles that are the sites of photosynthesis in eukaryotes; occur in some plant and algal cells.
- cholinergic neuron** (kohl'in-air'jik) A neuron that releases acetylcholine as a neurotransmitter. Compare with *adrenergic neuron*.
- chondrichthyes** (kon-drik'-thees) The class of cartilaginous fishes that includes the sharks, rays, and skates.
- chondrocytes** Cartilage cells.

- chordates** (kor' dates) Deuterostome animals that, at some time in their lives, have a cartilaginous, dorsal skeletal structure called a *notochord*; a dorsal, tubular, nerve cord; pharyngeal gill grooves; and a postanal tail.
- chorion** (kor' ee-on) An extraembryonic membrane in reptiles, birds, and mammals that forms an outer cover around the embryo, and in mammals contributes to the formation of the placenta.
- chorionic villus sampling (CVS)** (kor' ee-on' ik) Study of extraembryonic cells that are genetically identical to the cells of an embryo, making it possible to assess its genetic makeup. Compare with *amniocentesis*.
- choroid layer** A layer of cells filled with black pigment that absorbs light and prevents reflected light from blurring the image that falls on the retina; the layer of the eyeball outside the retina.
- chromatid** (kroh' mah-tid) One of the two identical halves of a duplicated chromosome; the two chromatids that make up a chromosome are referred to as *sister chromatids*.
- chromatin** (kro' mah-tin) The complex of DNA and protein that makes up eukaryotic chromosomes.
- chromoplasts** Pigment-containing plastids; usually found in flowers and fruits.
- chromosome theory of inheritance** A basic principle in biology that states that inheritance can be explained by assuming that genes are linearly arranged in specific locations along the chromosomes.
- chromosomes** Structures in the cell nucleus that consist of chromatin and contain the genes. The chromosomes become visible under the microscope as distinct structures during cell division.
- chylomicrons** (kie-low-my' kronz) Protein-covered fat droplets produced in the intestinal cells; they enter the lymphatic system and are transported to the blood.
- chytrid** See *chytridiomycete*.
- chytridiomycete** (ki-trid' ee-o-my' seat) A member of a phylum of fungi characterized by the production of flagellate cells at some stage in their life history. Also called *chytrid*.
- ciliate** (sil' e-ate) A unicellular protozoon covered by many short cilia.
- cilium** (sil' ee-um) (pl., *cilia*) One of many short, hairlike structures that project from the surface of some eukaryotic cells and are used for locomotion or movement of materials across the cell surface.
- circadian rhythm** (sir-kay' dee-un) An internal rhythm that approximates the 24-hour day. See *biological clocks*.
- circulatory system** The body system that functions in internal transport and protects the body from disease.
- cisternae** (sing., *cisterna*) Stacks of flattened membranous sacs that make up the Golgi complex.
- citrate (citric acid)** A six-carbon organic acid.
- citric acid cycle** Series of chemical reactions in aerobic respiration in which acetyl coenzyme A is completely degraded to carbon dioxide and water with the release of metabolic energy that is used to produce ATP; also known as the *Krebs cycle* and the *tricarboxylic acid (TCA) cycle*.
- clade** A group of organisms containing a common ancestor and all its descendants; a monophyletic group.
- cladistics** An approach to classification based on recency of common ancestry rather than degree of structural similarity. Also called *phylogenetic systematics*. Compare with *phenetics* and *evolutionary systematics*.
- cladogram** A branching diagram that illustrates taxonomic relationships based on the principles of cladistics.
- class** A taxonomic category made up of related orders.
- classical conditioning** A type of learning in which an association is formed between some normal response to a stimulus and a new stimulus, after which the new stimulus elicits the response.
- cleavage** Series of mitotic cell divisions, without growth, that converts the zygote to a multicellular blastula.
- cleavage furrow** A constricted region of the cytoplasm that forms and progressively deepens during cytokinesis of animal cells, thereby separating the two daughter cells.
- cline** Gradual change in phenotype and genotype frequencies among contiguous populations that is the result of an environmental gradient.
- clitoris** (klit' o-ris) A small, erectile structure at the anterior part of the vulva in female mammals; homologous to the male penis.
- cloaca** (klow-a' ka) An exit chamber in some animals that receives digestive wastes and urine; may also serve as an exit for gametes.
- clonal selection** Lymphocyte activation in which a specific antigen causes activation, cell division, and differentiation only in cells that express receptors with which the antigen binds.
- clone** (1) A population of cells descended by mitotic division from a single ancestral cell. (2) A population of genetically identical organisms asexually propagated from a single individual. Also see *DNA cloning*.
- cloning** The process of forming a clone.
- closed circulatory system** A type of circulatory system in which the blood flows through a continuous circuit of blood vessels; characteristic of annelids, cephalopods, and vertebrates. Compare with *open circulatory system*.
- closed system** An entity that does not exchange energy with its surroundings. Compare with *open system*.
- club mosses** A phylum of seedless vascular plants with a life cycle similar to that of ferns.
- clumped dispersion** The spatial distribution pattern of a population in which individuals are more concentrated in specific parts of the habitat. Also called *aggregated distribution* and *patchiness*. Compare with *random dispersion* and *uniform dispersion*.
- cnidarians** (ni-dah' ree-anz) Phylum of animals that have stinging cells called *cnidocytes*, two tissue layers, and radial symmetry; include hydras and jellyfish.
- cnidocytes** Stinging cells characteristic of cnidarians.
- coated pit** A depression in the plasma membrane, the cytosolic side of which is coated with the protein clathrin; important in receptor-mediated endocytosis.
- cochlea** (koke' lee-ah) The structure of the inner ear of mammals that contains the auditory receptors (organ of Corti).
- coccus** (kok' us) (pl., *cocci*) A bacterium with a spherical shape. Compare with *bacillus*, *spirillum*, *vibrio*, and *spirochete*.
- codominance** (koh' dom' in-ants) Condition in which two alleles of a locus are expressed in a heterozygote.
- codon** (koh' don) A triplet of mRNA nucleotides. The 64 possible codons collectively constitute a universal genetic code in which each codon specifies an amino acid in a polypeptide, or a signal to either start or terminate polypeptide synthesis.
- coelacanth** A genus of lobe-finned fishes that have survived to the present day.
- coelom** (see' lum) The main body cavity of most animals; a true coelom is lined with mesoderm. Compare with *pseudocoelom*.
- coelomate** (seel' oh-mate) Animal that has a true coelom. Compare with *acoelomate* and *pseudocoelomate*.
- coenocyte** (see' no-site) An organism consisting of a multinucleate cell, i.e., the nuclei are not separated from one another by septa.

- coenzyme** (koh-en'zime) An organic cofactor for an enzyme; generally participates in the reaction by transferring some component, such as electrons or part of a substrate molecule.
- coenzyme A (CoA)** Organic cofactor responsible for transferring groups derived from organic acids.
- coevolution** The reciprocal adaptation of two or more species that occurs as a result of their close interactions over a long period.
- cofactor** A nonprotein substance needed by an enzyme for normal activity; some cofactors are inorganic (usually metal ions); others are organic (coenzymes).
- cohesion** The property of sticking together. Compare with *adhesion*.
- cohort** A group of individuals of the same age.
- colchicine** A drug that blocks the division of eukaryotic cells by binding to tubulin subunits, which make up the microtubules, the major component of the mitotic spindle.
- coleoptile** (kol-ee-op'tile) A protective sheath that encloses the young stem in certain monocots.
- collagens** (kol'ah-gen) Proteins found in the collagen fibers of connective tissues.
- collecting duct** A tube in the kidney that receives filtrate from several nephrons and conducts it to the renal pelvis.
- collenchyma** (kol-en'kih-mah) Living cells with moderately but unevenly thickened primary cell walls; collenchyma cells help support the herbaceous plant body.
- colony** An association of loosely connected cells or individuals of the same species.
- commensalism** (kuh-men'sul-izm) A type of symbiosis in which one organism benefits and the other one is neither harmed nor helped. Compare with *mutualism* and *parasitism*.
- commercial harvest** The collection of commercially important organisms from the wild. Examples include the commercial harvest of parrots (for the pet trade) and cacti (for houseplants).
- community** An association of populations of different species living together in a defined habitat with some degree of interdependence. Compare with *ecosystem*.
- community ecology** The description and analysis of patterns and processes within the community.
- compact bone** Dense, hard bone tissue found mainly near the surfaces of a bone.
- companion cell** A cell in the phloem of flowering plants that governs loading and unloading sugar into the sieve tube element for translocation.
- compass sense** The sense of direction an animal requires to travel in a straight line toward a destination.
- competition** The interaction among two or more individuals that attempt to use the same essential resource, such as food, water, sunlight, or living space. See *interspecific* and *intraspecific competition*. See *interference* and *exploitation competition*.
- competitive exclusion principle** The concept that no two species with identical living requirements can occupy the same ecological niche indefinitely.
- competitive inhibitor** A substance that binds to the active site of an enzyme, thus lowering the rate of the reaction catalyzed by the enzyme. Compare with *noncompetitive inhibitor*.
- complement** A group of proteins in blood and other body fluids that are activated by an antigen-antibody complex and then destroy pathogens.
- complementary DNA (cDNA)** DNA synthesized by reverse transcriptase, using RNA as a template.
- complete flower** A flower that has all four parts: sepals, petals, stamens, and carpels. Compare with *incomplete flower*.
- compound eye** An eye, such as that of an insect, consisting of many light-sensitive units called *ommatidia*.
- concentration gradient** A difference in the concentration of a substance from one point to another, as for example, across a cell membrane.
- condensation synthesis** A reaction in which two monomers are combined covalently through the removal of the equivalent of a water molecule. Compare with *hydrolysis*.
- cone** (1) In botany, a reproductive structure in many gymnosperms that produces either microspores or megaspores. (2) In zoology, one of the conical photoreceptive cells of the retina that is particularly sensitive to bright light and, by distinguishing light of various wavelengths, mediates color vision. Compare with *rod*.
- conidiophore** (kah-nid'e-o-for") A specialized hypha that bears conidia.
- conidium** (kah-nid'e-um) (pl., *conidia*) An asexual spore that is usually formed at the tip of a specialized hypha called a *conidiophore*.
- conifer** (kon'ih-fur) Any of a large phylum of gymnosperms that are woody trees and shrubs with needlelike, mostly evergreen leaves and with seeds in cones.
- conjugation** (kon'jew-gay'shun) (1) A sexual process in certain protists that involves exchange or fusion of a cell with another cell. (2) A mechanism for DNA exchange in bacteria that involves cell-to-cell contact.
- connective tissue** Animal tissue consisting mostly of intercellular substance (fibers scattered through a matrix) in which the cells are embedded, e.g., bone.
- conservation biology** A multidisciplinary science that focuses on the study of how humans impact organisms and on the development of ways to protect biological diversity.
- constitutive gene** A gene that is constantly transcribed.
- consumer** See *heterotroph*.
- consumption overpopulation** A situation in which each individual in a human population consumes too large a share of resources; results in pollution, environmental degradation, and resource depletion. Compare with *people overpopulation*.
- contest competition** See *interference competition*.
- continental drift** The theory that continents were once joined and later split and drifted apart.
- contraception** Any method used to intentionally prevent pregnancy.
- contractile root** (kun-trak'til) A specialized type of root that contracts and pulls a bulb or corm deeper into the soil.
- contractile vacuole** A membrane-enclosed organelle found in certain freshwater protists, such as *Paramecium*; appears to have an osmoregulatory function.
- control group** In a scientific experiment, a group in which the experimental variable is kept constant. The control provides a standard of comparison used to verify the results of the experiment.
- controlled mating** A mating in which the genotypes of the parents are known.
- convergent circuit** (kun-vur'jent) A neural pathway in which a postsynaptic neuron is controlled by signals coming from two or more presynaptic neurons. Compare with *divergent circuit*.
- convergent evolution** (kun-vur'jent) The independent evolution of structural or functional similarity in two or more distantly related species, usually as a result of adaptations to similar environments.
- core angiosperms** The clade to which most angiosperm species belong. Core angiosperms are divided into three subclades: magnoliids, monocots, and eudicots. Compare with *basal angiosperms*.
- corepressor** Substance that binds to a repressor protein, converting it to its active form, which is capable of preventing transcription.
- Coriolis effect** (kor'e-o'lis) The tendency of moving air or water to be deflected from its path to the right in the Northern Hemi-

- sphere and to the left in the Southern Hemisphere. Caused by the direction of Earth's rotation.
- cork cambium** (kam'bee-um) A lateral meristem that produces cork cells and cork parenchyma; cork cambium and the tissues it produces make up the outer bark of a woody plant. Compare with *vascular cambium*.
- cork cell** A cell in the bark that is produced outwardly by the cork cambium; cork cells are dead at maturity and function for protection and reduction of water loss.
- cork parenchyma** (par-en'kih-mah) One or more layers of parenchyma cells produced inwardly by the cork cambium.
- corn** A short, thickened underground stem specialized for food storage and asexual reproduction, e.g., crocus, gladiolus.
- cornea** (kor'nee-ah) The transparent covering of an eye.
- corolla** (kor-ohl'ah) Collectively, the petals of a flower.
- corpus callosum** (kah-loh'sum) In mammals, a large bundle of nerve fibers interconnecting the two cerebral hemispheres.
- corpus luteum** (loo'tee'um) The temporary endocrine tissue in the ovary that develops from the ruptured follicle after ovulation; secretes progesterone and estrogen.
- cortex** (kor'teks) (1) The outer part of an organ, such as the cortex of the kidney. Compare with *medulla*. (2) The tissue between the epidermis and vascular tissue in the stems and roots of many herbaceous plants.
- cortical reaction** Process occurring after fertilization that prevents additional sperm from entering the egg; also known as the "slow block to polyspermy."
- cortisol** A steroid hormone, secreted by the adrenal cortex, that helps the body adjust to long-term stress; stimulates conversion of other nutrients to glucose in the liver, resulting in increased blood glucose concentration.
- cosmid cloning vector** A cloning vector with features of both bacteriophages and plasmids and with the ability to carry large segments of foreign DNA.
- cosmopolitan species** Species that have a nearly worldwide distribution and occur on more than one continent or throughout much of the ocean. Compare with *endemic species*.
- cotransport** The active transport of a substance from a region of low concentration to a region of high concentration by coupling its transport to the transport of a substance down its concentration gradient.
- cotyledon** (kot'uh-lee'dun) The seed leaf of a plant embryo, which may contain food stored for germination.
- cotylosaurs** The first reptiles; also known as *stem reptiles*.
- countercurrent exchange system** A biological mechanism that enables maximum exchange between two fluids. The two fluids must be flowing in opposite directions and have a concentration gradient between them.
- coupled reactions** A set of reactions in which an exergonic reaction provides the free energy required to drive an endergonic reaction; energy coupling generally occurs through a common intermediate.
- covalent bond** The chemical bond involving shared pairs of electrons; may be single, double, or triple (with one, two, or three shared pairs of electrons, respectively). Compare with *ionic bond* and *hydrogen bond*.
- covalent compound** A compound in which atoms are held together by covalent bonds; covalent compounds consist of molecules. Compare with *ionic compound*.
- cranial nerves** The 10 to 12 pairs of nerves in vertebrates that emerge directly from the brain.
- cranium** The bony framework that protects the brain in vertebrates.
- crassulacean acid metabolism** See *CAM plant*.
- creatine phosphate** An energy-storing compound in muscle cells.
- cretinism** (kree'tin-izm) A chronic condition caused by lack of thyroid secretion during fetal development and early childhood; results in retarded physical and mental development if untreated.
- cri du chat syndrome** A human genetic disease caused by losing part of the short arm of chromosome 5 and characterized by mental retardation, a cry that sounds like a kitten mewling, and death in infancy or childhood.
- cristae** (kris'tee) (sing., *crista*) Shelflike or fingerlike inward projections of the inner membrane of a mitochondrion.
- Cro-Magnons** Prehistoric humans (*Homo sapiens*) with modern features (tall, erect, lacking a heavy brow) who lived in Europe some 30,000 years ago.
- cross bridges** The connections between myosin and actin filaments in muscle fibers; formed by the binding of myosin heads to active sites on actin filaments.
- crossing-over** A process in which genetic material (DNA) is exchanged between paired, homologous chromosomes.
- cryptic coloration** Colors or markings that help some organisms hide from predators by blending into their physical surroundings. Compare with *aposematic coloration*.
- cryptochrome** A proteinaceous pigment that strongly absorbs blue light; implicated in resetting the biological clock in plants, fruit flies, and mice.
- ctenophores** (ten'oh-forz) Phylum of marine animals (comb jellies) whose bodies consist of two layers of cells enclosing a gelatinous mass. The outer surface is covered with comblike rows of cilia, by which the animal moves.
- cuticle** (kew'tih-kl) (1) A noncell, waxy covering over the epidermis of the aerial parts of plants that reduces water loss. (2) The outer covering of some animals, such as roundworms.
- cyanobacteria** (sy-an'oh-bak-teer'ee-uh) Prokaryotic photosynthetic microorganisms that possess chlorophyll and produce oxygen during photosynthesis. Formerly known as blue-green algae.
- cycad** (sih'kad) Any of a phylum of gymnosperms that live mainly in tropical and semitropical regions and have stout stems (to 20 m in height) and fernlike leaves.
- cyclic AMP (cAMP)** A form of adenosine monophosphate in which the phosphate is part of a ring-shaped structure; acts as a regulatory molecule and second messenger in organisms ranging from bacteria to humans.
- cyclic electron transport** In photosynthesis, the cyclic flow of electrons through photosystem I; ATP is formed by chemiosmosis, but no photolysis of water occurs, and O₂ and NADPH are not produced. Compare with *noncyclic electron transport*.
- cyclin-dependent kinases (Cdks)** Protein kinases involved in controlling the cell cycle.
- cyclins** Regulatory proteins whose levels oscillate during the cell cycle; activate cyclin-dependent kinases.
- cystic fibrosis** A genetic disease with an autosomal recessive inheritance pattern; characterized by secretion of abnormally thick mucus, particularly in the respiratory and digestive systems.
- cytochromes** (sy'toh-kroh-mz) Iron-containing heme proteins of an electron transport system.
- cytokines** Signaling proteins that regulate interactions between cells in the immune system. Important groups include interferons, interleukins, tumor necrosis factors, and chemokines.
- cytokinesis** (sy'toh-kih-nee'sis) Stage of cell division in which the cytoplasm divides to form two daughter cells.
- cytokinin** (sy'toh-ky'nin) A plant hormone involved in various aspects of plant growth and development, such as cell division and delay of senescence.

- cytoplasm** The plasma membrane and cell contents with the exception of the nucleus.
- cytosine** A nitrogenous pyrimidine base that is a component of nucleic acids.
- cytoskeleton** The dynamic internal network of protein fibers that includes microfilaments, intermediate filaments, and microtubules.
- cytosol** The fluid component of the cytoplasm in which the organelles are suspended.
- cytotoxic T cell** See *T cytotoxic cell*.
- dalton** See *atomic mass unit (amu)*.
- day-neutral plant** A plant whose flowering is not controlled by variations in day length that occur with changing seasons. Compare with *long-day*, *short-day*, and *intermediate-day plants*.
- deamination** (dee-am-ih-nay'shun) The removal of an amino group ($-\text{NH}_2$) from an amino acid or other organic compound.
- decarboxylation** A reaction in which a molecule of CO_2 is removed from a carboxyl group of an organic acid.
- deciduous** A term describing a plant that sheds leaves or other structures at regular intervals, e.g., during autumn. Compare with *evergreen*.
- decomposers** Microbial heterotrophs that break down dead organic material and use the decomposition products as a source of energy. Also called *saprotrophs* or *saprobies*.
- deductive reasoning** The reasoning that operates from generalities to specifics and can make relationships among data more apparent. Compare with *inductive reasoning*. See *hypothetico-deductive approach*.
- deforestation** The temporary or permanent removal of forest for agriculture or other uses.
- dehydrogenation** (dee-hy"dro-jen-ay'shun) A form of oxidation in which hydrogen atoms are removed from a molecule.
- deletion** (1) A chromosome abnormality in which part of a chromosome is missing, e.g., cri du chat syndrome. (2) The loss of one or more base pairs from DNA, which can result in a frameshift mutation.
- demographics** The science that deals with human population statistics, such as size, density, and distribution.
- denature** (dee-nay'ture) To alter the physical properties and three-dimensional structure of a protein, nucleic acid, or other macromolecule by treating it with excess heat, strong acids, or strong bases.
- dendrite** (den'drite) A branch of a neuron that receives and conducts nerve impulses toward the cell body. Compare with *axon*.
- dendritic cells** A set of immune cells present in many tissues that capture antigens and present them to T cells.
- dendrochronology** (den"dro-kruh-naal'uh-gee) A method of dating using the annual rings of trees.
- denitrification** (dee-nie"tra-fuh-kay'shun) The conversion of nitrate (NO_3^-) to nitrogen gas (N_2) by certain bacteria (denitrifying bacteria) in the soil; part of the nitrogen cycle.
- dense connective tissue** A type of tissue that may be irregular, as in the dermis of the skin, or regular, as in tendons.
- density-dependent factor** An environmental factor whose effects on a population change as population density changes; tends to retard population growth as population density increases and enhance population growth as population density decreases. Compare with *density-independent factor*.
- density gradient centrifugation** Procedure in which cell components are placed in a layer on top of a density gradient, usually a sucrose solution and water. Cell structures migrate during centrifugation, forming a band at the position in the gradient where their own density equals that of the sucrose solution.
- density-independent factor** An environmental factor that affects the size of a population but is not influenced by changes in population density. Compare with *density-dependent factor*.
- deoxyribonucleic acid (DNA)** Double-stranded nucleic acid; contains genetic information coded in specific sequences of its constituent nucleotides.
- deoxyribose** Pentose sugar lacking a hydroxyl ($-\text{OH}$) group on carbon-2'; a constituent of DNA.
- depolarization** (dee-pol"ar-ih-zay'shun) A decrease in the charge difference across a plasma membrane; may result in an action potential in a neuron or muscle cell.
- derived characters** See *shared derived characters*.
- dermal tissue system** The tissue that forms the outer covering over a plant; the epidermis or periderm.
- dermis** (dur'mis) The layer of dense connective tissue beneath the epidermis in the skin of vertebrates.
- desert** A temperate or tropical biome in which lack of precipitation limits plant growth.
- desertification** The degradation of once-fertile land into nonproductive desert; caused partly by soil erosion, deforestation, and overgrazing by domestic animals.
- desmosomes** (dez'moh-sohmz) Buttonlike plaques, present on two opposing cell surfaces, that hold the cells together by means of protein filaments that span the intercellular space.
- determinate growth** Growth of limited duration, as for example, in flowers and leaves. Compare with *indeterminate growth*.
- determination** The developmental process by which one or more cells become progressively committed to a particular fate. Determination is a series of molecular events usually leading to differentiation. Also called *cell determination*.
- detritivore** (duh-try'tuh-vore) An organism, such as an earthworm or crab, that consumes fragments of freshly dead or decomposing organisms; also called *detritus feeder*.
- detritus** (duh-try'tus) Organic debris from decomposing organisms.
- detritus feeder** See *detritivore*.
- deuteromycetes** (doo"ter-o-my'seats) An artificial grouping of fungi characterized by the absence of sexual reproduction but usually having other traits similar to ascomycetes; also called *imperfect fungi*.
- deuterostome** (doo'ter-oh-stome) Major division of the animal kingdom in which the anus develops from the blastopore; includes the echinoderms and chordates. Compare with *protostome*.
- development** All the progressive changes that take place throughout the life of an organism.
- diabetes mellitus** (mel'i-tus) The most common endocrine disorder. In type 1 diabetes, there is a marked decrease in the number of beta cells in the pancreas, resulting in insulin deficiency. In the more common type 2 diabetes, insulin receptors on target cells do not bind with insulin (insulin resistance).
- diacylglycerol (DAG)** (di'as-il-glis'er-ol) A lipid consisting of glycerol combined chemically with two fatty acids; also called *diglyceride*. Compare with *monoacylglycerol* and *triacylglycerol*.
- dialysis** The diffusion of certain solutes across a selectively permeable membrane.
- diaphragm** In mammals, the muscular floor of the chest cavity; contracts during inhalation, expanding the chest cavity.
- diastole** (di-ass'toh-lee) Phase of the cardiac cycle in which the heart is relaxed. Compare with *systole*.
- diatom** (die'eh-tom") A usually unicellular alga that is covered by an ornate, siliceous shell consisting of two overlapping halves; an important component of plankton in both marine and fresh waters.

- dichotomous branching** (di-kaut'uh-mus) In botany, a type of branching in which one part always divides into two more or less equal parts.
- diencephalon** See *forebrain*.
- differential centrifugation** Separation of cell particles according to their mass, size, or density. In differential centrifugation, the supernatant is spun at successively higher revolutions per minute.
- differential gene expression** The expression of different subsets of genes at different times and in different cells during development.
- differentiated cell** A specialized cell; carries out unique activities, expresses a specific set of proteins, and usually has a recognizable appearance.
- differentiation** (dif"ah-ren-she-ay'shun) Development toward a more mature state; a process changing a young, relatively unspecialized cell to a more specialized cell. Also called *cell differentiation*.
- diffusion** The net movement of particles (atoms, molecules, or ions) from a region of higher concentration to a region of lower concentration (i.e., down a concentration gradient), resulting from random motion. Compare with *facilitated diffusion* and *active transport*.
- digestion** The breakdown of food to smaller molecules.
- diglyceride** See *diacylglycerol*.
- dihybrid cross** (dy-hy'brid) A genetic cross that takes into account the behavior of alleles of two loci. Compare with *monohybrid cross*.
- dikaryotic** (dy-kare-ee-ot'ik) Condition of having two nuclei per cell (i.e., $n + n$), characteristic of certain fungal hyphae. Compare with *monokaryotic*.
- dimer** An association of two monomers (e.g., a disaccharide or a dipeptide).
- dinoflagellate** (dy"noh-flaj'eh-late) A unicellular, biflagellate, typically marine alga that is an important component of plankton; usually photosynthetic.
- dioecious** (dy-ee'shus) Having male and female reproductive structures on separate plants; compare with *monoecious*.
- dipeptide** See *peptide*.
- diploid** (dip'loyd) The condition of having two sets of chromosomes per nucleus. Compare with *haploid* and *polyploid*.
- dipomonads** Small, mostly parasitic zooflagellates with one or two nuclei, no mitochondria, and one to four flagella.
- direct fitness** An individual's reproductive success, measured by the number of viable offspring it produces. Compare with *inclusive fitness*.
- directed evolution** See *in vitro evolution*.
- directional selection** The gradual replacement of one phenotype with another because of environmental change that favors phenotypes at one of the extremes of the normal distribution. Compare with *stabilizing selection* and *disruptive selection*.
- disaccharide** (dy-sak'ah-ride) A sugar produced by covalently linking two monosaccharides (e.g., maltose or sucrose).
- disomy** The normal condition in which both members of a chromosome pair are present in a diploid cell or organism. Compare with *monosomy* and *trisomy*.
- dispersal** The movement of individuals among populations. See *immigration and emigration*.
- dispersion** The pattern of distribution in space of the individuals of a population relative to their neighbors; may be clumped, random, or uniform.
- disruptive selection** A special type of directional selection in which changes in the environment favor two or more variant phenotypes at the expense of the mean. Compare with *stabilizing selection* and *directional selection*.
- distal** Remote; farther from the point of reference. Compare with *proximal*.
- distal convoluted tubule** The part of the renal tubule that extends from the loop of Henle to the collecting duct. Compare with *proximal convoluted tubule*.
- disturbance** In ecology, any event that disrupts community or population structure.
- divergent circuit** A neural pathway in which a presynaptic neuron stimulates many postsynaptic neurons. Compare with *convergent circuit*.
- diving reflex** A group of physiological mechanisms, such as decrease in metabolic rate, that are activated when a mammal dives to its limit.
- dizygotic twins** Twins that arise from the separate fertilization of two eggs; commonly known as *fraternal twins*. Compare with *monozygotic twins*.
- DNA** See *deoxyribonucleic acid*.
- DNA cloning** The process of selectively amplifying DNA sequences so their structure and function can be studied.
- DNA fingerprinting** The analysis of DNA extracted from an individual, which is unique to that individual; also called *DNA typing*.
- DNA ligase** Enzyme that catalyzes the joining of the 5' and 3' ends of two DNA fragments; essential in DNA replication and used in recombinant DNA technology.
- DNA methylation** A process in which gene inactivation is perpetuated by enzymes that add methyl groups to DNA.
- DNA microarray** A diagnostic test involving thousands of DNA molecules placed on a glass slide or chip.
- DNA polymerases** Family of enzymes that catalyze the synthesis of DNA from a DNA template by adding nucleotides to a growing 3' end.
- DNA probe** See *genetic probe*.
- DNA provirus** Double-stranded DNA molecule that is an intermediate in the life cycle of an RNA tumor virus (retrovirus).
- DNA replication** The process by which DNA is duplicated; ordinarily a semiconservative process in which a double helix gives rise to two double helices, each with an "old" strand and a newly synthesized strand.
- DNA sequencing** Procedure by which the sequence of nucleotides in DNA is determined.
- DNA typing** See *DNA fingerprinting*.
- domain** (1) A structural and functional region of a protein. (2) The broadest taxonomic category; each domain includes one or more kingdoms.
- dominance hierarchy** A linear "pecking order" into which animals in a population may organize according to status; regulates aggressive behavior within the population.
- dominant allele** (al-leel') An allele that is always expressed when it is present, regardless of whether it is homozygous or heterozygous. Compare with *recessive allele*.
- dominant species** In a community, a species that as a result of its large biomass or abundance exerts a major influence on the distribution of populations of other species.
- dopamine** A neurotransmitter of the biogenic amine group.
- dormancy** A temporary period of arrested growth in plants or plant parts such as spores, seeds, bulbs, and buds.
- dorsal** (dor'sl) Toward the uppermost surface or back of an animal. Compare with *ventral*.
- dosage compensation** Genetic mechanism by which the expression of X-linked genes in mammals is made equivalent in XX females and XY males by rendering all but one X chromosome inactive.
- double fertilization** A process in the flowering plant life cycle in which there are two fertilizations; one fertilization results in for-

- mation of a zygote, whereas the second results in formation of endosperm
- double helix** The structure of DNA, which consists of two antiparallel polynucleotide chains twisted around each other.
- doubling time** The amount of time it takes for a population to double in size, assuming that its current rate of increase does not change.
- Down syndrome** An inherited condition in which individuals have abnormalities of the face, eyelids, tongue, and other parts of the body and are physically and mentally retarded; usually results from trisomy of chromosome 21.
- drupe** (droop) A simple, fleshy fruit in which the inner wall of the fruit is a hard stone, e.g., peach, cherry.
- duodenum** (doo"o-dee'num) The portion of the small intestine into which the contents of the stomach first enter.
- duplication** An abnormality in which a set of chromosomes contains more than one copy of a particular chromosomal segment; the translocation form of Down syndrome is an example.
- dura mater** The tough, outer meningeal layer that covers and protects the brain and spinal cord. Also see *arachnoid* and *pia mater*.
- dynamic equilibrium** The condition of a chemical reaction when the rate of change in one direction is exactly the same as the rate of change in the opposite direction, i.e., the concentrations of the reactants and products are not changing, and the difference in free energy between reactants and products is zero.
- ecdysis** Molting; shedding outer skin; common process in insects, crustaceans, snakes.
- ecdysone** (ek'dih-sone) See *molting hormone*.
- Ecdysozoa** A branch of the protostomes that includes animals that molt, such as the rotifers, nematodes, and arthropods.
- echinoderms** (eh-kine'oh-derms) Phylum of spiny-skinned marine deuterostome invertebrates characterized by a water vascular system and tube feet; include sea stars, sea urchins, and sea cucumbers.
- echo location** Determination of the position of objects by detecting echoes of high-pitched sounds emitted by an animal; a type of sensory system used by bats and dolphins.
- ecological niche** See *niche*.
- ecological pyramid** A graphical representation of the relative energy value at each trophic level. See *pyramid of biomass* and *pyramid of energy*.
- ecological succession** See *succession*.
- ecology** (ee-kol'uh-jee) A discipline of biology that studies the interrelations among living things and their environments.
- ecosystem** (ee'koh-sis-tem) The interacting system that encompasses a community and its nonliving, physical environment. Compare with *community*.
- ecosystem management** A conservation focus that emphasizes restoring and maintaining ecosystem quality rather than the conservation of individual species.
- ecosystem services** Important environmental services, such as clean air to breathe, clean water to drink, and fertile soil in which to grow crops, that ecosystems provide.
- ecotone** The transition zone where two communities meet and intergrade.
- ectoderm** (ek'toh-derm) The outer germ layer of the early embryo; gives rise to the skin and nervous system. Compare with *mesoderm* and *endoderm*.
- ectoparasite** A tick or other parasite that lives outside its host's body. Compare with *endoparasite*.
- ectotherm** An animal whose temperature fluctuates with that of the environment; may use behavioral adaptations to regulate temperature; sometimes referred to as *cold-blooded*. Compare with *endotherm*.
- edge effect** The ecological phenomenon in which ecotones between adjacent communities often contain a greater number of species or greater population densities of certain species than either adjacent community.
- Ediacaran period** (ee-dee-ack'uh-ran") The last (most recent) period of the Proterozoic eon, from 600 million to 542 million years ago; named for early animal fossils found in the Ediacara Hills in South Australia.
- effector** A muscle or gland that contracts or secretes in direct response to nerve impulses.
- efferent** (ef'fur-ent) Leading away from some point of reference. Compare with *afferent*.
- efferent neurons** Neurons that transmit action potentials from the brain or spinal cord to muscles or glands. Compare with *afferent neurons*.
- ejaculation** (ee-jak"yoo-lay'shun) A sudden expulsion, as in the ejection of semen from the penis.
- electrolyte** A substance that dissociates into ions when dissolved in water; the resulting solution can conduct an electric current.
- electron** A particle with one unit of negative charge and negligible mass, located outside the atomic nucleus. Compare with *neutron* and *proton*.
- electron configuration** The arrangement of electrons around the atom. In a Bohr model, the electron configuration is depicted as a series of concentric circles.
- electron microscope** A microscope capable of producing high-resolution, highly magnified images through the use of an electron beam (rather than light). Transmission electron microscopes (TEMs) produce images of thin sections; scanning electron microscopes (SEMs) produce images of surfaces.
- electron shell** Group of orbitals of electrons with similar energies.
- electron transport system** A series of chemical reactions during which hydrogens or their electrons are passed along an electron transport chain from one acceptor molecule to another, with the release of energy.
- electronegativity** A measure of an atom's attraction for electrons.
- electrophoresis, gel** See *gel electrophoresis*.
- electroreceptor** A receptor that responds to electrical stimuli.
- element** A substance that cannot be changed to a simpler substance by a normal chemical reaction.
- elimination** Ejection of undigested food from the body. Compare with *excretion*.
- El Niño–Southern Oscillation (ENSO)** (el nee'nyo) A recurring climatic phenomenon that involves a surge of warm water in the Pacific Ocean and unusual weather patterns elsewhere in the world.
- elongation** (in protein synthesis) Cyclic process by which amino acids are added one by one to a growing polypeptide chain. See *initiation* and *termination*.
- embryo** (em'bree-oh) (1) A young organism before it emerges from the egg, seed, or body of its mother. (2) Developing human until the end of the second month, after which it is referred to as a fetus. (3) In plants, the young sporophyte produced following fertilization and subsequent development of the zygote.
- embryo sac** The female gametophyte generation in flowering plants.
- embryo transfer** See *host mothering*.
- emergent properties** Characteristics of an object, process, or behavior that could not be predicted from its component parts; emergent properties can be identified at each level as we move up the hierarchy of biological organization.

- emigration** The movement of individuals out of a population. Compare with *immigration*.
- enantiomers** (en-an'tee-oh-merz) Two isomeric chemical compounds that are mirror images.
- end product inhibition** See *feedback inhibition*.
- endangered species** A species whose numbers are so severely reduced that it is in imminent danger of extinction throughout all or part of its range. Compare with *threatened species*.
- endemic species** Localized, native species that are not found anywhere else in the world. Compare with *cosmopolitan species*.
- endergonic reaction** (end'er-gon'ik) A nonspontaneous reaction; a reaction requiring a net input of free energy. Compare with *exergonic reaction*.
- endocrine gland** (en'doh-crin) A gland that secretes hormones directly into the blood or tissue fluid instead of into ducts. Compare with *exocrine gland*.
- endocrine system** The body system that helps regulate metabolic activities; consists of ductless glands and tissues that secrete hormones.
- endocytosis** (en'doh-sy-toh'sis) The active transport of substances into the cell by the formation of invaginated regions of the plasma membrane that pinch off and become cytoplasmic vesicles. Compare with *exocytosis*.
- endoderm** (en'doh-derm) The inner germ layer of the early embryo; becomes the lining of the digestive tract and the structures that develop from the digestive tract—liver, lungs, and pancreas. Compare with *ectoderm* and *mesoderm*.
- endodermis** (en'doh-der'mis) The innermost layer of the plant root cortex. Endodermal cells have a waterproof Casparian strip around their radial and transverse walls that ensures that water and minerals enter the xylem only by passing through the endoderm cells.
- endolymph** (en'doh-limf) The fluid of the membranous labyrinth and cochlear duct of the ear.
- endomembrane system** See *internal membrane system*.
- endometrium** (en'doh-mee'tree-um) The uterine lining.
- endoparasite** A parasite such as a tapeworm that lives within the host. Compare with *ectoparasite*.
- endoplasmic reticulum (ER)** (en'doh-plaz'mik reh-tik'yoo-lum) An interconnected network of internal membranes in eukaryotic cells enclosing a compartment, the ER lumen. Rough ER has ribosomes attached to the cytosolic surface; smooth ER, a site of lipid biosynthesis, lacks ribosomes.
- endorphins** (en-dor'finz) Neuropeptides released by certain brain neurons; block pain signals.
- endoskeleton** (en'doh-skel'eh-ton) Bony and/or cartilaginous structures within the body that provide support. Compare with *exoskeleton*.
- endosperm** (en'doh-sperm) The $3n$ nutritive tissue that is formed at some point in the development of all angiosperm seeds.
- endospore** A resting cell formed by certain bacteria; highly resistant to heat, radiation, and disinfectants.
- endostyle** In nonvertebrate chordates, a groove in the floor of the pharynx that secretes mucus and traps food particles in sea water passing through the pharynx. In vertebrates, the thyroid gland is derived from the endostyle.
- endosymbiont** (en'doe-sim'bee-ont) An organism that lives inside the body of another kind of organism. Endosymbionts may benefit their host (mutualism) or harm their host (parasitism).
- endothelium** (en-doh-theel'ee-um) The tissue that lines the cavities of the heart, blood vessels, and lymph vessels.
- endotherm** (en'doh-therm) An animal that uses metabolic energy to maintain a constant body temperature despite variations in environmental temperature; e.g., birds and mammals. Compare with *ectotherm*.
- endotoxin** A poisonous substance in the cell walls of gram-negative bacteria. Compare with *exotoxin*.
- energy** The capacity to do work; expressed in kilojoules or kilocalories.
- energy of activation** See *activation energy*.
- enhanced greenhouse effect** See *greenhouse effect*.
- enhancers** Regulatory DNA sequences that can be located long distances away from the actual coding regions of a gene.
- enkephalins** (en-kef'ah-linz) Neuropeptides released by certain brain neurons that block pain signals.
- enterocoely** (en'ter-oh-seely) The process by which the coelom forms as a cavity within mesoderm produced by outpocketings of the primitive gut (archenteron); characteristic of many deuterostomes. Compare with *schizocoely*.
- enthalpy** The total potential energy of a system; sometimes referred to as the “heat content of the system.”
- entropy** (en'trop-ee) Disorderliness; a quantitative measure of the amount of the random, disordered energy that is unavailable to do work.
- environmental resistance** Unfavorable environmental conditions, such as crowding, that prevent organisms from reproducing indefinitely at their intrinsic rate of increase.
- environmental sustainability** The ability to meet humanity's current needs without compromising the ability of future generations to meet their needs.
- enzyme** (en'zime) An organic catalyst (usually a protein) that accelerates a specific chemical reaction by lowering the activation energy required for that reaction.
- enzyme-substrate complex** The temporary association between enzyme and substrate that forms during the course of a catalyzed reaction; also called *ES complex*.
- eon** The largest division of the geologic time scale; eons are divided into eras.
- eosinophil** (ee-oh-sin'oh-fil) A type of white blood cell whose cytoplasmic granules absorb acidic stains; functions in parasitic infestations and allergic reactions.
- epidermis** (ep-ih-dur'mis) (1) An outer layer of cells that covers the body of plants and functions primarily for protection. (2) The outer layer of vertebrate skin.
- epididymis** (ep-ih-did'ih-mis) (pl., *epididymides*) A coiled tube that receives sperm from the testis and conveys it to the vas deferens.
- epigenetic inheritance** Inheritance that involves changes in how a gene is expressed without any change in that gene's nucleotide sequence.
- epiglottis** A thin, flexible structure that guards the entrance to the larynx, preventing food from entering the airway during swallowing.
- epinephrine** (ep-ih-nef'rin) Hormone produced by the adrenal medulla; stimulates the sympathetic nervous system.
- epistasis** (ep-ih-sta'-sis) Condition in which certain alleles of one locus alter the expression of alleles of a different locus.
- epithelial tissue** (ep-ih-theel'ee-al) The type of animal tissue that covers body surfaces, lines body cavities, and forms glands; also called *epithelium*.
- epoch** The smallest unit of geologic time; a subdivision of a period.
- equilibrium** See *dynamic equilibrium*, *genetic equilibrium*, and *punctuated equilibrium*.
- era** An interval of geologic time that is a subdivision of an eon; eras are divided into periods.

- erythroblastosis fetalis** (eh-rith"row-blas-toe'sis fi-tal'is) Serious condition in which Rh⁺ red blood cells (which bear antigen D) of a fetus are destroyed by maternal anti-D antibodies.
- erythrocyte** (eh-rith'row-site) A vertebrate red blood cell; contains hemoglobin, which transports oxygen.
- erythropoietin** (eh-rith"row-poy'ih-tin) A peptide hormone secreted mainly by kidney cells; stimulates red blood cell production.
- ES complex** See *enzyme–substrate complex*.
- esophagus** (e-sof'ah-gus) The part of the digestive tract that conducts food from the pharynx to the stomach.
- essential nutrient** A nutrient that must be provided in the diet because the body cannot make it or cannot make it in sufficient quantities to meet nutritional needs, e.g., essential amino acids and essential fatty acids.
- ester linkage** Covalent linkage formed by the reaction of a carboxyl group and a hydroxyl group, with the removal of the equivalent of a water molecule; the linkage includes an oxygen atom bonded to a carbonyl group.
- estivation** A state of torpor caused by lack of food or water during periods of high temperature. Compare with *hibernation*.
- estrogens** (es'troh-jenz) Female sex hormones produced by the ovary; promote the development and maintenance of female reproductive structures and of secondary sex characteristics.
- estuary** (es'choo-wear-ee) A coastal body of water that connects to an ocean, in which fresh water from the land mixes with salt water.
- ethology** (ee-thol'oh-jee) The study of animal behavior under natural conditions from the point of view of adaptation.
- ethyl alcohol** A two-carbon alcohol.
- ethylene** (eth'ih-leen) A gaseous plant hormone involved in various aspects of plant growth and development, such as leaf abscission and fruit ripening.
- euchromatin** (yoo-croh'mah-tin) A loosely coiled chromatin that is generally capable of transcription. Compare with *heterochromatin*.
- eudicot** (yoo-dy'kot) One of the two clades of flowering plants; eudicot seeds contain two cotyledons, or seed leaves. Compare with *monocot*.
- euglenoids** (yoo-gee'noidz) A group of mostly freshwater, flagellate, unicellular algae that move by means of an anterior flagellum and are usually photosynthetic.
- eukaryote** (yoo"kar'ee-ote) An organism whose cells have nuclei and other membrane-enclosed organelles. Includes protists, fungi, plants, and animals. Compare with *prokaryote*.
- euphotic zone** The upper reaches of the ocean, in which enough light penetrates to support photosynthesis.
- eustachian tube** (yoo-stay'shee-un) The auditory tube passing between the middle-ear cavity and the pharynx in vertebrates; permits the equalization of pressure on the tympanic membrane.
- eutrophic lake** A lake enriched with nutrients such as nitrate and phosphate and consequently overgrown with plants or algae.
- evergreen** A plant that sheds leaves over a long period, so some leaves are always present. Compare with *deciduous*.
- Evo Devo** The study of the evolution of the genetic control of development.
- evolution** Any cumulative genetic changes in a population from generation to generation. Evolution leads to differences in populations and explains the origin of all the organisms that exist today or have ever existed.
- evolutionary species concept** An alternative to the biological species concept in which for a population to be declared a separate species, it must have undergone evolution long enough for statistically significant differences to emerge. Compare with *species*.
- evolutionary systematics** An approach to classification that considers both evolutionary relationships and the extent of divergence that has occurred since a group branched from an ancestral group. Compare with *cladistics* and *phenetics*.
- excitatory postsynaptic potential (EPSP)** A change in membrane potential that brings a neuron closer to the firing level. Compare with *inhibitory postsynaptic potential (IPSP)*.
- excretion** (ek-skree'shun) The discharge from the body of a waste product of metabolism (not to be confused with the elimination of undigested food materials). Compare with *elimination*.
- excretory system** The body system in animals that functions in osmoregulation and in the discharge of metabolic wastes.
- exergonic reaction** (ex'er-gon"ik) A reaction characterized by a release of free energy. Also called *spontaneous reaction*. Compare with *endergonic reaction*.
- exocrine gland** (ex'oh-crin) A gland that excretes its products through a duct that opens onto a free surface, such as the skin (e.g., sweat glands). Compare with *endocrine gland*.
- exocytosis** (ex'oh-sy-toh'sis) The active transport of materials out of the cell by fusion of cytoplasmic vesicles with the plasma membrane. Compare with *endocytosis*.
- exon** (1) A protein-coding region of a eukaryotic gene. (2) The mRNA transcribed from such a region. Compare with *intron*.
- exoskeleton** (ex'oh-skel'eh-ton) An external skeleton, such as the shell of mollusks or outer covering of arthropods; provides protection and sites of attachment for muscles. Compare with *endoskeleton*.
- exotoxin** A poisonous substance released by certain bacteria. Compare with *endotoxin*.
- explicit memory** Factual knowledge of people, places, or objects; requires conscious recall of the information.
- exploitation competition** An intraspecific competition in which all the individuals in a population "share" the limited resource equally, so at high population densities, none of them obtains an adequate amount. Also called *scramble competition*. Compare with *interference competition*.
- exponential population growth** The accelerating population growth rate that occurs when optimal conditions allow a constant per capita growth rate. Compare with *logistic population growth*.
- ex situ conservation** Conservation efforts that involve conserving individual species in human-controlled settings, such as zoos. Compare with *in situ conservation*.
- exteroceptor** (ex'tur-oh-sep"tor) One of the sense organs that receives sensory stimuli from the outside world, such as the eyes or touch receptors. Compare with *interoceptor*.
- extinction** The elimination of a species; occurs when the last individual member of a species dies.
- extracellular matrix (ECM)** A network of proteins and carbohydrates that surrounds many animal cells.
- extraembryonic membranes** Multicellular membranous structures that develop from the germ layers of a terrestrial vertebrate embryo but are not part of the embryo itself. See *chorion*, *amnion*, *allantois*, and *yolk sac*.
- F₁ generation (first filial generation)** The first generation of hybrid offspring resulting from a cross between parents from two different true-breeding lines.
- F₂ generation (second filial generation)** The offspring of the F₁ generation.
- facilitated diffusion** The passive transport of ions or molecules by a specific carrier protein in a membrane. As in simple diffusion, net transport is down a concentration gradient, and no additional energy has to be supplied. Compare with *diffusion* and *active transport*.

facilitation (1) In neurology, a process in which a neuron is brought close to its threshold level by stimulation from various presynaptic neurons. (2) In ecology, a situation in which one species has a positive effect on other species in the community, for example, by enhancing the local environment.

facultative anaerobe An organism capable of carrying out aerobic respiration but able to switch to fermentation when oxygen is unavailable, e.g., yeast. Compare with *obligate anaerobe*.

FAD/FADH₂ Oxidized and reduced forms, respectively, of flavin adenine dinucleotide, a coenzyme that transfers electrons (as hydrogen) in metabolism, including cellular respiration.

fallopian tube See *oviduct*.

family A taxonomic category made up of related genera.

fatty acid A lipid that is an organic acid containing a long hydrocarbon chain, with no double bonds (saturated fatty acid), one double bond (monounsaturated fatty acid), or two or more double bonds (polyunsaturated fatty acid); components of triacylglycerols and phospholipids, as well as monoacylglycerols and diacylglycerols.

fecundity The potential capacity of an individual to produce offspring.

feedback inhibition A type of enzyme regulation in which the accumulation of the product of a reaction inhibits an earlier reaction in the sequence; also known as *end product inhibition*.

fermentation An anaerobic process by which ATP is produced by a series of redox reactions in which organic compounds serve both as electron donors and terminal electron acceptors.

fern One of a phylum of seedless vascular plants that reproduce by spores produced in sporangia; ferns undergo an alternation of generations between the dominant sporophyte and the gametophyte (prothallus).

fertilization The fusion of two *n* gametes; results in the formation of a *2n* zygote. Compare with *double fertilization*.

fetus The unborn human offspring from the third month of pregnancy to birth.

fiber (1) In plants, a type of sclerenchyma cell; fibers are long, tapered cells with thick walls. Compare with *sclereid*. (2) In animals, an elongated cell such as a muscle or nerve cell. (3) In animals, the microscopic, threadlike protein and carbohydrate complexes scattered through the matrix of connective tissues.

fibrin An insoluble protein formed from the plasma protein fibrinogen during blood clotting.

fibroblasts Connective tissue cells that produce the fibers and the protein and carbohydrate complexes of the matrix of connective tissues.

fibronectins Glycoproteins of the extracellular matrix that bind to integrins (receptor proteins in the plasma membrane).

fibrous root system A root system consisting of several adventitious roots of approximately equal size that arise from the base of the stem. Compare with *taproot system*.

Fick's law of diffusion A physical law governing rates of gas exchange in animal respiratory systems; states that the rate of diffusion of a substance across a membrane is directly proportional to the surface area and to the difference in pressure between the two sides.

filament In flowering plants, the thin stalk of a stamen; the filament bears an anther at its tip.

first law of thermodynamics The law of conservation of energy, which states that the total energy of any closed system (any object plus its surroundings, i.e., the universe) remains constant. Compare with *second law of thermodynamics*.

fitness See *direct fitness*.

fixed action pattern (FAP) An innate behavior triggered by a sign stimulus.

flagellum (flah-jel'um) (pl., *flagella*) A long, whiplike structure extending from certain cells and used in locomotion. (1) Eukaryote flagella consist of two central, single microtubules surrounded by nine double microtubules (9 + 2 structure), all covered by a plasma membrane. (2) Prokaryote flagella are filaments rotated by special structures located in the plasma membrane and cell wall.

flame cells Collecting cells that have cilia; part of the osmoregulatory system of flatworms.

flavin adenine dinucleotide See *FAD/FADH₂*.

flowering plants See *angiosperms*.

flowing-water ecosystem A river or stream ecosystem.

fluid-mosaic model The currently accepted model of the plasma membrane and other cell membranes, in which protein molecules "float" in a fluid phospholipid bilayer.

fluorescence The emission of light of a longer wavelength (lower energy) than the light originally absorbed.

fluorescent in situ hybridization (FISH) A technique to detect specific DNA segments by hybridization directly to chromosomes; visualized microscopically by using a fluorescent dye.

follicle (fol'i-kl) (1) A simple, dry, dehiscent fruit that develops from a single carpel and splits open at maturity along one suture to liberate the seeds. (2) A small sac of cells in the mammalian ovary that contains a maturing egg. (3) The pocket in the skin from which a hair grows.

follicle-stimulating hormone (FSH) A gonadotropic hormone secreted by the anterior lobe of the pituitary gland; stimulates follicle development in the ovaries of females and sperm production in the testes of males.

food chain The series of organisms through which energy flows in an ecosystem. Each organism in the series eats or decomposes the preceding organism in the chain. See *food web*.

food web A complex interconnection of all the food chains in an ecosystem.

foramen magnum The opening in the vertebrate skull through which the spinal cord passes.

foraminiferan (for'am-in-if'er-an) A marine protozoan that produces a shell, or test, that encloses an amoeboid body.

forebrain In the early embryo, one of the three divisions of the developing vertebrate brain; subdivides to form the telencephalon, which gives rise to the cerebrum, and the diencephalon, which gives rise to the thalamus and hypothalamus. Compare with *midbrain* and *hindbrain*.

forest decline A gradual deterioration (and often death) of many trees in a forest; can be caused by a combination of factors, such as acid precipitation, toxic heavy metals, and surface-level ozone.

fossil Parts or traces of an ancient organism usually preserved in rock.

fossil fuel Combustible deposits in Earth's crust that are composed of the remnants of prehistoric organisms that existed millions of years ago, e.g., oil, natural gas, and coal.

founder cell A cell from which a particular cell lineage is derived.

founder effect Genetic drift that results from a small population colonizing a new area.

fovea (foe'vee-ah) The area of sharpest vision in the retina; cone cells are concentrated here.

fragile site A weak point at a specific location on a chromosome where part of a chromatid appears attached to the rest of the chromosome by a thin thread of DNA.

fragile X syndrome A human genetic disorder caused by a fragile site that occurs near the tip on the X chromosome; effects range

from mild learning disabilities to severe mental retardation and hyperactivity.

frameshift mutation A mutation that results when one or two nucleotide pairs are inserted into or deleted from the DNA. The change causes the mRNA transcribed from the mutated DNA to have an altered reading frame such that all codons downstream from the mutation are changed.

fraternal twins See *dizygotic twins*.

free energy The maximum amount of energy available to do work under the conditions of a biochemical reaction.

free radicals Toxic, highly reactive compounds with unpaired electrons that bond with other compounds in the cell and interfere with normal function.

frequency-dependent selection Selection in which the relative fitness of different genotypes is related to how frequently they occur in the population.

freshwater wetlands Land that is transitional between freshwater and terrestrial ecosystems and is covered with water for at least part of the year, e.g., marshes and swamps.

frontal lobes In mammals, the anterior part of the cerebrum.

fruit In flowering plants, a mature, ripened ovary. Fruits contain seeds and usually provide seed protection and dispersal.

fruiting body A multicellular structure that contains the sexual spores of certain fungi; refers to the ascocarp of an ascomycete and the basidiocarp of a basidiomycete.

fucoxanthin (few"koh-zan'thin) The brown carotenoid pigment found in brown algae, golden algae, diatoms, and dinoflagellates.

functional genomics The study of the roles of genes in cells.

functional group A group of atoms that confers distinctive properties on an organic molecule (or region of a molecule) to which it is attached, e.g., hydroxyl, carbonyl, carboxyl, amino, phosphate, and sulfhydryl groups.

fundamental niche The potential ecological niche that an organism could occupy if there were no competition from other species. Compare with *realized niche*.

fungus (pl., *fungi*) A heterotrophic eukaryote with chitinous cell walls and a body usually in the form of a mycelium of branched, threadlike hyphae. Most fungi are decomposers; some are parasitic.

G protein One of a group of proteins that bind GTP and are involved in the transfer of signals across the plasma membrane.

G₁ phase The first gap phase within the interphase stage of the cell cycle; G₁ occurs before DNA synthesis (S phase) begins. Compare with S and G₂ phases.

G₂ phase Second gap phase within the interphase stage of the cell cycle; G₂ occurs after DNA synthesis (S phase) and before mitosis. Compare with S and G₁ phases.

gallbladder A small sac that stores bile.

gametangium (gam"uh-tan'gee-um) Special multicellular or unicellular structure of plants, protists, and fungi in which gametes are formed.

gamete (gam'eet) A sex cell; in plants and animals, an egg or sperm. In sexual reproduction, the union of gametes results in the formation of a zygote. The chromosome number of a gamete is designated *n*.

gametic isolation (gam-ee'tik) A prezygotic reproductive isolating mechanism in which sexual reproduction between two closely related species cannot occur because of chemical differences in the gametes.

gametogenesis The process of gamete formation. See *spermatogenesis* and *oogenesis*.

gametophyte generation (gam-ee'toh-fite) The *n*, gamete-producing stage in the life cycle of a plant. Compare with *sporophyte generation*.

gamma-aminobutyric acid (GABA) A neurotransmitter that has an inhibitory effect.

ganglion (gang'glee-on) (pl., *ganglia*) A mass of neuron cell bodies.

ganglion cell A type of neuron in the retina of the eye; receives input from bipolar cells.

gap junction Structure consisting of specialized regions of the plasma membrane of two adjacent cells; contains numerous pores that allow the passage of certain small molecules and ions between them.

gastrin (gas'trin) A hormone released by the stomach mucosa; stimulates the gastric glands to secrete pepsinogen.

gastrovascular cavity A central digestive cavity with a single opening that functions as both mouth and anus; characteristic of cnidarians and flatworms.

gastrula (gas'troo-lah) A three-layered embryo formed by the process of gastrulation.

gastrulation (gas'troo-lay'shun) Process in embryonic development during which the three germ layers (ectoderm, mesoderm, and endoderm) form.

gel electrophoresis Procedure by which proteins or nucleic acids are separated on the basis of size and charge as they migrate through a gel in an electric field.

gene A segment of DNA that serves as a unit of hereditary information; includes a transcribable DNA sequence (plus associated sequences regulating its transcription) that yields a protein or RNA product with a specific function.

gene amplification The developmental process in which certain cells produce multiple copies of a gene by selective replication, thus allowing for increased synthesis of the gene product. Compare with *nuclear equivalence* and *genomic rearrangement*.

gene flow The movement of alleles between local populations due to the migration of individuals; can have significant evolutionary consequences.

gene locus See *locus*.

gene pool All the alleles of all the genes present in a freely interbreeding population.

gene therapy Any of a variety of methods designed to correct a disease or alleviate its symptoms through the introduction of genes into the affected person's cells.

genetic bottleneck See *bottleneck*.

genetic code See *codon*.

genetic counseling Medical and genetic information provided to couples who are concerned about the risk of abnormality in their children.

genetic drift A random change in allele frequency in a small breeding population.

genetic engineering Manipulation of genes, often through recombinant DNA technology.

genetic equilibrium The condition of a population that is not undergoing evolutionary change, i.e., in which allele and genotype frequencies do not change from one generation to the next. See *Hardy-Weinberg principle*.

genetic polymorphism (pol"ee-mor'fizm) The presence in a population of two or more alleles for a given gene locus.

genetic probe A single-stranded nucleic acid (either DNA or RNA) used to identify a complementary sequence by hydrogen-bonding to it.

genetic recombination See *recombination, genetic*.

- genetic screening** A systematic search through a population for individuals with a genotype or karyotype that might cause a serious genetic disease in them or their offspring.
- genetics** The science of heredity; includes genetic similarities and genetic variation between parents and offspring or among individuals of a population.
- genome** (jee'nome) Originally, all the genetic material in a cell or individual organism. The term is used in more than one way depending on context, e.g., an organism's haploid genome is all the DNA contained in one haploid set of its chromosomes, and its mitochondrial genome is all the DNA in a mitochondrion. See *human genome*.
- genomic DNA library** A collection of recombinant plasmids in which all the DNA in the genome is represented. Compare with *cDNA library*.
- genomic imprinting** See *imprinting*, first definition.
- genomic rearrangement** A physical change in the structure of one or more genes that occurs during the development of an organism and leads to an alteration in gene expression; compare with *nuclear equivalence* and *gene amplification*.
- genomics** The emerging field of biology that studies the entire DNA sequence of an organism's genome to identify all the genes, determine their RNA or protein products, and ascertain how the genes are regulated.
- genotype** (jeen'oh-type) The genetic makeup of an individual. Compare with *phenotype*.
- genotype frequency** The proportion of a particular genotype in the population.
- genus** (jee'nus) A taxonomic category made up of related species.
- geometric isomer** One of two or more chemical compounds having the same arrangement of covalent bonds but differing in the spatial arrangement of their atoms or groups of atoms.
- germ layers** In animals, three embryonic tissue layers: endoderm, mesoderm, and ectoderm.
- germ line cell** In animals, a cell that is part of the line of cells that will ultimately undergo meiosis to form gametes. Compare with *somatic cell*.
- germination** Resumption of growth of an embryo or spore; occurs when a seed or spore sprouts.
- germplasm** Any plant or animal material that may be used in breeding; includes seeds, plants, and plant tissues of traditional crop varieties and the sperm and eggs of traditional livestock breeds.
- gibberellin** (jib'ur-el'lin) A plant hormone involved in many aspects of plant growth and development, such as stem elongation, flowering, and seed germination.
- gills** (1) The respiratory organs characteristic of many aquatic animals, usually thin-walled projections from the body surface or from some part of the digestive tract. (2) The spore-bearing, platelike structures under the caps of mushrooms.
- ginkgo** (ging'ko) A member of an ancient gymnosperm group that consists of a single living representative (*Ginkgo biloba*), a hardy, deciduous tree with broad, fan-shaped leaves and naked, fleshy seeds (on female trees).
- gland** See *endocrine gland* and *exocrine gland*.
- glial cells** (glee'ul) In nervous tissue, cells that support and nourish neurons; they also communicate with neurons and have several other functions; also see *astrocyte*, *microglia*, and *oligodendrocyte*.
- globulin** (glob'yoo-lin) One of a class of proteins in blood plasma, some of which (gamma globulins) function as antibodies.
- glomeromycetes** A group of fungal symbionts that form arbuscular mycorrhizae with the roots of many plants; belong to phylum Glomeromycota.
- glomerulus** (glom-air'yoo-lus) The cluster of capillaries at the proximal end of a nephron; the glomerulus is surrounded by Bowman's capsule.
- glucagon** (gloo'kah-gahn) A hormone secreted by the pancreas that stimulates glycogen breakdown, thereby increasing the concentration of glucose in the blood. Compare with *insulin*.
- glucose** A hexose aldehyde sugar that is central to many metabolic processes.
- glutamate** An amino acid that functions as the major excitatory neurotransmitter in the vertebrate brain.
- glyceraldehyde-3-phosphate (G3P)** Phosphorylated three-carbon compound that is an important intermediate in glycolysis and in the Calvin cycle.
- glycerol** A three-carbon alcohol with a hydroxyl group on each carbon; a component of triacylglycerols and phospholipids, as well as monoacylglycerols and diacylglycerols.
- glycocalyx** (gly'koh-kay'lix) A coating on the outside of an animal cell, formed by the polysaccharide portions of glycoproteins and glycolipids associated with the plasma membrane.
- glycogen** (gly'koh-jen) The principal storage polysaccharide in animal cells; formed from glucose and stored primarily in the liver and, to a lesser extent, in muscle cells.
- glycolipid** A lipid with covalently attached carbohydrates.
- glycolysis** (gly-kol'ih-sis) The first stage of cellular respiration, literally the "splitting of sugar." The metabolic conversion of glucose into pyruvate, accompanied by the production of ATP.
- glycoprotein** (gly'koh-pro-teen) A protein with covalently attached carbohydrates.
- glycosidic linkage** Covalent linkage joining two sugars; includes an oxygen atom bonded to a carbon of each sugar.
- glyoxysomes** (gly-ox'ih-sohmz) Membrane-enclosed structures in cells of certain plant seeds; contain a large array of enzymes that convert stored fat to sugar.
- gnetophyte** (nee'toe-fite) One of a small phylum of unusual gymnosperms that have some features similar to those of flowering plants.
- goblet cells** Unicellular glands that secrete mucus.
- goiter** (goy'ter) An enlargement of the thyroid gland.
- golden alga** A member of a phylum of algae, most of which are biflagellate, are unicellular, and contain pigments, including chlorophylls *a* and *c* and carotenoids, including fucoxanthin.
- Golgi complex** (goal'jee) Organelle composed of stacks of flattened, membranous sacs. Mainly responsible for modifying, packaging, and sorting proteins that will be secreted or targeted to other organelles of the internal membrane system or to the plasma membrane; also called *Golgi body* or *Golgi apparatus*.
- gonad** (goh'nad) A gamete-producing gland; an ovary or a testis.
- gonadotropic hormones** (go-nad-oh-troh'pic) Hormones produced by the anterior pituitary gland that stimulate the testes and ovaries; include follicle-stimulating hormone (FSH) and luteinizing hormone (LH).
- gonadotropin-releasing hormone (GnRH)** A hormone secreted by the hypothalamus that stimulates the anterior pituitary to secrete the gonadotropic hormones: follicle-stimulating hormone (FSH) and luteinizing hormone (LH).
- graded potential** A local change in electrical potential that varies in magnitude depending on the strength of the applied stimulus.
- gradualism** The idea that evolution occurs by a slow, steady accumulation of genetic changes over time. Compare with *punctuated equilibrium*.
- graft rejection** An immune response directed against a transplanted tissue or organ.

grain A simple, dry, one-seeded fruit in which the fruit wall is fused to the seed coat, e.g., corn and wheat kernels. Also called *caryopsis*.

granulosa cells In mammals, cells that surround the developing oocyte and are part of the follicle; produce estrogens and inhibin.

granum (pl., *grana*) A stack of thylakoids within a chloroplast.

gravitropism (grav"ih-troh'pizm) Growth of a plant in response to gravity.

gray crescent The grayish area of cytoplasm that marks the region where gastrulation begins in an amphibian embryo.

gray matter Nervous tissue in the brain and spinal cord that contains cell bodies, dendrites, and unmyelinated axons. Compare with *white matter*.

green alga A member of a diverse phylum of algae that contain the same pigments as plants (chlorophylls *a* and *b* and carotenoids).

greenhouse effect The natural global warming of Earth's atmosphere caused by the presence of carbon dioxide and other gases that trap the sun's radiation. The additional warming produced when increased levels of greenhouse gases absorb infrared radiation is known as the *enhanced greenhouse effect*.

greenhouse gases Trace gases in the atmosphere that allow the sun's energy to penetrate to Earth's surface but do not allow as much of it to escape as heat.

gross primary productivity The rate at which energy accumulates (is assimilated) in an ecosystem during photosynthesis. Compare with *net primary productivity*.

ground state The lowest energy state of an atom.

ground tissue system All tissues in the plant body other than the dermal tissue system and vascular tissue system; consists of parenchyma, collenchyma, and sclerenchyma.

growth factors A group of more than 50 extracellular peptides that signal certain cells to grow and divide.

growth hormone (GH) A hormone secreted by the anterior lobe of the pituitary gland; stimulates growth of body tissues; also called *somatotropin*.

growth rate The rate of change of a population's size on a per capita basis.

guanine (gwan'een) A nitrogenous purine base that is a component of nucleic acids and GTP.

guanosine triphosphate (GTP) An energy transfer molecule similar to ATP that releases free energy with the hydrolysis of its terminal phosphate group.

guard cell One of a pair of epidermal cells that adjust their shape to form a stomatal pore for gas exchange.

guttation (gut-tay'shun) The appearance of water droplets on leaves, forced out through leaf pores by root pressure.

gymnosperm (jim'noh-sperm) Any of a group of seed plants in which the seeds are not enclosed in an ovary; gymnosperms frequently bear their seeds in cones. Includes four phyla: conifers, cycads, ginkgoes, and gnetophytes.

habitat The natural environment or place where an organism, population, or species lives.

habitat fragmentation The division of habitats that formerly occupied large, unbroken areas into smaller pieces by roads, fields, cities, and other human land-transforming activities.

habitat isolation A prezygotic reproductive isolating mechanism in which reproduction between similar species is prevented because they live and breed in different habitats.

habituation (hab-it'yoo-ay'shun) A type of learning in which an animal becomes accustomed to a repeated, irrelevant stimulus and no longer responds to it.

hair cell A vertebrate mechanoreceptor found in the lateral line of fishes, the vestibular apparatus, semicircular canals, and cochlea.

half-life The period of time required for a radioisotope to change into a different material.

haploid (hap'loyd) The condition of having one set of chromosomes per nucleus. Compare with *diploid* and *polyploid*.

"hard-wiring" Refers to how neurons signal one another, how they connect, and how they carry out basic functions such as regulating heart rate, blood pressure, and sleep-wake cycles.

Hardy-Weinberg principle The mathematical prediction that allele frequencies do not change from generation to generation in a large population in the absence of microevolutionary processes (mutation, genetic drift, gene flow, natural selection).

haustorium (hah-stor'ee-um) (pl., *haustoria*) In parasitic fungi, a specialized hypha that penetrates a host cell and obtains nourishment from the cytoplasm.

Haversian canals (ha-vur'zee-un) Channels extending through the matrix of bone; contain blood vessels and nerves.

heat The total amount of kinetic energy in a sample of a substance.

heat energy The thermal energy that flows from an object with a higher temperature to an object with a lower temperature.

heat of vaporization The amount of heat energy that must be supplied to change one gram of a substance from the liquid phase to the vapor phase.

helicases Enzymes that unwind the two strands of a DNA double helix.

helper T cell See *T helper cell*.

hemichordates A phylum of sedentary, wormlike deuterostomes.

hemizygous (hem"ih-zy'gus) Possessing only one allele for a particular locus; a human male is hemizygous for all X-linked genes. Compare with *homozygous* and *heterozygous*.

hemocoel Blood cavity characteristic of animals with an open circulatory system.

hemocyanin A hemolymph pigment that transports oxygen in some mollusks and arthropods.

hemoglobin (hee'moh-gloh"bin) The red, iron-containing protein pigment in blood that transports oxygen and carbon dioxide and aids in regulation of pH.

hemolymph (hee'moh-limf) The fluid that bathes the tissues in animals with an open circulatory system, e.g., arthropods and most mollusks.

hemophilia (hee'moh-feel'ee-ah) A hereditary disease in which blood does not clot properly; the form known as *hemophilia A* has an X-linked, recessive inheritance pattern.

Hensen's node See *primitive streak*.

hepatic (heh-pat'ik) Pertaining to the liver.

hepatic portal system The portion of the circulatory system that carries blood from the intestine through the liver.

herbivore (erb'uh-vore) An animal that feeds on plants or algae. Also called *primary consumer*.

heredity The transmission of genetic information from parent to offspring.

hermaphrodite (her-maf'roh-dite) An organism that has both male and female sex organs.

heterochromatin (het"ur-oh-kroh'mah-tin) Highly coiled and compacted chromatin in an inactive state. Compare with *euchromatin*.

heterocyst (het'ur-oh-sist") An oxygen-excluding cell of cyanobacteria that is the site of nitrogen fixation.

heterogametic A term describing an individual that produces two classes of gametes with respect to their sex chromosome constitutions. Human males (XY) are heterogametic, producing X and Y sperm. Compare with *homogametic*.

heterospory (het"ur-os'pur-ee) Production of two types of *n* spores, microspores (male) and megaspores (female). Compare with *homospory*.

- heterothallic** (het'ur-oh-thal'ik) Pertaining to certain algae and fungi that have two mating types; only by combining a plus strain and a minus strain can sexual reproduction occur. Compare with *homothallic*.
- heterotroph** (het'ur-oh-trof) An organism that cannot synthesize its own food from inorganic raw materials and therefore must obtain energy and body-building materials from other organisms. Also called *consumer*. Compare with *autotroph*. See *chemoheterotroph* and *photoheterotroph*.
- heterozygote advantage** A phenomenon in which the heterozygous condition confers some special advantage on an individual that either homozygous condition does not (i.e., *Aa* has a higher degree of fitness than does *AA* or *aa*).
- heterozygous** (het-ur'oh-zye'gus) Having a pair of unlike alleles for a particular locus. Compare with *homozygous*.
- hexose** A monosaccharide containing six carbon atoms.
- hibernation** Long-term torpor in response to winter cold and scarcity of food. Compare with *estivation*.
- high-density lipoprotein (HDL)** See *lipoprotein*.
- hindbrain** In the early embryo, one of the three divisions of the developing vertebrate brain; subdivides to form the metencephalon, which gives rise to the cerebellum and pons, and the myelencephalon, which gives rise to the medulla. Compare with *forebrain* and *midbrain*.
- histamine** (his'tah-meen) Substance released from mast cells that is involved in allergic and inflammatory reactions.
- histones** (his'tohnz) Small, positively charged (basic) proteins in the cell nucleus that bind to the negatively charged DNA. See *nucleosomes*.
- holdfast** The basal structure for attachment to solid surfaces found in multicellular algae.
- holoblastic cleavage** A cleavage pattern in which the entire embryo cleaves; characteristic of eggs with little or moderate yolk (isolecithal or moderately telolecithal), e.g., the eggs of echinoderms, amphioxus, and mammals. Compare with *meroblastic cleavage*.
- home range** A geographic area that an individual animal seldom or never leaves. Compare with *range*.
- homeobox** A short (180-nucleotide) DNA sequence that characterizes many homeotic genes as well as some other genes that play a role in development.
- homeodomain** A functional region of certain transcription factors; consists of approximately 60 amino acids specified by a homeobox DNA sequence and includes a recognition alpha helix, which binds to specific DNA sequences and affects their transcription.
- homeostasis** (home'ee-oh-stay'sis) The balanced internal environment of the body; the automatic tendency of an organism to maintain such a steady state.
- homeotic gene** (home'ee-ah'tik) A gene that controls the formation of specific structures during development. Such genes were originally identified through insect mutants in which one body part is substituted for another.
- hominid** (hah'min-id) Any of a group of extinct and living humans.
- hominoid** (hah'min-oid) The apes and hominids.
- homogametic** Term describing an individual that produces gametes with identical sex chromosome constitutions. Human females (XX) are homogametic, producing all X eggs. Compare with *heterogametic*.
- homologous chromosomes** (hom-ol'ah-gus) Chromosomes that are similar in morphology and genetic constitution. In humans there are 23 pairs of homologous chromosomes; one member of each pair is inherited from the mother, and the other from the father.
- homologous features** See *homology*.
- homology** Similarity in different species that results from their derivation from a common ancestor. The features that exhibit such similarity are called *homologous features*. Compare with *homoplasy*.
- homoplastic features** See *homoplasy*.
- homoplasy** Similarity in the characters in different species that is due to convergent evolution, not common descent. Characters that exhibit such similarity are called *homoplastic features*. Compare with *homology*.
- homospory** (hoh'mos'pur-ee) Production of one type of *n* spore that gives rise to a bisexual gametophyte. Compare with *heterospory*.
- homothallic** (hoh'moh-thal'ik) Pertaining to certain algae and fungi that are self-fertile. Compare with *heterothallic*.
- homozygous** (hoh'moh-zy'gous) Having a pair of identical alleles for a particular locus. Compare with *heterozygous*.
- hormone** An organic chemical messenger in multicellular organisms that is produced in one part of the body and often transported to another part where it signals cells to alter some aspect of metabolism.
- hornwort** A phylum of spore-producing, nonvascular, thallose plants with a life cycle similar to that of mosses.
- host mothering** The introduction of an embryo from one species into the uterus of another species, where it implants and develops; the host mother subsequently gives birth and may raise the offspring as her own.
- Hox genes** Clusters of homeobox-containing genes that specify the anterior-posterior axis of various animals during development.
- human chorionic gonadotropin (hCG)** A hormone secreted by cells surrounding the early embryo; signals the mother's corpus luteum to continue to function.
- human genetics** The science of inherited variation in humans.
- human genome** The totality of genetic information in human cells; includes the DNA content of both the nucleus and mitochondria. See *genome*.
- human immunodeficiency virus (HIV)** The retrovirus that causes AIDS (acquired immunodeficiency syndrome).
- human leukocyte antigen (HLA)** See *major histocompatibility complex*.
- humus** (hew'mus) Organic matter in various stages of decomposition in the soil; gives soil a dark brown or black color.
- Huntington disease** A genetic disease that has an autosomal dominant inheritance pattern and causes mental and physical deterioration.
- hybrid** The offspring of two genetically dissimilar parents.
- hybrid breakdown** A postzygotic reproductive isolating mechanism in which, although an interspecific hybrid is fertile and produces a second (F_2) generation, the F_2 has defects that prevent it from successfully reproducing.
- hybrid inviability** A postzygotic reproductive isolating mechanism in which the embryonic development of an interspecific hybrid is aborted.
- hybrid sterility** A postzygotic reproductive isolating mechanism in which an interspecific hybrid cannot reproduce successfully.
- hybrid vigor** The genetic superiority of an F_1 hybrid over either parent, caused by the presence of heterozygosity for a number of different loci.
- hybrid zone** An area of overlap between two closely related populations, subspecies, or species in which interbreeding occurs.
- hybridization** (1) Interbreeding between members of two different taxa. (2) Interbreeding between genetically dissimilar parents. (3) In molecular biology, complementary base pairing between nucleic acid (DNA or RNA) strands from different sources.

- hydration** Process of association of a substance with the partial positive and/or negative charges of water molecules.
- hydrocarbon** An organic compound composed solely of hydrogen and carbon atoms.
- hydrogen bond** A weak attractive force existing between a hydrogen atom with a partial positive charge and an electronegative atom (usually oxygen or nitrogen) with a partial negative charge. Compare with *covalent bond* and *ionic bond*.
- hydrologic cycle** The water cycle, which includes evaporation, precipitation, and flow to the ocean; supplies terrestrial organisms with a continual supply of fresh water.
- hydrolysis** Reaction in which a covalent bond between two subunits is broken through the addition of the equivalent of a water molecule; a hydrogen atom is added to one subunit and a hydroxyl group to the other. Compare with *condensation synthesis*.
- hydrophilic** Interacting readily with water; having a greater affinity for water molecules than they have for each other. Compare with *hydrophobic*.
- hydrophobic** Not readily interacting with water; having less affinity for water molecules than they have for each other. Compare with *hydrophilic*.
- hydroponics** (hy"dra-paun'iks) Growing plants in an aerated solution of dissolved inorganic minerals, i.e., without soil.
- hydrostatic skeleton** A type of skeleton found in some invertebrates in which contracting muscles push against a tube of fluid.
- hydroxide ion** An anion (negatively charged particle) consisting of oxygen and hydrogen; usually written OH⁻.
- hydroxyl group** (hy-drok'sil) Polar functional group; abbreviated —OH.
- hyperpolarize** To change the membrane potential so that the inside of the cell becomes more negative than its resting potential.
- hypertonic** A term referring to a solution having an osmotic pressure (or solute concentration) greater than that of the solution with which it is compared. Compare with *hypotonic* and *isotonic*.
- hypha** (hy'fah) (pl., *hyphae*) One of the threadlike filaments composing the mycelium of a water mold or fungus.
- hypocotyl** (hy'poh-kah"tl) The part of the axis of a plant embryo or seedling below the point of attachment of the cotyledons.
- hypothalamus** (hy-poh-thal'uh-mus) Part of the vertebrate brain; in mammals it regulates the pituitary gland, the autonomic system, emotional responses, body temperature, water balance, and appetite; located below the thalamus.
- hypothesis** A testable statement about the nature of an observation or relationship. Compare with *theory*.
- hypothetico-deductive approach** Emphasizes the use of deductive reasoning to test hypotheses. Compare with *hypothetico-inductive approach*. See *deductive reasoning*.
- hypothetico-inductive approach** Emphasizes the use of inductive reasoning to discover new general principles. Compare with *hypothetico-deductive approach*. See *inductive reasoning*.
- hypotonic** A term referring to a solution having an osmotic pressure (or solute concentration) less than that of the solution with which it is compared. Compare with *hypertonic* and *isotonic*.
- hypotrichs** A group of dorsoventrally flattened ciliates that exhibit an unusual creeping–darting locomotion.
- identical twins** See *monozygotic twins*.
- illuviation** The deposition of material leached from the upper layers of soil into the lower layers.
- imaginal discs** Paired structures in an insect larva that develop into specific adult structures during complete metamorphosis.
- imago** (ih-may'go) The adult form of an insect.
- imbibition** (im"bi-bish'en) The absorption of water by a seed prior to germination.
- immigration** The movement of individuals into a population. Compare with *emigration*.
- immune response** Process of recognizing foreign macromolecules and mounting a response aimed at eliminating them. See *specific* and *nonspecific immune responses*; *primary* and *secondary immune responses*.
- immunoglobulin** (im-yoon"oh-glob'yoo-lin) See *antibody*.
- imperfect flower** A flower that lacks either stamens or carpels. Compare with *perfect flower*.
- imperfect fungi** See *deuteromycetes*.
- implantation** The embedding of a developing embryo in the inner lining (endometrium) of the uterus.
- implicit memory** The unconscious memory for perceptual and motor skills, e.g., riding a bicycle.
- imprinting** (1) The expression of a gene based on its parental origin; also called *genomic imprinting*. (2) A type of learning by which a young bird or mammal forms a strong social attachment to an individual (usually a parent) or object within a few hours after hatching or birth.
- in situ conservation** Conservation efforts that concentrate on preserving biological diversity in the wild. Compare with *ex situ conservation*.
- in vitro** Occurring outside a living organism (literally “in glass”). Compare with *in vivo*.
- in vitro evolution** Test tube experiments that demonstrate that RNA molecules in the RNA world could have catalyzed the many different chemical reactions needed for life. Also called *directed evolution*.
- in vitro fertilization** The fertilization of eggs in the laboratory prior to implantation in the uterus for development..
- in vivo** Occurring in a living organism. Compare with *in vitro*.
- inborn error of metabolism** A metabolic disorder caused by the mutation of a gene that codes for an enzyme needed for a biochemical pathway.
- inbreeding** The mating of genetically similar individuals. Homozygosity increases with each successive generation of inbreeding. Compare with *outbreeding*.
- inbreeding depression** The phenomenon in which inbred offspring of genetically similar individuals have lower fitness (e.g., decline in fertility and high juvenile mortality) than do noninbred individuals.
- inclusive fitness** The total of an individual's direct and indirect fitness; includes the genes contributed directly to offspring and those contributed indirectly by kin selection. Compare with *direct fitness*. See *kin selection*.
- incomplete dominance** A condition in which neither member of a pair of contrasting alleles is completely expressed when the other is present.
- incomplete flower** A flower that lacks one or more of the four parts: sepals, petals, stamens, and/or carpels. Compare with *complete flower*.
- independent assortment, principle of** The genetic principle, first noted by Gregor Mendel, that states that the alleles of unlinked loci are randomly distributed to gametes.
- indeterminate growth** Unrestricted growth, as for example, in stems and roots. Compare with *determinate growth*.
- index fossils** Fossils restricted to a narrow period of geologic time and found in the same sedimentary layers in different geographic areas.
- indoleacetic acid** See *auxin*.
- induced fit** Conformational change in the active site of an enzyme that occurs when it binds to its substrate.
- inducer** A molecule that binds to a repressor protein, converting it to its inactive form, which is unable to prevent transcription.

- inducible operon** An operon that is normally inactive because a repressor molecule is attached to its operator; transcription is activated when an inducer binds to the repressor, making it incapable of binding to the operator. Compare with *repressible operon*.
- induction** The process by which the differentiation of a cell or group of cells is influenced by interactions with neighboring cells.
- inductive reasoning** The reasoning that uses specific examples to draw a general conclusion or discover a general principle. Compare with *deductive reasoning*. See *hypothetico-inductive approach*.
- infant mortality rate** The number of infant deaths per 1000 live births. (A child is an infant during its first 2 years of life.)
- inflammatory response** The response of body tissues to injury or infection, characterized clinically by heat, swelling, redness, and pain, and physiologically by increased dilation of blood vessels and increased phagocytosis.
- inflorescence** A cluster of flowers on a common floral stalk.
- ingestion** The process of taking food (or other material) into the body.
- ingroup** See *outgroup*.
- inhibin** A hormone that inhibits FSH secretion; produced by Sertoli cells in the testes and by granulosa cells in the ovaries.
- inhibitory postsynaptic potential (IPSP)** A change in membrane potential that takes a neuron farther from the firing level. Compare with *excitatory postsynaptic potential (EPSP)*.
- initiation (of protein synthesis)** The first steps of protein synthesis, in which the large and small ribosomal subunits and other components of the translation machinery bind to the 5' end of mRNA. See *elongation* and *termination*.
- initiation codon** See *start codon*.
- innate behavior** Behavior that is inherited and typical of the species; also called *instinct*.
- innate immune responses** See *nonspecific immune responses*.
- inner cell mass** The cluster of cells in the early mammalian embryo that gives rise to the embryo proper.
- inorganic compound** A simple substance that does not contain a carbon backbone. Compare with *organic compound*.
- inositol trisphosphate (IP₃)** A second messenger that increases intracellular calcium concentration and activates enzymes.
- insight learning** A complex learning process in which an animal adapts past experience to solve a new problem that may involve different stimuli.
- instinct** See *innate behavior*.
- insulin** (in'suh-lin) A hormone secreted by the pancreas that lowers blood glucose concentration. Compare with *glucagon*.
- insulin-like growth factors (IGFs)** Somatomedins; proteins that mediate responses to growth hormone.
- insulin resistance** See *diabetes mellitus*.
- insulin shock** A condition in which the blood glucose concentration is so low that the individual may appear intoxicated or may become unconscious and even die; caused by the injection of too much insulin or by certain metabolic malfunctions.
- integral membrane protein** A protein that is tightly associated with the lipid bilayer of a biological membrane; a transmembrane integral protein spans the bilayer. Compare with *peripheral membrane protein*.
- integration** The process of summing (adding and subtracting) incoming neural signals.
- integrins** Receptor proteins that bind to specific proteins in the extracellular matrix and to membrane proteins on adjacent cells; transmit signals into the cell from the extracellular matrix.
- integumentary system** (in-teg'yoo-men'tar-ee) The body's covering, including the skin and its nails, glands, hair, and other associated structures.
- integuments** The outer cell layers that surround the megasporangium of an ovule; develop into the seed coat.
- intercellular substance** In connective tissues, the combination of matrix and fibers in which the cells are embedded.
- interference competition** Intraspecific competition in which certain dominant individuals obtain an adequate supply of the limited resource at the expense of other individuals in the population. Also called *contest competition*. Compare with *exploitation competition*.
- interferons** (in'tur-feer'onz) Cytokines produced by animal cells when challenged by a virus; prevent viral reproduction and enable cells to resist a variety of viruses.
- interkinesis** The stage between meiosis I and meiosis II. Interkinesis is usually brief; the chromosomes may decondense, reverting at least partially to an interphase-like state, but DNA synthesis and chromosome duplication do not occur.
- interleukins** A diverse group of cytokines produced mainly by macrophages and lymphocytes.
- intermediate-day plant** A plant that flowers when it is exposed to days and nights of intermediate length but does not flower when the day length is too long or too short. Compare with *long-day*, *short-day*, and *day-neutral plants*.
- intermediate disturbance hypothesis** In community ecology, the idea that species richness is greatest at moderate levels of disturbance, which create a mosaic of habitat patches at different stages of succession.
- intermediate filaments** Cytoplasmic fibers that are part of the cytoskeletal network and are intermediate in size between microtubules and microfilaments.
- internal membrane system** The group of membranous structures in eukaryotic cells that interact through direct connections by vesicles; includes the endoplasmic reticulum, outer membrane of the nuclear envelope, Golgi complex, lysosomes, and the plasma membrane; also called *endomembrane system*.
- interneuron** (in'tur-noor'on) A nerve cell that carries impulses from one nerve cell to another and is not directly associated with either an effector or a sensory receptor. Also known as an *association neuron*.
- internode** The region on a stem between two successive nodes. Compare with *node*.
- interoceptor** (in'tur-oh-sep'tor) A sense organ within a body organ that transmits information regarding chemical composition, pH, osmotic pressure, or temperature. Compare with *exteroceptor*.
- interphase** The stage of the cell cycle between successive mitotic divisions; its subdivisions are the G₁ (first gap), S (DNA synthesis), and G₂ (second gap) phases.
- interspecific competition** The interaction between members of different species that vie for the same resource in an ecosystem (e.g., food or living space). Compare with *intraspecific competition*.
- interstitial cells (of testis)** The cells between the seminiferous tubules that secrete testosterone.
- interstitial fluid** The fluid that bathes the tissues of the body; also called *tissue fluid*.
- intertidal zone** The marine shoreline area between the high-tide mark and the low-tide mark.
- intraspecific competition** The interaction between members of the same species that vie for the same resource in an ecosystem (e.g., food or living space). Compare with *interspecific competition*.
- intrinsic rate of increase** The theoretical maximum rate of increase in population size occurring under optimal environmental conditions. Also called *biotic potential*.

- intron** A non-protein-coding region of a eukaryotic gene and also of the pre-mRNA transcribed from such a region. Introns do not appear in mRNA. Compare with *exon*.
- invasive species** A foreign species that, when introduced into an area where it is not native, upsets the balance among the organisms living there and causes economic or environmental harm.
- inversion** A chromosome abnormality in which the breakage and rejoining of chromosome parts results in a chromosome segment that is oriented in the opposite (reverse) direction.
- invertebrate** An animal without a backbone (vertebral column); invertebrates account for about 95% of animal species.
- ion** An atom or group of atoms bearing one or more units of electric charge, either positive (cation) or negative (anion).
- ion channels** Channels for the passage of ions through a membrane; formed by specific membrane proteins.
- ionic bond** The chemical attraction between a cation and an anion. Compare with *covalent bond* and *hydrogen bond*.
- ionic compound** A substance consisting of cations and anions, which are attracted by their opposite charges; ionic compounds do not consist of molecules. Compare with *covalent compound*.
- ionization** The dissociation of a substance to yield ions, e.g., the ionization of water yields H^+ and OH^- .
- iris** The pigmented portion of the vertebrate eye.
- iron-sulfur world hypothesis** The hypothesis that simple organic molecules that are the precursors of life originated at hydrothermal vents in the deep-ocean floor. Compare with *prebiotic soup hypothesis*.
- irreversible inhibitor** A substance that permanently inactivates an enzyme. Compare with *reversible inhibitor*.
- islets of Langerhans** (eye'lets of lahng'er-hanz) The endocrine portion of the pancreas that secretes glucagon and insulin, hormones that regulate the concentration of glucose in the blood.
- isogamy** (eye-sog'uh-me) Sexual reproduction involving motile gametes of similar form and size. Compare with *anisogamy* and *oogamy*.
- isolecithal egg** An egg containing a relatively small amount of uniformly distributed yolk. Compare with *telolecithal egg*.
- isomer** (eye'soh-mer) One of two or more chemical compounds having the same chemical formula but different structural formulas, e.g., structural and geometrical isomers and enantiomers.
- isoprene units** Five-carbon hydrocarbon monomers that make up certain lipids such as carotenoids and steroids.
- isotonic** (eye'soh-ton'ik) A term applied to solutions that have identical concentrations of solute molecules and hence the same osmotic pressure. Compare with *hypertonic* and *hypotonic*.
- isotope** (eye'suh-tope) An alternative form of an element with a different number of neutrons but the same number of protons and electrons. See *radioisotopes*.
- iteroparity** The condition of having repeated reproductive cycles throughout a lifetime. Compare with *semelparity*.
- jasmonate** One of a group of lipid-derived plant hormones that affect several processes, such as pollen development, root growth, fruit ripening, and senescence; also involved in defense against insect pests and disease-causing organisms.
- jelly coat** One of the acellular coverings of the eggs of certain animals, such as echinoderms.
- joint** The junction between two or more bones of the skeleton.
- joule** A unit of energy, equivalent to 0.239 calorie.
- juvenile hormone (JH)** An arthropod hormone that preserves juvenile structure during a molt. Without it, metamorphosis toward the adult form takes place.
- juxtaglomerular apparatus** (juks'tah-glo-mer'yoo-lar) A structure in the kidney that secretes renin in response to a decrease in blood pressure.
- K selection** A reproductive strategy recognized by some ecologists in which a species typically has a large body size, slow development, and long life span and does not devote a large proportion of its metabolic energy to the production of offspring. Compare with *r selection*.
- karyogamy** (kar-e-og'uh-me) The fusion of two haploid nuclei; follows fusion (plasmogamy) of cells from two sexually compatible mating types.
- karyotype** (kare'ee-oh-type) The chromosomal composition of an individual.
- keratin** (kare'ah-tin) A horny, water-insoluble protein found in the epidermis of vertebrates and in nails, feathers, hair, and horns.
- ketone** An organic molecule containing a carbonyl group bonded to two carbon atoms. Compare with *aldehyde*.
- keystone species** A species whose presence in an ecosystem largely determines the species composition and functioning of that ecosystem.
- kidney** The paired vertebrate organ important in excretion of metabolic wastes and in osmoregulation.
- killer T cell** See *T cytotoxic cell*.
- kilobase (kb)** 1000 bases or base pairs of a nucleic acid.
- kilocalorie** The amount of heat required to raise the temperature of 1 kg of water 1°C; also called *Calorie*, which is equivalent to 1000 calories.
- kilojoule** 1000 joules. See *joule*.
- kinases** Enzymes that catalyze the transfer of phosphate groups from ATP to acceptor molecules. See *protein kinases*.
- kinetic energy** Energy of motion. Compare with *potential energy*.
- kinetochore** (kin-eh'toh-kore) The portion of the chromosome centromere to which the mitotic spindle fibers attach.
- kingdom** A broad taxonomic category made up of related phyla; many biologists currently recognize six kingdoms of living organisms.
- kin selection** A type of natural selection that favors altruistic behavior toward relatives (kin), thereby ensuring that although the chances of an individual's survival are lessened, some of its genes will survive through successful reproduction of close relatives; increases inclusive fitness.
- Klinefelter syndrome** Inherited condition in which the affected individual is a sterile male with an XXY karyotype.
- Koch's postulates** A set of guidelines used to demonstrate that a specific pathogen causes specific disease symptoms.
- Krebs cycle** See *citric acid cycle*.
- krummholz** The gnarled, shrublike growth habit found in trees at high elevations, near their upper limit of distribution.
- labyrinth** The system of interconnecting canals of the inner ear of vertebrates.
- labyrinthodonts** The first successful group of tetrapods.
- lactate (lactic acid)** A three-carbon organic acid.
- lactation** (lak-tay'shun) The production or release of milk from the breast.
- lacteal** (lak'tee-al) One of the many lymphatic vessels in the intestinal villi that absorb fat.
- lagging strand** A strand of DNA that is synthesized as a series of short segments, called *Okazaki fragments*, which are then covalently joined by DNA ligase. Compare with *leading strand*.
- lamins** Polypeptides attached to the inner surface of the nuclear envelope that provide a type of skeletal framework.
- landscape** A large land area (several to many square kilometers) composed of interacting ecosystems.

- landscape ecology** The subdiscipline in ecology that studies the connections in a heterogeneous landscape.
- large intestine** The portion of the digestive tract of humans (and other vertebrates) consisting of the cecum, colon, rectum, and anus.
- larva** (pl., *larvae*) An immature form in the life history of some animals; may be unlike the parent.
- larynx** (lare'inks) The organ at the upper end of the trachea that contains the vocal cords.
- lateral meristems** Areas of localized cell division on the side of a plant that give rise to secondary tissues. Lateral meristems, including the vascular cambium and the cork cambium, cause an increase in the girth of the plant body. Compare with *apical meristem*.
- leaching** The process by which dissolved materials are washed away or carried with water down through the various layers of the soil.
- leader sequence** Noncoding sequence of nucleotides in mRNA that is transcribed from the region that precedes (is upstream to) the coding region.
- leading strand** Strand of DNA that is synthesized continuously. Compare with *lagging strand*.
- learning** A change in the behavior of an animal that results from experience.
- legume** (leg'yoom) (1) A simple, dry fruit that develops from a single carpel and splits open at maturity along two sutures to release seeds. (2) Any member of the pea family, e.g., pea, bean, peanut, alfalfa.
- lek** A small territory in which males compete for females.
- lens** The oval, transparent structure located behind the iris of the vertebrate eye; bends incoming light rays and brings them to a focus on the retina.
- lenticels** (len'tih-sels) Porous swellings of cork cells in the stems of woody plants; facilitate the exchange of gases.
- leptin** A hormone produced by adipose tissue that signals brain centers about the status of energy stores.
- leukocytes** (loo'koh-sites) White blood cells; colorless amoeboid cells that defend the body against disease-causing organisms.
- leukoplasts** Colorless plastids; include amyloplasts, which are used for starch storage in cells of roots and tubers.
- lichen** (ly'ken) A compound organism consisting of a symbiotic fungus and an alga or cyanobacterium.
- life history traits** Significant features of a species' life cycle, particularly traits that influence survival and reproduction.
- life span** The maximum duration of life for an individual of a species.
- life table** A table showing mortality and survival data by age of a population or cohort.
- ligament** (lig'uh-ment) A connective tissue cable or strap that connects bones to each other or holds other organs in place.
- ligand** A molecule that binds to a specific site in a receptor or other protein.
- light-dependent reactions** Reactions of photosynthesis in which light energy absorbed by chlorophyll is used to synthesize ATP and usually NADPH. Include *cyclic electron transport* and *noncyclic electron transport*.
- lignin** (lig'nin) A substance found in many plant cell walls that confers rigidity and strength, particularly in woody tissues.
- limbic system** In vertebrates, an action system of the brain. In humans, plays a role in emotional responses, motivation, autonomic function, and sexual response.
- limiting resource** An environmental resource that because it is scarce or unfavorable tends to restrict the ecological niche of an organism.
- limnetic zone** (lim-net'ik) The open water away from the shore of a lake or pond extending down as far as sunlight penetrates. Compare with *littoral zone* and *profundal zone*.
- linkage** The tendency for a group of genes located on the same chromosome to be inherited together in successive generations.
- lipase** (lip'ase) A fat-digesting enzyme.
- lipid** Any of a group of organic compounds that are insoluble in water but soluble in nonpolar solvents; lipids serve as energy storage and are important components of cell membranes.
- lipoprotein** (lip-oh-proh'teen) A large molecular complex consisting of lipids and protein; transports lipids in the blood. High-density lipoproteins (HDLs) transport cholesterol to the liver; low-density lipoproteins (LDLs) deliver cholesterol to many cells of the body.
- littoral zone** (lit'or-ul) The region of shallow water along the shore of a lake or pond. Compare with *limnetic zone* and *profundal zone*.
- liver** A large, complex organ that secretes bile, helps maintain homeostasis by removing or adding nutrients to the blood, and performs many other metabolic functions.
- liverworts** A phylum of spore-producing, nonvascular, thallose or leafy plants with a life cycle similar to that of mosses.
- local hormones** See *local regulators*.
- local regulators** Prostaglandins (a group of local hormones), growth factors, cytokines, and other soluble molecules that act on nearby cells by paracrine regulation or act on the cells that produce them (autocrine regulation).
- locus** The place on the chromosome at which the gene for a given trait occurs, i.e., a segment of the chromosomal DNA containing information that controls some feature of the organism; also called *gene locus*.
- logistic population growth** Population growth that initially occurs at a constant rate of increase over time (i.e., exponential) but then levels out as the carrying capacity of the environment is approached. Compare with *exponential population growth*.
- long-day plant** A plant that flowers in response to shortening nights; also called *short-night plant*. Compare with *short-day*, *intermediate-day*, and *day-neutral plants*.
- long-night plant** See *short-day plant*.
- long-term potentiation (LTP)** Long-lasting increase in the strength of synaptic connections that occurs in response to a series of high-frequency electrical stimuli. Compare with *long-term synaptic depression (LTD)*.
- long-term synaptic depression (LTD)** Long-lasting decrease in the strength of synaptic connections that occurs in response to low-frequency stimulation of neurons. Compare with *long-term potentiation (LTP)*.
- loop of Henle** (hen'lee) The U-shaped loop of a mammalian kidney tubule that extends down into the renal medulla.
- loose connective tissue** A type of connective tissue that is widely distributed in the body; consists of fibers strewn through a semi-fluid matrix.
- lophophorate phyla** Three related invertebrate protostome phyla, characterized by a ciliated ring of tentacles that surrounds the mouth.
- Lophotrochozoa** A branch of the protostomes that includes the flatworms, nemertean (proboscis worms), mollusks, annelids, and the lophophorate phyla.
- low-density lipoprotein (LDL)** See *lipoprotein*.
- lumen** (loo'men) (1) The space enclosed by a membrane, such as the lumen of the endoplasmic reticulum or the thylakoid lumen. (2) The cavity or channel within a tube or tubular organ, such as a blood vessel or the digestive tract. (3) The space left within a plant cell after the cell's living material dies, as in tracheids.

- lung** An internal respiratory organ that functions in gas exchange; enables an animal to breathe air.
- luteinizing hormone (LH)** (loo't'eh-ny-zing) Gonadotropic hormone secreted by the anterior pituitary; stimulates ovulation and maintains the corpus luteum in the ovaries of females; stimulates testosterone production in the testes of males.
- lymph** (limf) The colorless fluid within the lymphatic vessels that is derived from blood plasma; contains white blood cells; ultimately lymph is returned to the blood.
- lymph node** A mass of lymph tissue surrounded by a connective tissue capsule; manufactures lymphocytes and filters lymph.
- lymphatic system** A subsystem of the cardiovascular system; returns excess interstitial fluid (lymph) to the circulation; defends the body against disease organisms.
- lymphocyte** (lim'foh-site) White blood cell with nongranular cytoplasm that governs immune responses. See *B cell* and *T cell*.
- lysis** (ly'sis) The process of disintegration of a cell or some other structure.
- lysogenic conversion** The change in properties of bacteria that results from the presence of a prophage.
- lysosomes** (ly'soh-sohmz) Intracellular organelles present in many animal cells; contain a variety of hydrolytic enzymes.
- lysozyme** An enzyme found in many tissues and in tears and other body fluids; attacks the cell wall of many gram-positive bacteria.
- macroevolution** Large-scale evolutionary events over long time spans. Macroevolution results in phenotypic changes in populations that are significant enough to warrant their placement in taxonomic groups at the species level and higher. Compare with *microevolution*.
- macromolecule** A very large organic molecule, such as a protein or nucleic acid.
- macronucleus** A large nucleus found, along with one or several micronuclei, in ciliates. The macronucleus regulates metabolism and growth. Compare with *micronucleus*.
- macronutrient** An essential element required in fairly large amounts for normal growth. Compare with *micronutrient*.
- macrophage** (mak'roh-faje) A large phagocytic cell capable of ingesting and digesting bacteria and cell debris. Macrophages are also antigen-presenting cells.
- magnoliid** One of the clades of flowering plants; magnoliids are core angiosperms that were traditionally classified as "dicots," but molecular evidence indicates they are neither eudicots or monocots.
- major histocompatibility complex (MHC)** A group of membrane proteins, present on the surface of most cells, that are slightly different in each individual. In humans, the MHC is called the *HLA (human leukocyte antigen) group*.
- malignant cells** Cancer cells; tumor cells that are able to invade tissue and metastasize.
- malignant transformation** See *transformation*.
- malnutrition** Poor nutritional status; results from dietary intake that is either below or above required needs.
- Malpighian tubules** (mal-pig'ee-an) The excretory organs of many arthropods.
- mammals** The class of vertebrates characterized by hair, mammary glands, a diaphragm, and differentiation of teeth.
- mandible** (man'dih-bl) (1) The lower jaw of vertebrates. (2) Jaw-like, external mouthparts of insects.
- mangrove forest** A tidal wetland dominated by mangrove trees in which the salinity fluctuates between that of sea water and fresh water.
- mantle** In the mollusk, a fold of tissue that covers the visceral mass and that usually produces a shell.
- marine snow** The organic debris (plankton, dead organisms, fecal material, etc.) that "rains" into the dark area of the oceanic province from the lighted region above; the primary food of most organisms that live in the ocean's depths.
- marsupials** (mar-soo'pee-ulz) A subclass of mammals, characterized by the presence of an abdominal pouch in which the young, which are born in a very undeveloped condition, are carried for some time after birth.
- mass extinction** The extinction of numerous species during a relatively short period of geologic time. Compare with *background extinction*.
- mast cell** A type of cell found in connective tissue; contains histamine and is important in an inflammatory response and in allergic reactions.
- maternal effect genes** Genes of the mother that are transcribed during oogenesis and subsequently affect the development of the embryo. Compare with *zygotic genes*.
- matrix** (may'triks) (1) In cell biology, the interior of the compartment enclosed by the inner mitochondrial membrane. (2) In zoology, nonliving material secreted by and surrounding connective tissue cells; contains a network of microscopic fibers.
- matter** Anything that has mass and takes up space.
- maxillae** Appendages used for manipulating food; characteristic of crustaceans.
- mechanical isolation** A prezygotic reproductive isolating mechanism in which fusion of the gametes of two species is prevented by morphological or anatomical differences.
- mechanoreceptor** (meh-kan'oh-ree-sep'tor) A sensory cell or organ that perceives mechanical stimuli, e.g., touch, pressure, gravity, stretching, or movement.
- medulla** (meh-dul'uh) (1) The inner part of an organ, such as the medulla of the kidney. Compare with *cortex*. (2) The most posterior part of the vertebrate brain, lying next to the spinal cord.
- medusa** A jellyfish-like animal; a free-swimming, umbrella-shaped stage in the life cycle of certain cnidarians. Compare with *polyp*.
- megaphyll** (meg'uh-fil) Type of leaf found in horsetails, ferns, gymnosperms, and angiosperms; contains multiple vascular strands (i.e., complex venation). Compare with *microphyll*.
- megaspore** (meg'uh-spor) The *n* spore in heterosporous plants that gives rise to a female gametophyte. Compare with *microspore*.
- meiosis** (my-oh'sis) Process in which a $2n$ cell undergoes two successive nuclear divisions (meiosis I and meiosis II), potentially producing four *n* nuclei; leads to the formation of gametes in animals and spores in plants.
- melanin** A dark pigment present in many animals; contributes to the color of the skin.
- melanocortins** A group of peptides that appear to decrease appetite in response to increased fat stores.
- melatonin** (mel-ah-toh'nin) A hormone secreted by the pineal gland that plays a role in setting circadian rhythms.
- memory cell** B or T cell (lymphocyte) that permits rapid mobilization of immune response on second or subsequent exposure to a particular antigen. Memory B cells continue to produce antibodies after the immune system overcomes an infection.
- meninges** (meh-nin'jeez) (sing., *meninx*) The three membranes that protect the brain and spinal cord: the dura mater, arachnoid, and pia mater.
- menopause** The period (usually occurring between 45 and 55 years of age) in women when the recurring menstrual cycle ceases.
- menstrual cycle** (men'stroo-ul) In the human female, the monthly sequence of events that prepares the body for pregnancy.

- menstruation** (men-stroo-ay'shun) The monthly discharge of blood and degenerated uterine lining in the human female; marks the beginning of each menstrual cycle.
- meristem** (mer'ih-stem) A localized area of mitotic cell division in the plant body. See *apical meristem* and *lateral meristems*.
- meroblastic cleavage** Cleavage pattern observed in the telolecithal eggs of reptiles and birds, in which cleavage is restricted to a small disc of cytoplasm at the animal pole. Compare with *holoblastic cleavage*.
- mesencephalon** See *midbrain*.
- mesenchyme** (mes'en-kime) A loose, often jellylike connective tissue containing undifferentiated cells; found in the embryos of vertebrates and the adults of some invertebrates.
- mesoderm** (mez'oh-derm) The middle germ layer of the early embryo; gives rise to connective tissue, muscle, bone, blood vessels, kidneys, and many other structures. Compare with *ectoderm* and *endoderm*.
- mesophyll** (mez'oh-fil) Photosynthetic tissue in the interior of a leaf; sometimes differentiated into palisade mesophyll and spongy mesophyll.
- Mesozoic era** That part of geologic time extending from roughly 251 million to 66 million years ago.
- messenger RNA (mRNA)** RNA that specifies the amino acid sequence of a protein; transcribed from DNA.
- metabolic pathway** A series of chemical reactions in which the product of one reaction becomes the substrate of the next reaction.
- metabolic rate** Energy use by an organism per unit time. See *basal metabolic rate (BMR)*.
- metabolism** The sum of all the chemical processes that occur within a cell or organism; the transformations by which energy and matter are made available for use by the organism. See *anabolism* and *catabolism*.
- metamorphosis** (met'ah-mor'fuh-sis) Transition from one developmental stage to another, such as from a larva to an adult.
- metanephridia** (sing., *metanephridium*) The excretory organs of annelids and mollusks; each consists of a tubule open at both ends; at one end a ciliated funnel opens into the coelom, and the other end opens to the outside of the body.
- metaphase** (met'ah-faze) The stage of mitosis in which the chromosomes line up on the midplane of the cell. Occurs after prometaphase and before anaphase.
- metapopulation** A population that is divided into several local populations among which individuals occasionally disperse.
- metastasis** (met-tas'tuh-sis) The spreading of cancer cells from one organ or part of the body to another.
- metencephalon** See *hindbrain*.
- methyl group** A nonpolar functional group; abbreviated —CH₃.
- micro RNAs (miRNAs)** Single-stranded RNA molecules about 21 to 22 nucleotides long that inhibit the translation of mRNAs involved in growth and development.
- microclimate** Local variations in climate produced by differences in elevation, in the steepness and direction of slopes, and in exposure to prevailing winds.
- microevolution** Small-scale evolutionary change caused by changes in allele or genotype frequencies that occur within a population over a few generations. Compare with *macroevolution*.
- microfilaments** Thin fibers consisting of actin protein subunits; form part of the cytoskeleton.
- microfossils** Ancient traces (fossils) of microscopic life.
- microglia** Phagocytic glial cells found in the CNS.
- micronucleus** One or more smaller nuclei found, along with the macronucleus, in ciliates. The micronucleus is involved in sexual reproduction. Compare with *macronucleus*.
- micronutrient** An essential element that is required in trace amounts for normal growth. Compare with *macronutrient*.
- microphyll** (mi'kro-fil) Type of leaf found in club mosses; contains one vascular strand (i.e., simple venation). Compare with *megaphyll*.
- microsphere** A protobiont produced by adding water to abiotically formed polypeptides.
- microspore** (mi'kro-spor) The *n* spore in heterosporous plants that gives rise to a male gametophyte. Compare with *megaspore*.
- microsporidia** Small, unicellular, fungal parasites that infect eukaryotic cells; classified with the zygomycetes.
- microtubule-associated proteins (MAPs)** Include structural proteins that help regulate microtubule assembly and cross-link microtubules to other cytoskeletal polymers; and motors, such as kinesin and dynein, that use ATP to produce movement.
- microtubule-organizing center (MTOC)** The region of the cell from which microtubules are anchored and possibly assembled. The MTOCs of many organisms (including animals, but not flowering plants or most gymnosperms) contain a pair of centrioles.
- microtubules** (my-kroh-too'bewls) Hollow, cylindrical fibers consisting of tubulin protein subunits; major components of the cytoskeleton and found in mitotic spindles, cilia, flagella, centrioles, and basal bodies.
- microvilli** (sing., *microvillus*) Minute projections of the plasma membrane that increase the surface area of the cell; found mainly in cells concerned with absorption or secretion, such as those lining the intestine or the kidney tubules.
- midbrain** In vertebrate embryos, one of the three divisions of the developing brain. Also called *mesencephalon*. Compare with *forebrain* and *hindbrain*.
- middle lamella** The layer composed of pectin polysaccharides that serves to cement together the primary cell walls of adjacent plant cells.
- midvein** The main, or central, vein of a leaf.
- migration** (1) The periodic or seasonal movement of an organism (individual or population) from one place to another, usually over a long distance. See *dispersal*. (2) In evolutionary biology, a movement of individuals that results in a transfer of alleles from one population to another. See *gene flow*.
- mineralocorticoids** (min'ur-al-oh-kor'tih-koidz) Hormones produced by the adrenal cortex that regulate mineral metabolism and, indirectly, fluid balance. The principal mineralocorticoid is aldosterone.
- minerals** Inorganic nutrients ingested as salts dissolved in food and water.
- minimum viable population (MVP)** The smallest population size at which a species has a high chance of sustaining its numbers and surviving into the future.
- mismatch repair** A DNA repair mechanism in which special enzymes recognize the incorrectly paired nucleotides and remove them. DNA polymerases then fill in the missing nucleotides.
- missense mutation** A type of base-substitution mutation that causes one amino acid to be substituted for another in the resulting protein product. Compare with *nonsense mutation*.
- mitochondria** (my'toh-kon'dree-ah) (sing., *mitochondrion*) Intracellular organelles that are the sites of oxidative phosphorylation in eukaryotes; include an outer membrane and an inner membrane.

- mitochondrial DNA (mtDNA)** DNA present in mitochondria that is transmitted maternally, from mothers to their offspring. Mitochondrial DNA mutates more rapidly than nuclear DNA.
- mitosis** (my-toh'sis) The division of the cell nucleus resulting in two daughter nuclei, each with the same number of chromosomes as the parent nucleus; mitosis consists of prophase, prometaphase, metaphase, anaphase, and telophase. Cytokinesis usually overlaps the telophase stage.
- mitotic spindle** Structure consisting mainly of microtubules that provides the framework for chromosome movement during cell division.
- mitral valve** See *atrioventricular valve*.
- mobile genetic element** See *transposon*.
- model organism** A species chosen for biological studies because it has characteristics that allow for the efficient analysis of biological processes. Most model organisms are small, have short generation times, and are easy to grow and study under controlled conditions.
- modern synthesis** A comprehensive, unified explanation of evolution based on combining previous theories, especially of Mendelian genetics, with Darwin's theory of evolution by natural selection; also called the *synthetic theory of evolution*.
- mole** The atomic mass of an element or the molecular mass of a compound, expressed in grams; one mole of any substance has 6.02×10^{23} units (Avogadro's number).
- molecular anthropology** The branch of science that compares genetic material from individuals of regional human populations to help unravel the origin and migrations of modern humans.
- molecular chaperones** Proteins that help other proteins fold properly. Although not dictating the folding pattern, chaperones make the process more efficient.
- molecular clock analysis** A comparison of the DNA nucleotide sequences of related organisms to estimate when they diverged from one another during the course of evolution.
- molecular formula** The type of chemical formula that gives the actual numbers of each type of atom in a molecule. Compare with *simplest formula* and *structural formula*.
- molecular mass** The sum of the atomic masses of the atoms that make up a single molecule of a compound; expressed in atomic mass units (amu) or daltons.
- molecule** The smallest particle of a covalently bonded element or compound; two or more atoms joined by covalent bonds.
- mollusks** A phylum of coelomate protostome animals characterized by a soft body, visceral mass, mantle, and foot.
- molting** The shedding and replacement of an outer covering such as an exoskeleton.
- molting hormone** A steroid hormone that stimulates growth and molting in insects. Also called *ecdysone*.
- monoacylglycerol** (mon"o-as"il-glis'er-ol) Lipid consisting of glycerol combined chemically with a single fatty acid. Also called *monoglyceride*. Compare with *diacylglycerol* and *triacylglycerol*.
- monocot** (mon'oh-kot) One of two classes of flowering plants; monocot seeds contain a single cotyledon, or seed leaf. Compare with *eudicot*.
- monoclonal antibodies** Identical antibody molecules produced by cells cloned from a single cell.
- monocyte** (mon'oh-site) A type of white blood cell; a large, phagocytic, nongranular leukocyte that enters the tissues and differentiates into a macrophage.
- monoecious** (mon-ee'shus) Having male and female reproductive parts in separate flowers or cones on the same plant; compare with *dioecious*.
- monogamy** A mating system in which a male animal mates with a single female during a breeding season.
- monoglyceride** See *monoacylglycerol*.
- monohybrid cross** A genetic cross that takes into account the behavior of alleles of a single locus. Compare with *dihybrid cross*.
- monokaryotic** (mon"o-kare-ee-ot'ik) The condition of having a single *n* nucleus per cell, characteristic of certain fungal hyphae. Compare with *dikaryotic*.
- monomer** (mon'oh-mer) A molecule that can link with other similar molecules; two monomers join to form a dimer, whereas many form a polymer. Monomers are small (e.g., sugars or amino acids) or large (e.g., tubulin or actin proteins).
- monophyletic group** (mon"oh-fye-let'ik) A group of organisms that evolved from a common ancestor. Compare with *polyphyletic group* and *paraphyletic group*.
- monosaccharide** (mon-oh-sak'ah-ride) A sugar that cannot be degraded by hydrolysis to a simpler sugar (e.g., glucose or fructose).
- monosomy** The condition in which only one member of a chromosome pair is present and the other is missing. Compare with *trisomy* and *disomy*.
- monotremes** (mon'oh-treemz) Egg-laying mammals such as the duck-billed platypus of Australia.
- monounsaturated fatty acid** See *fatty acid*.
- monozygotic twins** Genetically identical twins that arise from the division of a single fertilized egg; commonly known as *identical twins*. Compare with *dizygotic twins*.
- morphogen** Any chemical agent thought to govern the processes of cell differentiation and pattern formation that lead to morphogenesis.
- morphogenesis** (mor-foh-jen'eh-sis) The development of the form and structures of an organism and its parts; proceeds by a series of steps known as *pattern formation*.
- mortality** The rate at which individuals die; the average per capita death rate.
- morula** (mor'yoo-lah) An early embryo consisting of a solid ball of cells.
- mosaic development** A rigid developmental pattern in which the fates of cells become restricted early in development. Compare with *regulative development*.
- mosses** A phylum of spore-producing nonvascular plants with an alternation of generations in which the dominant *n* gametophyte alternates with a *2n* sporophyte that remains attached to the gametophyte.
- motor neuron** An efferent neuron that transmits impulses away from the central nervous system to skeletal muscle.
- motor program** A coordinated sequences of muscle actions responsible for many behaviors we think of as automatic.
- motor unit** All the skeletal muscle fibers that are stimulated by a single motor neuron.
- mRNA cap** An unusual nucleotide, 7-methylguanylate, that is added to the 5' end of a eukaryotic messenger RNA. Capping enables eukaryotic ribosomes to bind to mRNA.
- mucosa** (mew-koh'suh) See *mucous membrane*.
- mucous membrane** A type of epithelial membrane that lines a body cavity that opens to the outside of the body, e.g., the digestive and respiratory tracts; also called *mucosa*.
- mucus** (mew'cus) A sticky secretion composed of covalently linked protein and carbohydrate; serves to lubricate body parts and trap particles of dirt and other contaminants. (The adjectival form is spelled *mucous*.)
- Müllerian mimicry** (mul-ler'ee-un mim'ih-kree) The resemblance of dangerous, unpalatable, or poisonous species to one another

- so that potential predators recognize them more easily. Compare with *Batesian mimicry*.
- multiple alleles** (al-leelz') Three or more alleles of a single locus (in a population), such as the alleles governing the ABO series of blood types.
- multiple fruit** A fruit that develops from many ovaries of many separate flowers, e.g., pineapple. Compare with *simple*, *aggregate*, and *accessory fruits*.
- muscle** (1) A tissue specialized for contraction. (2) An organ that produces movement by contraction.
- mutagen** (mew'tah-jen) Any agent capable of entering the cell and producing mutations.
- mutation** Any change in DNA; may include a change in the nucleotide base pairs of a gene, a rearrangement of genes within the chromosomes so that their interactions produce different effects, or a change in the chromosomes themselves.
- mutualism** (1) In ecology, a symbiotic relationship in which both partners benefit from the association. Compare with *parasitism* and *commensalism*. (2) In animal behavior, cooperative behavior in which each animal in the group benefits.
- mycelium** (my-seel'ee-um) (pl., *mycelia*) The vegetative body of most fungi and certain protists (water molds); consists of a branched network of hyphae.
- mycorrhizae** (my'kor-rye'zee) Mutualistic associations of fungi and plant roots that aid in the plant's absorption of essential minerals from the soil.
- mycotoxins** Poisonous chemical compounds produced by fungi, e.g., aflatoxins that harm the liver and are known carcinogens.
- myelencephalon** See *hindbrain*.
- myelin sheath** (my'eh-lin) The white, fatty material that forms a sheath around the axons of certain nerve cells, which are then called *myelinated fibers*.
- myocardial infarction (MI)** Heart attack; serious consequence occurring when the heart muscle receives insufficient oxygen.
- myofibrils** (my-oh-fy'brilz) Tiny threadlike structures in the cytoplasm of striated and cardiac muscle that are composed of myosin filaments and actin filaments; these filaments are responsible for muscle contraction; see *myosin filaments* and *actin filaments*.
- myoglobin** (my'oh-glo'bin) A hemoglobin-like, oxygen-transferring protein found in muscle.
- myosin** (my'oh-sin) A protein that together with actin is responsible for muscle contraction.
- myosin filaments** Thick filaments consisting mainly of the protein myosin; actin and myosin filaments make up the myofibrils of muscle fibers.
- n** The chromosome number of a gamete. The chromosome number of a zygote is $2n$. If an organism is not polyploid, the n gametes are haploid and the $2n$ zygotes are diploid.
- NAD⁺/NADH** Oxidized and reduced forms, respectively, of nicotinamide adenine dinucleotide, a coenzyme that transfers electrons (as hydrogen), particularly in catabolic pathways, including cellular respiration.
- NADP⁺/NADPH** Oxidized and reduced forms, respectively, of nicotinamide adenine dinucleotide phosphate, a coenzyme that acts as an electron (hydrogen) transfer agent, particularly in anabolic pathways, including photosynthesis.
- nanoplankton** Extremely minute (<20 μm in length) algae that are major producers in the ocean because of their great abundance; part of phytoplankton.
- natality** The rate at which individuals produce offspring; the average per capita birth rate.
- natural killer cell (NK cell)** A large, granular lymphocyte that functions in both nonspecific and specific immune responses; releases cytokines and proteolytic enzymes that target tumor cells and cells infected with viruses and other pathogens.
- natural selection** The mechanism of evolution proposed by Charles Darwin; the tendency of organisms that have favorable adaptations to their environment to survive and become the parents of the next generation. Evolution occurs when natural selection results in changes in allele frequencies in a population.
- necrosis** Uncontrolled cell death that causes inflammation and damages other cells. Compare with *apoptosis*.
- nectary** (nek'ter-ee) In plants, a gland or other structure that secretes nectar.
- negative feedback mechanism** A homeostatic mechanism in which a change in some condition triggers a response that counteracts, or reverses, the changed condition, restoring homeostasis, e.g., how mammals maintain body temperature. Compare with *positive feedback mechanism*.
- nekton** (nek'ton) Free-swimming aquatic organisms such as fish and turtles. Compare with *plankton*.
- nematocyst** (nem-at'oh-sist) A stinging structure found within cnidocytes (stinging cells) in cnidarians; used for anchorage, defense, and capturing prey.
- nematodes** The phylum of animals commonly known as *roundworms*.
- nemerteans** The phylum of animals commonly known as *ribbon worms*; each has a proboscis (tubular feeding organ) for capturing prey.
- neonate** Newborn individual.
- neoplasm** See *tumor*.
- nephridial organ** (neh-frid'ee-al) The excretory organ of many invertebrates; consists of simple or branching tubes that usually open to the outside of the body through pores; also called *nephridium*.
- nephron** (nef'ron) The functional, microscopic unit of the vertebrate kidney.
- neritic province** (ner-ih'tik) Ocean water that extends from the shoreline to where the bottom reaches a depth of 200 m. Compare with *oceanic province*.
- nerve** A bundle of axons (or dendrites) wrapped in connective tissue that conveys impulses between the central nervous system and some other part of the body.
- nerve net** A system of interconnecting nerve cells found in cnidarians and echinoderms.
- nervous tissue** A type of animal tissue specialized for transmitting electrical and chemical signals.
- net primary productivity** The energy that remains in an ecosystem (as biomass) after cellular respiration has occurred; net primary productivity equals gross primary productivity minus respiration. Compare with *gross primary productivity*.
- neural crest** (noor'ul) A group of cells along the neural tube that migrate and form various parts of the embryo, including parts of the peripheral nervous system.
- neural plasticity** The ability of the nervous system to change in response to experience.
- neural plate** See *neural tube*.
- neural transmission** See *transmission, neural*.
- neural tube** The hollow, longitudinal structure in the early vertebrate embryo that gives rise to the brain and spinal cord. The neural tube forms from the neural plate, a flattened, thickened region of the ectoderm that rolls up and sinks below the surface.
- neuroendocrine cells** Neurons that produce neurohormones.

- neurohormones** Hormones produced by neuroendocrine cells; transported down axons and released into interstitial fluid; common in invertebrates; in vertebrates, hypothalamus produces neurohormones.
- neuron** (noor'on) A nerve cell; a conducting cell of the nervous system that typically consists of a cell body, dendrites, and an axon.
- neuropeptide** One of a group of peptides produced in neural tissue that function as signaling molecules; many are neurotransmitters.
- neuropeptide Y** A signaling molecule produced by the hypothalamus that increases appetite and slows metabolism; helps restore energy homeostasis when leptin levels and food intake are low.
- neurotransmitter** A chemical signal used by neurons to transmit impulses across a synapse.
- neutral solution** A solution of pH 7; there are equal concentrations of hydrogen ions [H^+] and hydroxide ions [OH^-]. Compare with *acidic solution* and *basic solution*.
- neutral variation** Variation that does not appear to confer any selective advantage or disadvantage to the organism.
- neutron** (noo'tron) An electrically neutral particle with a mass of 1 atomic mass unit (amu) found in the atomic nucleus. Compare with *proton* and *electron*.
- neutrophil** (new'truh-fil) A type of granular leukocyte important in immune responses; a type of phagocyte that engulfs and destroys bacteria and foreign matter.
- niche** (nich) The totality of an organism's adaptations, its use of resources, and the lifestyle to which it is fitted in its community; how an organism uses materials in its environment as well as how it interacts with other organisms; also called *ecological niche*. See *fundamental niche* and *realized niche*.
- nicotinamide adenine dinucleotide** See *NAD⁺/NADH*.
- nicotinamide adenine dinucleotide phosphate** See *NADP⁺/NADPH*.
- nitric oxide (NO)** A gaseous signaling molecule; a neurotransmitter.
- nitrification** (nie'tra-fuh-kay'shun) The conversion of ammonia (NH_3) to nitrate (NO_3^-) by certain bacteria (nitrifying bacteria) in the soil; part of the nitrogen cycle.
- nitrogen cycle** The worldwide circulation of nitrogen from the abiotic environment into living things and back into the abiotic environment.
- nitrogen fixation** The conversion of atmospheric nitrogen (N_2) to ammonia (NH_3) by certain bacteria; part of the nitrogen cycle.
- nitrogenase** (nie-traa'jen-ase) The enzyme responsible for nitrogen fixation under anaerobic conditions.
- nociceptors** (no'sih-sep-torz) Pain receptors; free endings of certain sensory neurons whose stimulation is perceived as pain.
- node** The area on a stem where each leaf is attached. Compare with *internode*.
- nodules** Swellings on the roots of plants, such as legumes, in which symbiotic nitrogen-fixing bacteria (*Rhizobium*) live.
- noncompetitive inhibitor** A substance that lowers the rate at which an enzyme catalyzes a reaction but does not bind to the active site. Compare with *competitive inhibitor*.
- noncyclic electron transport** In photosynthesis, the linear flow of electrons, produced by photolysis of water, through photosystems II and I; results in the formation of ATP (by chemiosmosis), NADPH, and O_2 . Compare with *cyclic electron transport*.
- nondisjunction** Abnormal separation of sister chromatids or of homologous chromosomes caused by their failure to disjoin (move apart) properly during mitosis or meiosis.
- nonpolar covalent bond** Chemical bond formed by the equal sharing of electrons between atoms of approximately equal electronegativity. Compare with *polar covalent bond*.
- nonpolar molecule** Molecule that does not have a positively charged end and a negatively charged end; nonpolar molecules are generally insoluble in water. Compare with *polar molecule*.
- nonsense mutation** A base-substitution mutation that results in an amino acid–specifying codon being changed to a termination (stop) codon; when the abnormal mRNA is translated, the resulting protein is usually truncated and nonfunctional. Compare with *missense mutation*.
- nonspecific immune responses** Mechanisms such as physical barriers (e.g., the skin) and phagocytosis that provide immediate and general protection against pathogens. Also called *innate immunity*. Compare with *specific immune responses*.
- norepinephrine** (nor-ep-ih-nef'rin) A neurotransmitter that is also a hormone secreted by the adrenal medulla.
- Northern blot** A technique in which RNA fragments, previously separated by gel electrophoresis, are transferred to a nitrocellulose membrane and detected by autoradiography or chemical luminescence. Compare with *Southern blot* and *Western blot*.
- notochord** (no'toe-kord) The flexible, longitudinal rod in the anterior-posterior axis that serves as an internal skeleton in the embryos of all chordates and in the adults of some.
- nuclear area** Region of a prokaryotic cell that contains DNA; not enclosed by a membrane. Also called *nucleoid*.
- nuclear envelope** The double membrane system that encloses the cell nucleus of eukaryotes.
- nuclear equivalence** The concept that the nuclei of all differentiated cells of an adult organism are genetically identical to one another and to the nucleus of the zygote from which they were derived. Compare with *genomic rearrangement* and *gene amplification*.
- nuclear pores** Structures in the nuclear envelope that allow passage of certain materials between the cell nucleus and the cytoplasm.
- nucleoid** See *nuclear area*.
- nucleolus** (new-klee'oh-lus) (pl., *nucleoli*) Specialized structure in the cell nucleus formed from regions of several chromosomes; site of assembly of the ribosomal subunits.
- nucleoplasm** The contents of the cell nucleus.
- nucleoside triphosphate** Molecule consisting of a nitrogenous base, a pentose sugar, and three phosphate groups, e.g., adenosine triphosphate (ATP).
- nucleosomes** (new'klee-oh-sohmz) Repeating units of chromatin structure, each consisting of a length of DNA wound around a complex of eight histone molecules. Adjacent nucleosomes are connected by a DNA linker region associated with another histone protein.
- nucleotide** (noo'klee-oh-tide) A molecule consisting of one or more phosphate groups, a five-carbon sugar (ribose or deoxyribose), and a nitrogenous base (purine or pyrimidine).
- nucleotide excision repair** A DNA repair mechanism commonly used to repair a damaged segment of DNA caused by the sun's ultraviolet radiation or by harmful chemicals.
- nucleus** (new'klee-us) (pl., *nuclei*) (1) The central region of an atom that contains the protons and neutrons. (2) A cell organelle in eukaryotes that contains the DNA and serves as the control center of the cell. (3) A mass of nerve cell bodies in the central nervous system. Compare with *ganglion*.
- nut** A simple, dry fruit that contains a single seed and is surrounded by a hard fruit wall.
- nutrients** The chemical substances in food that are used as components for synthesizing needed materials and/or as energy sources.
- nutrition** The process of taking in and using food (nutrients).
- obesity** Excess accumulation of body fat; a person is considered obese if the body mass index (BMI) is 30 or higher.

- obligate anaerobe** An organism that grows only in the absence of oxygen. Compare with *facultative anaerobe*.
- occipital lobes** Posterior areas of the mammalian cerebrum; interpret visual stimuli from the retina of the eye.
- oceanic province** That part of the open ocean that overlies an ocean bottom deeper than 200 m. Compare with *neritic province*.
- Okazaki fragment** One of many short segments of DNA, each 100 to 1000 nucleotides long, that must be joined by DNA ligase to form the lagging strand in DNA replication.
- olfactory epithelium** Tissue containing odor-sensing neurons.
- oligodendrocyte** A type of glial cell that forms myelin sheaths around neurons in the CNS.
- oligosaccharin** One of several signaling molecules in plants that trigger the production of phytoalexins and affect aspects of growth and development.
- ommatidium** (om"ah-tid'ee-um) (pl., *ommatidia*) One of the light-detecting units of a compound eye, consisting of a lens and a crystalline cone that focus light onto photoreceptors called *retinular cells*.
- omnivore** (om'nih-vore) An animal that eats a variety of plant and animal materials.
- oncogene** (on'koh-jeen) An abnormally functioning gene implicated in causing cancer. Compare with *proto-oncogene* and *tumor suppressor gene*.
- oocytes** (oh'oh-sites) Meiotic cells that give rise to egg cells (ova).
- oogamy** (oh-og'uh-me) The fertilization of a large, nonmotile female gamete by a small, motile male gamete. Compare with *isogamy* and *anisogamy*.
- oogenesis** (oh"oh-jen'eh-sis) Production of female gametes (eggs) by meiosis. Compare with *spermatogenesis*.
- ospore** A thick-walled, resistant spore formed from a zygote during sexual reproduction in water molds.
- open circulatory system** A type of circulatory system in which the blood bathes the tissues directly; characteristic of arthropods and many mollusks. Compare with *closed circulatory system*.
- open system** An entity that exchanges energy with its surroundings. Compare with *closed system*.
- operant conditioning** A type of learning in which an animal is rewarded or punished for performing a behavior it discovers by chance.
- operator site** One of the control regions of an operon; the DNA segment to which a repressor binds, thereby inhibiting the transcription of the adjacent structural genes of the operon.
- operculum** In bony fishes, a protective flap of the body wall that covers the gills.
- operon** (op'er-on) In prokaryotes, a group of structural genes that are coordinately controlled and transcribed as a single message, plus their adjacent regulatory elements.
- opisthokont** A member of a clade of eukaryotes, including certain protists (choanoflagellates), fungi, and animals; flagellate cells in this group have a single, posterior flagellum.
- opposable thumb** The arrangement of the fingers so that they are positioned opposite the thumb, enabling the organism to grasp objects.
- optimal foraging** The process of obtaining food in a manner that maximizes benefits and/or minimizes costs.
- orbital** Region in which electrons occur in an atom or molecule
- order** A taxonomic category made up of related families.
- organ** A specialized structure, such as the heart or liver, made up of tissues and adapted to perform a specific function or group of functions.
- organ of Corti** The structure within the inner ear of vertebrates that contains receptor cells that sense sound vibrations.
- organ system** An organized group of tissues and organs that work together to perform a specialized set of functions, e.g., the digestive system or circulatory system.
- organelle** One of the specialized structures within the cell, such as the mitochondria, Golgi complex, ribosomes, or contractile vacuole; many organelles are membrane-enclosed.
- organic compound** A compound consisting of a backbone made up of carbon atoms. Compare with *inorganic compound*.
- organism** Any living system consisting of one or more cells.
- organismic respiration** See *respiration*.
- organogenesis** The process of organ formation.
- orgasm** (or'gazm) The climax of sexual excitement.
- origin of replication** A specific site on the DNA where replication begins.
- osmoconformer** An animal in which the salt concentration of body fluids varies along with changes in the surrounding sea water so that it stays in osmotic equilibrium with its surroundings. Compare with *osmoregulator*.
- osmoregulation** (oz"moh-reg-yoo-lay'shun) The active regulation of the osmotic pressure of body fluids so that they do not become excessively dilute or excessively concentrated.
- osmoregulator** An animal that maintains an optimal salt concentration in its body fluids despite changes in salinity of its surroundings. Compare with *osmoconformer*.
- osmosis** (oz-moh'sis) The net movement of water (the principal solvent in biological systems) by diffusion through a selectively permeable membrane from a region of higher concentration of water (a hypotonic solution) to a region of lower concentration of water (a hypertonic solution).
- osmotic pressure** The pressure that must be exerted on the hypertonic side of a selectively permeable membrane to prevent diffusion of water (by osmosis) from the side containing pure water.
- osteichthyes** (os'tee-ick'thees) Historically, the vertebrate class of bony fishes. Biologists now divide bony fishes into three classes: Actinopterygii, the ray-finned fishes; Actinistia, the lobe-finned fishes; and Dipnoi, the lungfishes.
- osteoblast** (os'tee-oh-blast) A type of bone cell that secretes the protein matrix of bone. Also see *osteocyte*.
- osteoclast** (os'tee-oh-clast) Large, multinucleate cell that helps sculpt and remodel bones by dissolving and removing part of the bony substance.
- osteocyte** (os'tee-oh-site) A mature bone cell; an osteoblast that has become embedded within the bone matrix and occupies a lacuna.
- osteon** (os'tee-on) The spindle-shaped unit of bone composed of concentric layers of osteocytes organized around a central Haversian canal containing blood vessels and nerves.
- otoliths** (oh'toe-liths) Small calcium carbonate crystals in the sacculus and utricle of the inner ear; sense gravity and are important in static equilibrium.
- outbreeding** The mating of individuals of unrelated strains, also called *outcrossing*. Compare with *inbreeding*.
- outcrossing** See *outbreeding*.
- outgroup** In cladistics, a taxon that represents an approximation of the ancestral condition; the outgroup is related to the *ingroup* (the members of the group under study) but separated from the ingroup lineage before they diversified.
- ovary** (oh'var-ee) (1) In animals, one of the paired female gonads responsible for producing eggs and sex hormones. (2) In flowering plants, the base of the carpel that contains ovules; ovaries develop into fruits after fertilization.

- oviduct** (oh'vih-dukt) The tube that carries ova from the ovary to the uterus, cloaca, or body exterior. Also called *fallopian tube* or *uterine tube*.
- oviparous** (oh-vip'ur-us) Bearing young in the egg stage of development; egg laying. Compare with *viviparous* and *ovoviviparous*.
- ovoviviparous** (oh'voh-vih-vip'ur-us) A type of development in which the young hatch from eggs incubated inside the mother's body. Compare with *viviparous* and *oviparous*.
- ovulation** (ov-u-lay'shun) The release of an egg from the ovary.
- ovule** (ov'yool) The structure (i.e., megasporangium) in the plant ovary that develops into the seed following fertilization.
- ovum** (pl., ova) Female gamete of an animal.
- oxaloacetate** Four-carbon compound; important intermediate in the citric acid cycle and in the C₄ and CAM pathways of carbon fixation in photosynthesis.
- oxidants** Highly reactive molecules such as free radicals, peroxides, and superoxides that are produced during normal cell processes that require oxygen; can damage DNA and other molecules by snatching electrons. Compare with *antioxidants*.
- oxidation** The loss of one or more electrons (or hydrogen atoms) by an atom, ion, or molecule. Compare with *reduction*.
- oxidative phosphorylation** (fos'for-ih-lay'shun) The production of ATP using energy derived from the transfer of electrons in the electron transport system of mitochondria; occurs by chemiosmosis.
- oxygen-carrying capacity** The maximum amount of oxygen transported by hemoglobin.
- oxygen debt** The oxygen necessary to metabolize the lactic acid produced during strenuous exercise.
- oxygen-hemoglobin dissociation curve** A curve depicting the percentage saturation of hemoglobin with oxygen, as a function of certain variables such as oxygen concentration, carbon dioxide concentration, or pH.
- oxyhemoglobin** Hemoglobin that has combined with oxygen.
- oxytocin** (ok'see-tow'sin) Hormone secreted by the hypothalamus and released by the posterior lobe of the pituitary gland; stimulates contraction of the pregnant uterus and the ducts of mammary glands.
- ozone** A blue gas, O₃, with a distinctive odor that is a human-made pollutant near Earth's surface (in the troposphere) but a natural and essential component of the stratosphere.
- P generation (parental generation)** Members of two different true-breeding lines that are crossed to produce the F₁ generation.
- P680** Chlorophyll *a* molecules that serve as the reaction center of photosystem II, transferring photoexcited electrons to a primary acceptor; named by their absorption peak at 680 nm.
- P700** Chlorophyll *a* molecules that serve as the reaction center of photosystem I, transferring photoexcited electrons to a primary acceptor; named by their absorption peak at 700 nm.
- pacemaker (of the heart)** See *sinoatrial (SA) node*.
- Pacinian corpuscle** (pah-sin'ee-an kor'pus-el) A receptor located in the dermis of the skin that responds to pressure.
- paedomorphosis** Retention of juvenile or larval features in a sexually mature animal.
- pair bond** A stable relationship between animals of opposite sex that ensures cooperative behavior in mating and rearing the young.
- paleoanthropology** (pay'lee-o-an-thro-pol'uh-gee) The study of human evolution.
- Paleozoic era** That part of geologic time extending from roughly 542 million to 251 million years ago.
- palindromic** Reading the same forward and backward; DNA sequences are palindromic when the base sequence of one strand reads the same as its complement when both are read in the 5' to 3' direction.
- palisade mesophyll** (mez'oh-fil) The vertically stacked, columnar mesophyll cells near the upper epidermis in certain leaves. Compare with *spongy mesophyll*.
- pancreas** (pan'kree-us) Large gland located in the vertebrate abdominal cavity. The pancreas produces pancreatic juice containing digestive enzymes; also serves as an endocrine gland, secreting the hormones insulin and glucagon.
- panspermia** The idea that life did not originate on Earth but began elsewhere in the galaxy and drifted through space to Earth.
- parabronchi** (sing., *parabronchus*) Thin-walled ducts in the lungs of birds; gases are exchanged across their walls.
- paracrine regulation** A type of regulation in which a signal molecule (e.g., certain hormones) diffuses through interstitial fluid and acts on nearby target cells. Compare with *autocrine regulation*.
- paraphyletic group** A group of organisms made up of a common ancestor and some, but not all, of its descendants. Compare with *monophyletic group* and *polyphyletic group*.
- parapodia** (par'uh-poh'dee-ah) (sing., *parapodium*) Paired, thickly bristled paddlelike appendages extending laterally from each segment of polychaete worms.
- parasite** A heterotrophic organism that obtains nourishment from the living tissue of another organism (the host).
- parasitism** (par'uh-si-tiz'm) A symbiotic relationship in which one member (the parasite) benefits and the other (the host) is adversely affected. Compare with *commensalism* and *mutualism*.
- parasympathetic nervous system** A division of the autonomic nervous system concerned with the control of the internal organs; functions to conserve or restore energy. Compare with *sympathetic nervous system*.
- parathyroid glands** Small, pea-sized glands closely adjacent to the thyroid gland; they secrete parathyroid hormone, which regulates calcium and phosphate metabolism.
- parathyroid hormone (PTH)** A hormone secreted by the parathyroid glands; regulates calcium and phosphate metabolism.
- parenchyma** (par-en'kih-mah) Highly variable living plant cells that have thin primary walls; function in photosynthesis, the storage of nutrients, and/or secretion.
- parsimony** The principle based on the experience that the simplest explanation is most probably the correct one.
- parthenogenesis** (par'theh-noh-jen'eh-sis) The development of an unfertilized egg into an adult organism; common among honeybees, wasps, and certain other arthropods.
- partial pressure (of a gas)** The pressure exerted by a gas in a mixture, which is the same pressure it would exert if alone. For example, the partial pressure of atmospheric oxygen (P_{O₂}) is 160 mm Hg at sea level.
- parturition** (par'to-rish'un) The birth process.
- passive immunity** Temporary immunity that depends on the presence of immunoglobulins produced by another organism. Compare with *active immunity*.
- passive ion channel** A channel in the plasma membrane that permits the passage of specific ions such as Na⁺, K⁺, or Cl⁻.
- patch-clamp technique** A method that allows researchers to study the ion channels of a tiny patch of membrane by tightly sealing a micropipette to the patch and measuring the flow of ions through the channels.
- patchiness** See *clumped dispersion*.
- pathogen** (path'oh-gen) An organism, usually a microorganism, capable of producing disease.
- pathogen-associated molecular patterns (PAMPs)** Molecules on bacteria and other pathogens that combine with Toll-like receptors on macrophages, stimulating them to produce cytokines.

- pattern formation** See *morphogenesis*.
- pedigree** A chart constructed to show an inheritance pattern within a family through multiple generations.
- peduncle** The stalk of a flower or inflorescence.
- pellicle** A flexible outer covering consisting of protein; characteristic of certain protists, e.g., ciliates and euglenoids.
- penis** The male sexual organ of copulation in reptiles, mammals, and a few birds.
- pentose** A sugar molecule containing five carbons.
- people overpopulation** A situation in which there are too many people in a given geographic area; results in pollution, environmental degradation, and resource depletion. Compare with *consumption overpopulation*.
- pepsin** (pep'sin) An enzyme produced in the stomach that initiates digestion of protein.
- pepsinogen** The precursor of pepsin; secreted by chief cells in the gastric glands of the stomach.
- peptide** (pep'tide) A compound consisting of a chain of amino acid groups linked by peptide bonds. A dipeptide consists of two amino acids, a polypeptide of many.
- peptide bond** A distinctive covalent carbon-to-nitrogen bond that links amino acids in peptides and proteins.
- peptidoglycan** (pep'tid-oh-gly'kan) A modified protein or peptide having an attached carbohydrate; component of the bacterial cell wall.
- peptidyl transferase** The ribosomal enzyme that catalyzes the formation of a peptide bond.
- perennial plant** (purr-en'ee-ul) A woody or herbaceous plant that grows year after year, i.e., lives more than 2 years. Compare with *annual* and *biennial*.
- perfect flower** A flower that has both stamens and carpels. Compare with *imperfect flower*.
- pericentriolar material** Fibrils surrounding the centrioles in the microtubule-organizing centers in cells of animals and other organisms having centrioles.
- pericycle** (pehr'eh-sy'kl) A layer of meristematic cells typically found between the endodermis and phloem in roots.
- periderm** (pehr'ih-durm) The outer bark of woody stems and roots; composed of cork cells, cork cambium, and cork parenchyma, along with traces of primary tissues.
- period** An interval of geologic time that is a subdivision of an era; each period is divided into epochs.
- peripheral membrane protein** A protein associated with one of the surfaces of a biological membrane. Compare with *integral membrane protein*.
- peripheral nervous system (PNS)** In vertebrates, the nerves and receptors that lie outside the central nervous system. Compare with *central nervous system (CNS)*.
- peristalsis** (pehr'ih-stal'sis) Rhythmic waves of muscular contraction and relaxation in the walls of hollow tubular organs, such as the ureter or parts of the digestive tract, that serve to move the contents through the tube.
- permafrost** Permanently frozen subsoil characteristic of frigid areas such as the tundra.
- peroxisomes** (pehr-ox'ih-sohmz) In eukaryotic cells, membrane-enclosed organelles containing enzymes that produce or degrade hydrogen peroxide.
- persistence** A characteristic of certain chemicals that are extremely stable and may take many years to be broken down into simpler forms by natural processes.
- petal** One of the parts of the flower attached inside the whorl of sepals; petals are usually colored.
- petiole** (pet'ee-ohl) The part of a leaf that attaches to a stem.
- pH** The negative logarithm of the hydrogen ion concentration of a solution (expressed as moles per liter). Neutral pH is 7, values less than 7 are acidic, and those greater than 7 are basic.
- phage** See *bacteriophage*.
- phagocytosis** (fag'oh-sy-toh'sis) Literally, "cell eating"; a type of endocytosis by which certain cells engulf food particles, microorganisms, foreign matter, or other cells.
- pharmacogenetics** A new field of gene-based medicine in which drugs are personalized to match a patient's genetic makeup.
- pharyngeal slits** (fair-in'jel) Openings that lead from the pharyngeal cavity to the outside; evolved as part of a filter-feeding system in chordates and later became modified for other functions, including gill slits in many aquatic vertebrates.
- pharynx** (fair'inks) Part of the digestive tract. In complex vertebrates, it is bounded anteriorly by the mouth and nasal cavities and posteriorly by the esophagus and larynx; the throat region in humans.
- phenetics** (feh-neh'tiks) An approach to classification based on measurable similarities in phenotypic characters without consideration of homology or other evolutionary relationships. Compare with *cladistics* and *evolutionary systematics*.
- phenotype** (fee'noh-type) The physical or chemical expression of an organism's genes. Compare with *genotype*.
- phenotype frequency** The proportion of a particular phenotype in the population.
- phenylketonuria (PKU)** (fee'nl-kee'toh-noor'ee-ah) An inherited disease in which there is a deficiency of the enzyme that normally converts phenylalanine to tyrosine; results in mental retardation if untreated.
- pheromone** (fer'oh-mone) A substance secreted by an organism to the external environment that influences the development or behavior of other members of the same species.
- phloem** (flo'em) The vascular tissue that conducts dissolved sugar and other organic compounds in plants.
- phosphate group** A weakly acidic functional group that can release one or two hydrogen ions.
- phosphodiester linkage** Covalent linkage between two nucleotides in a strand of DNA or RNA; includes a phosphate group bonded to the sugars of two adjacent nucleotides.
- phosphoenolpyruvate (PEP)** Three-carbon phosphorylated compound that is an important intermediate in glycolysis and is a reactant in the initial carbon fixation step in C₄ and CAM photosynthesis.
- phosphoglycerate (PGA)** Phosphorylated three-carbon compound that is an important metabolic intermediate.
- phospholipids** (fos'foh-lip'idz) Lipids in which two fatty acids and a phosphorus-containing group are attached to glycerol; major components of cell membranes.
- phosphorus cycle** The worldwide circulation of phosphorus from the abiotic environment into living things and back into the abiotic environment.
- phosphorylation** (fos'for-ih-lay'shun) The introduction of a phosphate group into an organic molecule. See *kinases*.
- photoautotroph** An organism that obtains energy from light and synthesizes organic compounds from inorganic raw materials; includes plants, algae, and some bacteria. Compare with *photoheterotroph*, *chemoautotroph*, and *chemoheterotroph*.
- photoheterotroph** An organism that can carry out photosynthesis to obtain energy but cannot fix carbon dioxide and therefore requires organic compounds as a carbon source; includes some bacteria. Compare with *photoautotroph*, *chemoautotroph*, and *chemoheterotroph*.

- photolysis** (foh-tol'uh-sis) The photochemical splitting of water in the light-dependent reactions of photosynthesis; a specific enzyme is needed to catalyze this reaction.
- photon** (foh'ton) A particle of electromagnetic radiation; one quantum of radiant energy.
- photoperiodism** (foh'teh-peer'ee-o-dizm) The physiological response (such as flowering) of plants to variations in the length of daylight and darkness.
- photophosphorylation** (foh'toh-fos-for-ih-lay'shun) The production of ATP in photosynthesis.
- photoreceptor** (foh'toh-ree-sep'tor) (1) A sense organ specialized to detect light. (2) A pigment that absorbs light before triggering a physiological response.
- photorespiration** (foh'toh-res-pur-ay'shun) The process that reduces the efficiency of photosynthesis in C_3 plants during hot spells in summer; consumes oxygen and produces carbon dioxide through the degradation of Calvin cycle intermediates.
- photosynthesis** The biological process that captures light energy and transforms it into the chemical energy of organic molecules (e.g., carbohydrates), which are manufactured from carbon dioxide and water.
- photosystem** One of two photosynthetic units responsible for capturing light energy and transferring excited electrons; photosystem I strongly absorbs light of about 700 nm, whereas photosystem II strongly absorbs light of about 680 nm. See *antenna complex* and *reaction center*.
- phototroph** (foh'toh-trof) Organism that uses light as a source of energy. Compare with *chemotroph*. See *photoautotroph* and *photoheterotroph*.
- phototropism** (foh'toh-troh'pizm) The growth of a plant in response to the direction of light.
- phycocyanin** (fy'koh-sy-ah'nin) A blue pigment found in cyanobacteria and red algae.
- phycoerythrin** (fy'koh-ee-rih'thrin) A red pigment found in cyanobacteria and red algae.
- phylogenetic systematics** See *cladistics*.
- phylogenetic tree** A branching diagram that shows lines of descent among a group of related species.
- phylogeny** (fy-loj'en-ee) The complete evolutionary history of a group of organisms.
- phylum** (fy'lum) A taxonomic grouping of related, similar classes; a category beneath the kingdom and above the class.
- phytoalexins** Antimicrobial compounds produced by plants that limit the spread of pathogens such as fungi.
- phytochemicals** Compounds found in plants that play important roles in preventing certain diseases; some function as antioxidants.
- phytochrome** (fy'toh-krome) A blue-green, proteinaceous pigment involved in a wide variety of physiological responses to light; occurs in two interchangeable forms depending on the ratio of red to far-red light.
- phytoplankton** (fy'toh-plank'tun) Microscopic floating algae and cyanobacteria that are the base of most aquatic food webs. Compare with *zooplankton*. See *plankton* and *nanoplankton*.
- pia mater** (pee'a may'ter) The inner membrane covering the brain and spinal cord; the innermost of the meninges; also see *dura mater* and *arachnoid*.
- pigment** A substance that selectively absorbs light of specific wavelengths.
- pili** (pie'lie) (sing., *pilus*) Hairlike structures on the surface of many bacteria; function in conjugation or attachment.
- pineal gland** (pie-nee'al) Endocrine gland located in the brain.
- pinocytosis** (pin'oh-sy-toh'sis) Cell drinking; a type of endocytosis by which cells engulf and absorb droplets of liquids.
- pioneer** The first organism to colonize an area and begin the first stage of succession.
- pistil** The female reproductive organ of a flower; consists of either a single carpel or two or more fused carpels. See *carpel*.
- pith** The innermost tissue in the stems and roots of many herbaceous plants; primarily a storage tissue.
- pituitary gland** (pi-too'ih-tehr'ee) An endocrine gland located below the hypothalamus; secretes several hormones that influence a wide range of physiological processes.
- placenta** (plah-sen'tah) The partly fetal and partly maternal organ whereby materials are exchanged between fetus and mother in the uterus of placental mammals.
- placoderms** (plak'oh-durmz) A group of extinct jawed fishes.
- plankton** Free-floating, mainly microscopic aquatic organisms found in the upper layers of the water; consisting of phytoplankton and zooplankton. Compare with *nekton*.
- planula larva** (plan'yoo-lah) A ciliated larval form found in cnidarians.
- plasma** The fluid portion of blood in which red blood cells, white blood cells, and platelets are suspended.
- plasma cell** Cell that secretes antibodies; a differentiated B lymphocyte (B cell).
- plasma membrane** The selectively permeable surface membrane that encloses the cell contents and through which all materials entering or leaving the cell must pass.
- plasma proteins** Proteins such as albumins, globulins, and fibrinogen that circulate in the blood plasma.
- plasmid** (plaz'mid) Small, circular, double-stranded DNA molecule that carries genes separate from those in the main DNA of a cell.
- plasmodesmata** (sing., *plasmodesma*) Cytoplasmic channels connecting adjacent plant cells and allowing for the movement of molecules and ions between cells.
- plasmodial slime mold** (plaz-moh'dee-uhl) A funguslike protist whose feeding stage consists of a plasmodium.
- plasmodium** (plaz-moh'dee-um) A multinucleate mass of living matter that moves and feeds in an amoeboid fashion.
- plasmogamy** (1) Fusion of the cytoplasm of two cells without fusion of nuclei. (2) A stage in the asexual reproduction of some fungi; hyphae of two compatible mating types come together, and their cytoplasm fuses.
- plasmolysis** (plaz-mol'ih-sis) The shrinkage of cytoplasm and the pulling away of the plasma membrane from the cell wall when a plant cell (or other walled cell) loses water, usually in a hypertonic environment.
- plastids** (plas'tidz) A family of membrane-enclosed organelles occurring in photosynthetic eukaryotic cells; include chloroplasts, chromoplasts, and amyloplasts and other leukoplasts.
- platelets** (playt'lets) Cell fragments in vertebrate blood that function in clotting; also called *thrombocytes*.
- platyhelminths** The phylum of acoelomate animals commonly known as *flatworms*.
- pleiotropy** The ability of a single gene to have multiple effects.
- plesiomorphic characters** See *shared ancestral characters*.
- pleural membrane** (ploor'ul) The membrane that lines the thoracic cavity and envelops each lung.
- ploidy** The number of chromosome sets in a nucleus or cell. See *haploid*, *diploid*, and *polyploid*.
- plumule** (ploom'yool) The embryonic shoot apex, or terminal bud, located above the point of attachment of the cotyledon(s).

- pluripotent** (ploor-i-poh'tent) A term describing a stem cell that can divide to give rise to many, but not all, types of cells in an organism. Compare with *totipotent*.
- pneumatophore** (noo-mat'uh-for") Roots that extend up out of the water in swampy areas and are thought to provide aeration between the atmosphere and submerged roots.
- polar body** A small *n* cell produced during oogenesis in female animals that does not develop into a functional ovum.
- polar covalent bond** Chemical bond formed by the sharing of electrons between atoms that differ in electronegativity; the end of the bond near the more electronegative atom has a partial negative charge, and the other end has a partial positive charge. Compare with *nonpolar covalent bond*.
- polar molecule** Molecule that has one end with a partial positive charge and the other with a partial negative charge; polar molecules are generally soluble in water. Compare with *nonpolar molecule*.
- polar nucleus** In flowering plants, one of two *n* cells in the embryo sac that fuse with a sperm during double fertilization to form the *3n* endosperm.
- pollen grain** The immature male gametophyte of seed plants (gymnosperms and angiosperms) that produces sperm capable of fertilization.
- pollen tube** In gymnosperms and flowering plants, a tube or extension that forms after germination of the pollen grain and through which male gametes (sperm cells) pass into the ovule.
- pollination** (pol'uh-nay'shen) In seed plants, the transfer of pollen from the male to the female part of the plant.
- poly-A tail** See *polyadenylation*.
- polyadenylation** (pol'ee-a-den-uh-lay'shun) That part of eukaryotic mRNA processing in which multiple adenine-containing nucleotides (a poly-A tail) are added to the 3' end of the molecule.
- polyandry** A mating system in which a female mates with several males during a breeding season. Compare with *polygyny*.
- polygenic inheritance** (pol'ee-jen'ik) Inheritance in which several independently assorting or loosely linked nonallelic genes modify the intensity of a trait or contribute to the phenotype in additive fashion.
- polygyny** A mating system in which a male animal mates with many females during a breeding season. Compare with *polyandry*.
- polymer** (pol'ih-mer) A molecule built up from repeating subunits of the same general type (monomers); examples include proteins, nucleic acids, or polysaccharides.
- polymerase chain reaction (PCR)** A method by which a targeted DNA fragment is amplified *in vitro* to produce millions of copies.
- polymorphism** (pol'ee-mor'fizm) (1) The existence of two or more phenotypically different individuals within a population. (2) The presence of detectable variation in the genomes of different individuals in a population.
- polyp** (pol'ip) A hydralike animal; the sessile stage of the life cycle of certain cnidarians. Compare with *medusa*.
- polypeptide** See *peptide*.
- polyphyletic group** (pol'ee-fye-let'ik) A group made up of organisms that evolved from two or more different ancestors. Compare with *monophyletic group* and *paraphyletic group*.
- polyploid** (pol'ee-ployd) The condition of having more than two sets of chromosomes per nucleus. Compare with *diploid* and *haploid*.
- polyribosome** A complex consisting of a number of ribosomes attached to an mRNA during translation; also known as a *polysome*.
- polysaccharide** (pol-ee-sak'ah-ride) A carbohydrate consisting of many monosaccharide subunits (e.g., starch, glycogen, and cellulose).
- polysome** See *polyribosome*.
- polyspermy** The fertilization of an egg by more than one sperm.
- polytene** A term describing a giant chromosome consisting of many (usually >1000) parallel DNA double helices. Polytene chromosomes are typically found in cells of the salivary glands and some other tissues of certain insects, such as the fruit fly, *Drosophila*.
- polyunsaturated fatty acid** See *fatty acid*.
- pons** (ponz) The white bulge that is the part of the brain stem between the medulla and the midbrain; connects various parts of the brain.
- population** A group of organisms of the same species that live in a defined geographic area at the same time.
- population bottleneck** See *bottleneck*.
- population crash** An abrupt decline in the size of a population.
- population density** The number of individuals of a species per unit of area or volume at a given time.
- population dynamics** The study of changes in populations, such as how and why population numbers change over time.
- population ecology** That branch of biology that deals with the numbers of a particular species that are found in an area and how and why those numbers change (or remain fixed) over time.
- population genetics** The study of genetic variability in a population and of the forces that act on it.
- population growth momentum** The continued growth of a population after fertility rates have declined, as a result of a population's young age structure.
- poriferans** Sponges; members of phylum Porifera.
- positive feedback mechanism** A homeostatic mechanism in which a change in some condition triggers a response that intensifies the changing condition. Compare with *negative feedback mechanism*.
- posterior** Toward the tail end of a bilaterally symmetrical animal. Compare with *anterior*.
- postsynaptic neuron** A neuron that transmits an impulse away from a synapse. Compare with *presynaptic neuron*.
- postzygotic barrier** One of several reproductive isolating mechanisms that prevent gene flow between species after fertilization has taken place, e.g., hybrid inviability, hybrid sterility, and hybrid breakdown. Compare with *prezygotic barrier*.
- potential energy** Stored energy; energy that can do work as a consequence of its position or state. Compare with *kinetic energy*.
- potentiation** A form of synaptic enhancement (increase in neurotransmitter release) that can last for several minutes; occurs when a presynaptic neuron continues to transmit action potentials at a high rate for a minute or longer.
- preadaptation** A novel evolutionary change in a pre-existing biological structure that enables it to have a different function; feathers, which evolved from reptilian scales, represent a preadaptation for flight.
- prebiotic soup hypothesis** The hypothesis that simple organic molecules that are the precursors of life originated and accumulated at Earth's surface, in shallow seas or on rock or clay surfaces. Compare with *iron-sulfur world hypothesis*.
- predation** Relationship in which one organism (the predator) kills and devours another organism (the prey).
- pre-mRNA** RNA precursor to mRNA in eukaryotes; contains both introns and exons.
- prenatal** Pertaining to the time before birth.
- pressure-flow hypothesis** The mechanism by which dissolved sugar is thought to be transported in phloem; caused by a pressure gradient between the source (where sugar is loaded into the phloem) and the sink (where sugar is removed from phloem).

- presynaptic neuron** A neuron that transmits an impulse to a synapse. Compare with *postsynaptic neuron*.
- prezygotic barrier** One of several reproductive isolating mechanisms that interfere with fertilization between male and female gametes of different species, e.g., temporal isolation, habitat isolation, behavioral isolation, mechanical isolation, and gametic isolation. Compare with *postzygotic barrier*.
- primary consumer** See *herbivore*.
- primary growth** An increase in the length of a plant that occurs at the tips of the shoots and roots due to the activity of apical meristems. Compare with *secondary growth*.
- primary immune response** The response of the immune system to first exposure to an antigen. Compare with *secondary immune response*.
- primary mycelium** A mycelium in which the cells are monokaryotic and haploid; a mycelium that grows from either an ascospore or a basidiospore. Compare with *secondary mycelium*.
- primary producer** See *autotroph*.
- primary productivity** The amount of light energy converted to organic compounds by autotrophs in an ecosystem over a given period. Compare with *secondary productivity*. See *gross primary productivity* and *net primary productivity*.
- primary structure (of a protein)** The complete sequence of amino acids in a polypeptide chain, beginning at the amino end and ending at the carboxyl end. Compare with *secondary*, *tertiary*, and *quaternary protein structure*.
- primary succession** An ecological succession that occurs on land that has not previously been inhabited by plants; no soil is present initially. See *succession*. Compare with *secondary succession*.
- primates** Mammals that share such traits as flexible hands and feet with five digits; a strong social organization; and front-facing eyes; includes lemurs, tarsiers, monkeys, apes, and humans.
- primer** See *RNA primer*.
- primitive streak** Dynamic, constantly changing structure that forms at the midline of the blastodisc in birds, mammals, and some other vertebrates and is active in gastrulation. The anterior end of the primitive streak is Hensen's node.
- primosome** A complex of proteins responsible for synthesizing the RNA primers required in DNA synthesis.
- principle** In science, a statement of a rule that explains how something works. A scientific principle has withstood repeated testing and has the highest level of scientific confidence.
- prion** (pri'on) An infectious agent that consists only of protein.
- producer** See *autotroph*.
- product** Substance formed by a chemical reaction. Compare with *reactant*.
- product rule** The rule for combining the probabilities of independent events by multiplying their individual probabilities. Compare with *sum rule*.
- profundal zone** (pro-fun'dl) The deepest zone of a large lake, located below the level of penetration by sunlight. Compare with *littoral zone* and *limnetic zone*.
- progesterone** (pro-jes'ter-own) A steroid hormone secreted by the ovary (mainly by the corpus luteum) and placenta; stimulates the uterus (to prepare the endometrium for implantation) and breasts (for milk secretion).
- progymnosperm** (pro-jim'noh-sperm) An extinct group of plants that may have been the ancestors of gymnosperms.
- prokaryote** (pro-kar'ee-ote) A cell that lacks a nucleus and other membrane-enclosed organelles; includes the bacteria and archaea (kingdoms Eubacteria and Archaea). Compare with *eukaryote*.
- prometaphase** Stage of mitosis during which spindle microtubules attach to kinetochores of chromosomes, which begin to move toward the cell's midplane; occurs after prophase and before metaphase.
- promoter** The nucleotide sequence in DNA to which RNA polymerase attaches to begin transcription.
- prop root** An adventitious root that arises from the stem and provides additional support for a plant such as corn.
- prophage** (pro'faj) Bacteriophage nucleic acid that is inserted into the bacterial DNA.
- prophase** The first stage of mitosis. During prophase the chromosomes become visible as distinct structures, the nuclear envelope breaks down, and a spindle forms.
- proplastids** Organelles that are plastid precursors; may mature into various specialized plastids, including chloroplasts, chromoplasts, or leukoplasts.
- proprioceptors** (pro'pree-oh-sep'torz) Receptors in muscles, tendons, and joints that respond to changes in movement, tension, and position; enable an animal to perceive the position of its body.
- prostaglandins** (pros'tah-glan'dinz) A group of local regulators derived from fatty acids; synthesized by most cells of the body and produce a wide variety of effects; sometimes called local hormones.
- prostate gland** A gland in male animals that produces an alkaline secretion that is part of the semen.
- proteasome** A large multiprotein structure that recognizes and degrades protein molecules tagged with ubiquitin into short, non-functional peptide fragments.
- protein** A large, complex organic compound composed of covalently linked amino acid subunits; contains carbon, hydrogen, oxygen, nitrogen, and sulfur.
- protein kinase** One of a group of enzymes that activate or inactivate other proteins by phosphorylating (adding phosphate groups to) them.
- proteomics** The study of all the proteins encoded by the human genome and produced in a person's cells and tissues.
- Proterozoic eon** The period of Earth's history that began approximately 2.5 billion years ago and ended 542 million years ago; marked by the accumulation of oxygen and the appearance of the first multicellular eukaryotic life-forms.
- prothallus** (pro-thal'us) (pl., *prothalli*) The free-living, *n* gametophyte in ferns and other seedless vascular plants.
- protist** (pro'tist) One of a vast kingdom of eukaryotic organisms, primarily unicellular or simple multicellular; mostly aquatic.
- protobionts** (pro'toh-by'ontz) Assemblages of organic polymers that spontaneously form under certain conditions. Protobionts may have been involved in chemical evolution.
- proton** A particle present in the nuclei of all atoms that has one unit of positive charge and a mass of 1 atomic mass unit (amu). Compare with *electron* and *neutron*.
- protonema** (pro'toh-nee'mah) (pl., *protonemata*) In mosses, a filament of *n* cells that grows from a spore and develops into leafy moss gametophytes.
- protonephridia** (pro'toh-nef-rid'ee-ah) (sing., *protonephridium*) The flame-cell excretory organs of flatworms and some other simple invertebrates.
- proto-oncogene** A gene that normally promotes cell division in response to the presence of certain growth factors; when mutated, it may become an oncogene, possibly leading to the formation of a cancer cell. Compare with *oncogene*.
- protostome** (pro'toh-stome) A major division of the animal kingdom in which the blastopore develops into the mouth, and the anus forms secondarily; includes the annelids, arthropods, and mollusks. Compare with *deuterostome*.

- protozoa** (proh"toh-zoh'a) (sing., *protozoan*) An informal group of unicellular, animal-like protists, including amoebas, foraminiferans, actinopods, ciliates, flagellates, and apicomplexans. (The adjectival form is *protozoan*.)
- provirus** (pro-vy'rus) A part of a virus, consisting of nucleic acid only, that was inserted into a host genome. See *DNA provirus*.
- proximal** Closer to the point of reference. Compare with *distal*.
- proximal convoluted tubule** The part of the renal tubule that extends from Bowman's capsule to the loop of Henle. Compare with *distal convoluted tubule*.
- proximate causes (of behavior)** The immediate causes of behavior, such as genetic, developmental, and physiological processes that permit the animal to carry out a specific behavior. Compare with *ultimate causes of behavior*.
- pseudocoelom** (sue"doh-see'lom) A body cavity between the mesoderm and endoderm; derived from the blastocoel. Compare with *coelom*.
- pseudocoelomate** (sue"doh-seel'oh-mate) An animal having a pseudocoelom. Compare with *coelomate* and *acoelomate*.
- pseudoplasmodium** (sue"doe-plaz-moh'dee-um) In cellular slime molds, an aggregation of amoeboid cells that forms a spore-producing fruiting body during reproduction.
- pseudopodium** (sue"doe-poe'dee-um) (pl., *pseudopodia*) A temporary extension of an amoeboid cell that is used for feeding and locomotion.
- puff** In a polytene chromosome, a decondensed region that is a site of intense RNA synthesis.
- pulmonary circulation** The part of the circulatory system that delivers blood to and from the lungs for oxygenation. Compare with *systemic circulation*.
- pulse, arterial** The alternate expansion and recoil of an artery.
- punctuated equilibrium** The idea that evolution proceeds with periods of little or no genetic change, followed by very active phases, so that major adaptations or clusters of adaptations appear suddenly in the fossil record. Compare with *gradualism*.
- Punnett square** The grid structure, first developed by Reginald Punnett, that allows direct calculation of the probabilities of occurrence of all possible offspring of a genetic cross.
- pupa** (pew'pah) (pl., *pupae*) A stage in the development of an insect, between the larva and the imago (adult); a form that neither moves nor feeds and may be in a cocoon.
- purines** (pure'eenz) Nitrogenous bases with carbon and nitrogen atoms in two attached rings, e.g., adenine and guanine; components of nucleic acids, ATP, GTP, NAD⁺, and certain other biologically active substances. Compare with *pyrimidines*.
- pyramid of biomass** An ecological pyramid that illustrates the total biomass, as, for example, the total dry weight, of all organisms at each trophic level in an ecosystem.
- pyramid of energy** An ecological pyramid that shows the energy flow through each trophic level of an ecosystem.
- pyrimidines** (pyr-im'ih-deenz) Nitrogenous bases, each composed of a single ring of carbon and nitrogen atoms, e.g., thymine, cytosine, and uracil; components of nucleic acids. Compare with *purines*.
- pyruvate (pyruvic acid)** A three-carbon compound; the end product of glycolysis.
- quadrupedal** (kwad'roo-ped'ul) Walking on all fours.
- quantitative trait** A trait that shows continuous variation in a population (e.g., human height) and typically has a polygenic inheritance pattern.
- quaternary structure (of a protein)** The overall conformation of a protein produced by the interaction of two or more polypeptide chains. Compare with *primary*, *secondary*, and *tertiary protein structure*.
- r selection** A reproductive strategy recognized by some ecologists, in which a species typically has a small body size, rapid development, and short life span and devotes a large proportion of its metabolic energy to the production of offspring. Compare with *K selection*.
- radial cleavage** The pattern of blastomere production in which the cells are located directly above or below one another; characteristic of early deuterostome embryos. Compare with *spiral cleavage*.
- radial symmetry** A body plan in which any section through the mouth and down the length of the body divides the body into similar halves. Jellyfish and other cnidarians have radial symmetry. Compare with *bilateral symmetry*.
- radicle** (rad'ih-kl) The embryonic root of a seed plant.
- radioactive decay** The process in which a radioactive element emits radiation, and as a result, its nucleus changes into the nucleus of a different element.
- radioisotopes** Unstable isotopes that spontaneously emit radiation; also called *radioactive isotopes*.
- radiolarians** Those actinopods that secrete elaborate shells of silica (glass).
- radula** (rad'yoo-lah) A rasplike structure in the digestive tract of chitons, snails, squids, and certain other mollusks.
- rain shadow** An area that has very little precipitation, found on the downwind side of a mountain range. Deserts often occur in rain shadows.
- random dispersion** The spatial distribution pattern of a population in which the presence of one individual has no effect on the distribution of other individuals. Compare with *clumped dispersion* and *uniform dispersion*.
- range** The area where a particular species occurs. Compare with *home range*.
- ray** A chain of parenchyma cells (one to many cells thick) that functions for lateral transport in stems and roots of woody plants.
- ray-finned fishes** A class (Actinopterygii) of modern bony fishes; contains about 95% of living fish species.
- reabsorption** The selective removal of certain substances from the glomerular filtrate by the renal tubules and collecting ducts of the kidney, and their return into the blood.
- reactant** Substance that participates in a chemical reaction. Compare with *product*.
- reaction center** The portion of a photosystem that includes chlorophyll *a* molecules capable of transferring electrons to a primary electron acceptor, which is the first of several electron acceptors in a series. See *antenna complex* and *photosystem*.
- realized niche** The lifestyle that an organism actually pursues, including the resources that it actually uses. An organism's realized niche is narrower than its fundamental niche because of interspecific competition. Compare with *fundamental niche*.
- receptacle** The end of a flower stalk where the flower parts (sepals, petals, stamens, and carpels) are attached.
- reception** Process of detecting a stimulus.
- receptor** (1) In cell biology, a molecule on the surface of a cell, or inside a cell, that serves as a recognition or binding site for signaling molecules such as hormones, antibodies, or neurotransmitters. (2) A sensory receptor. See *sensory receptor*.
- receptor down-regulation** The process by which some hormone receptors decrease in number, thereby suppressing the sensitivity of target cells to the hormone. Compare with *receptor up-regulation*.
- receptor up-regulation** The process by which some hormone receptors increase in number, thereby increasing the sensitivity of the target cells to the hormone. Compare with *receptor down-regulation*.

- receptor-mediated endocytosis** A type of endocytosis in which extracellular molecules become bound to specific receptors on the cell surface and then enter the cytoplasm enclosed in vesicles.
- recessive allele** (al-leel') An allele that is not expressed in the heterozygous state. Compare with *dominant allele*.
- recombinant DNA** Any DNA molecule made by combining genes from different organisms.
- recombination, genetic** The appearance of new gene combinations. Recombination in eukaryotes generally results from meiotic events, either crossing-over or shuffling of chromosomes.
- red alga** A member of a diverse phylum of algae that contain the pigments chlorophyll *a*, carotenoids, phycocyanin, and phycoerythrin.
- red blood cell (RBC)** See *erythrocyte*.
- red tide** A red or brown coloration of ocean water caused by a population explosion, or bloom, of dinoflagellates.
- redox reaction** (ree'dox) The chemical reaction in which one or more electrons are transferred from one substance (the substance that becomes oxidized) to another (the substance that becomes reduced). See *oxidation* and *reduction*.
- reduction** The gain of one or more electrons (or hydrogen atoms) by an atom, ion, or molecule. Compare with *oxidation*.
- reflex action** An automatic, involuntary response to a given stimulus that generally functions to restore homeostasis.
- refractory period** The brief period that elapses after the response of a neuron or muscle fiber, during which it cannot respond to another stimulus.
- regulative development** The very plastic developmental pattern in which each individual cell of an early embryo retains totipotency. Compare with *mosaic development*.
- regulatory gene** Gene that turns the transcription of other genes on or off.
- releasing hormone** A hormone secreted by the hypothalamus that stimulates secretion of a specific hormone by the anterior lobe of the pituitary gland.
- renal** (ree'nl) Pertaining to the kidney.
- renal pelvis** The funnel-shaped chamber of the kidney that receives urine from the collecting ducts; urine then moves into the ureters.
- renin** (reh'nin) An enzyme released by the kidney in response to a decrease in blood pressure; activates a pathway leading to production of angiotensin II, a hormone that increases aldosterone release; aldosterone increases blood pressure.
- replacement-level fertility** The number of children a couple must produce to "replace" themselves. The average number is greater than two, because some children die before reaching reproductive age.
- replication** See *DNA replication*.
- replication fork** Y-shaped structure produced during the semiconservative replication of DNA.
- repolarization** The process of returning membrane potential to its resting level.
- repressible operon** An operon that is normally active, but can be controlled by a repressor protein, which becomes active when it binds to a corepressor; the active repressor binds to the operator, making the operon transcriptionally inactive. Compare with *inducible operon*.
- repressor protein** A negative regulatory protein that inhibits transcription when bound to DNA; some repressors require a corepressor to be active; some other repressors become inactive when bound to an inducer molecule. Compare with *activator protein*.
- reproduction** The process by which new individuals are produced. See *asexual reproduction* and *sexual reproduction*.
- reproductive isolating mechanisms** The reproductive barriers that prevent a species from interbreeding with another species; as a result, each species' gene pool is isolated from those of other species. See *prezygotic barrier* and *postzygotic barrier*.
- reptiles** A class of vertebrates characterized by dry skin with horny scales and adaptations for terrestrial reproduction; include turtles, snakes, and alligators; reptiles are a paraphyletic group.
- residual capacity** The volume of air that remains in the lungs at the end of a normal exhalation.
- resin** A viscous organic material that certain plants produce and secrete into specialized ducts; may play a role in deterring disease organisms or plant-eating insects.
- resolution** See *resolving power*.
- resolving power** The ability of a microscope to show fine detail, defined as the minimum distance between two points at which they are seen as separate images; also called *resolution*.
- resource partitioning** The reduction of competition for environmental resources such as food that occurs among coexisting species as a result of each species' niche differing from the others in one or more ways.
- respiration** (1) Cellular respiration is the process by which cells generate ATP through a series of redox reactions. In aerobic respiration the terminal electron acceptor is molecular oxygen; in anaerobic respiration the terminal acceptor is an inorganic molecule other than oxygen. (2) Organismic respiration is the process of gas exchange between a complex animal and its environment, generally through a specialized respiratory surface, such as a lung or gill.
- respiratory centers** Centers in the medulla and pons that regulate breathing.
- resting potential** The membrane potential (difference in electric charge between the two sides of the plasma membrane) of a neuron in which no action potential is occurring. The typical resting potential is about -70 millivolts. Compare with *action potential*.
- restoration ecology** The scientific field that uses the principles of ecology to help return a degraded environment as closely as possible to its former undisturbed state.
- restriction enzyme** One of a class of enzymes that cleave DNA at specific base sequences; produced by bacteria to degrade foreign DNA; used in recombinant DNA technology.
- restriction map** A physical map of DNA in which sites cut by specific restriction enzymes serve as landmarks.
- reticular activating system (RAS)** (reh-tik'yoo-lur) A diffuse network of neurons in the brain stem; responsible for maintaining consciousness.
- retina** (ret'ih-nah) The innermost of the three layers (retina, choroid layer, and sclera) of the eyeball, which is continuous with the optic nerve and contains the light-sensitive rod and cone cells.
- retinular cells** See *ommatidium*.
- retrovirus** (ret'roh-vy'rus) An RNA virus that uses reverse transcriptase to produce a DNA intermediate, known as a *DNA provirus*, in the host cell. See *DNA provirus*.
- reverse transcriptase** An enzyme produced by retroviruses that catalyzes the production of DNA using RNA as a template.
- reversible inhibitor** A substance that forms weak bonds with an enzyme, temporarily interfering with its function; a reversible inhibitor is either competitive or noncompetitive. Compare with *irreversible inhibitor*.
- Rh factors** Red blood cell antigens, known as *D antigens*, first identified in *Rhesus* monkeys. People who have these antigens are Rh⁺; people lacking them are Rh⁻. See *erythroblastosis fetalis*.
- rhizome** (ry'zome) A horizontal underground stem that bears leaves and buds and often serves as a storage organ and a means of asexual reproduction, e.g., iris.

- rhodopsin** (rho-dop'sin) Visual purple; a light-sensitive pigment found in the rod cells of the vertebrate eye; a similar molecule is employed by certain bacteria in the capture of light energy to make ATP.
- ribonucleic acid (RNA)** A family of single-stranded nucleic acids that function mainly in protein synthesis
- ribose** The five-carbon sugar present in RNA and in important nucleoside triphosphates such as ATP.
- ribosomal RNA (rRNA)** See *ribosomes*.
- ribosomes** (ry'boh-sohmz) Organelles that are part of the protein synthesis machinery of both prokaryotic and eukaryotic cells; consist of a larger and smaller subunit, each composed of ribosomal RNA (rRNA) and ribosomal proteins.
- ribozyme** (ry'boh-zime) A molecule of RNA that has catalytic properties.
- ribulose biphosphate (RuBP)** A five-carbon phosphorylated compound with a high energy potential that reacts with carbon dioxide in the initial step of the Calvin cycle.
- ribulose biphosphate carboxylase/oxygenase** See *rubisco*.
- RNA interference (RNAi)** Phenomenon in which certain small RNA molecules interfere with the expression of genes or their RNA transcripts; RNA interference involves small interfering RNAs, microRNAs, and a few other kinds of short RNA molecules.
- RNA polymerase** An enzyme that catalyzes the synthesis of RNA from a DNA template.
- RNA primer** The sequence of about five RNA nucleotides that are synthesized during DNA replication to provide a 3' end to which DNA polymerase adds nucleotides. The RNA primer is later degraded and replaced with DNA.
- RNA world** A model that proposes that during the evolution of cells, RNA was the first informational molecule to evolve, followed at a later time by proteins and DNA.
- rod** One of the rod-shaped, light-sensitive cells of the retina that are particularly sensitive to dim light and mediate black-and-white vision. Compare with *cone*.
- root cap** A covering of cells over the root tip that protects the delicate meristematic tissue directly behind it.
- root graft** The process of roots from two different plants growing together and becoming permanently attached to each other.
- root hair** An extension, or outgrowth, of a root epidermal cell. Root hairs increase the absorptive capacity of roots.
- root pressure** The pressure in xylem sap that occurs as a result of the active absorption of mineral ions followed by the osmotic uptake of water into roots from the soil.
- root system** The underground portion of a plant that anchors it in the soil and absorbs water and dissolved minerals.
- rough ER** See *endoplasmic reticulum*.
- rubisco** The common name of ribulose biphosphate carboxylase/oxygenase, the enzyme that catalyzes the fixation of carbon dioxide in the Calvin cycle.
- rugae** (roo'jee) Folds, such as those in the lining of the stomach.
- runner** See *stolon*.
- S phase** Stage in interphase of the cell cycle during which DNA and other chromosomal constituents are synthesized. Compare with G_1 and G_2 phases.
- sacculus** The structure within the vestibule of the inner vertebrate ear that along with the utricle houses the receptors of static equilibrium.
- salicylic acid** A signaling molecule that helps plants defend against insect pests and pathogens such as viruses by helping activate systemic acquired resistance.
- salinity** The concentration of dissolved salts (e.g., sodium chloride) in a body of water.
- salivary glands** Accessory digestive glands found in vertebrates and some invertebrates; in humans there are three pairs.
- salt** An ionic compound consisting of an anion other than a hydroxide ion and a cation other than a hydrogen ion. A salt is formed by the reaction between an acid and a base.
- salt marsh** A wetland dominated by grasses in which the salinity fluctuates between that of sea water and fresh water; salt marshes are usually located in estuaries.
- saltatory conduction** The transmission of a neural impulse along a myelinated neuron; ion activity at one node depolarizes the next node along the axon.
- saprobe** See *decomposer*.
- saprotroph** (sap'roh-trof) See *decomposer*.
- sarcolemma** (sar'koh-lem'mah) The muscle cell plasma membrane.
- sarcomere** (sar'koh-meer) A segment of a striated muscle cell located between adjacent Z lines that serves as a unit of contraction.
- sarcoplasmic reticulum** The system of vesicles in a muscle cell that surrounds the myofibrils and releases calcium in muscle contraction; a modified endoplasmic reticulum.
- saturated fatty acid** See *fatty acid*.
- savanna** (suh-van'uh) A tropical grassland containing scattered trees; found in areas of low rainfall or seasonal rainfall with prolonged dry periods.
- scaffolding proteins** (1) Proteins that organize groups of intracellular signaling molecules into signaling complexes. (2) Nonhistone proteins that help maintain the structure of a chromosome.
- schizocoely** (skiz'oh-seely) The process of coelom formation in which the mesoderm splits into two layers, forming a cavity between them; characteristic of protostomes. Compare with *enterocoely*.
- Schwann cells** Supporting cells found in nervous tissue outside the central nervous system; produce the myelin sheath around peripheral neurons.
- sclera** (skler'ah) The outer coat of the eyeball; a tough, opaque sheet of connective tissue that protects the inner structures and helps maintain the rigidity of the eyeball.
- sclereid** (skler'id) In plants, a sclerenchyma cell that is variable in shape but typically not long and tapered. Compare with *fiber*.
- sclerenchyma** (skler-en'kim-uh) Cells that provide strength and support in the plant body, are often dead at maturity, and have extremely thick walls; includes fibers and sclereids.
- scramble competition** See *exploitation competition*.
- scrotum** (skroh'tum) The external sac of skin found in most male mammals that contains the testes and their accessory organs.
- second law of thermodynamics** The physical law stating that the total amount of entropy in the universe continually increases. Compare with *first law of thermodynamics*.
- second messenger** A substance, e.g., cyclic AMP or calcium ions, that relays a message from a hormone bound to a cell-surface receptor; leads to some change in the cell.
- secondary consumer** See *carnivore*.
- secondary growth** An increase in the girth of a plant due to the activity of the vascular cambium and cork cambium; secondary growth results in the production of secondary tissues, i.e., wood and bark. Compare with *primary growth*.
- secondary immune response** The rapid production of antibodies induced by a second exposure to an antigen several days, weeks, or even months after the initial exposure. Compare with *primary immune response*.
- secondary mycelium** A dikaryotic mycelium formed by the fusion of two primary hyphae. Compare with *primary mycelium*.
- secondary productivity** The amount of food molecules converted to biomass by consumers in an ecosystem over a given period. Compare with *primary productivity*.

- secondary structure (of a protein)** A regular geometric shape produced by hydrogen bonding between the atoms of the uniform polypeptide backbone; includes the alpha helix and the beta-pleated sheet. Compare with *primary*, *tertiary*, and *quaternary protein structure*.
- secondary succession** An ecological succession that takes place after some disturbance destroys the existing vegetation; soil is already present. See *succession*. Compare with *primary succession*.
- secretory vesicles** Small cytoplasmic vesicles that move substances from an internal membrane system to the plasma membrane.
- seed** A plant reproductive body consisting of a young, multicellular plant and nutritive tissue (food reserves), enclosed by a seed coat.
- seed coat** The outer protective covering of a seed.
- seed fern** An extinct group of seed-bearing woody plants with fern-like leaves; seed ferns probably descended from progymnosperms and gave rise to cycads and possibly ginkgoes.
- segmentation genes** In *Drosophila*, genes transcribed in the embryo that are responsible for generating a repeating pattern of body segments within the embryo and adult fly.
- segregation, principle of** The genetic principle, first noted by Gregor Mendel, that states that two alleles of a locus become separated into different gametes.
- selectively permeable membrane** A membrane that allows some substances to cross it more easily than others. Biological membranes are generally permeable to water but restrict the passage of many solutes.
- self-incompatibility** A genetic condition in which the pollen cannot fertilize the same flower or flowers on the same plant.
- semelparity** The condition of having a single reproductive effort in a lifetime. Compare with *iteroparity*.
- semen** The fluid consisting of sperm suspended in various glandular secretions that is ejaculated from the penis during orgasm.
- semicircular canals** The passages in the vertebrate inner ear containing structures that control the sense of equilibrium (balance).
- semiconservative replication** See *DNA replication*.
- semilunar valves** Valves between the ventricles of the heart and the arteries that carry blood away from the heart; aortic and pulmonary valves.
- seminal vesicles** (1) In mammals, glandular sacs that secrete a component of semen (seminal fluid). (2) In some invertebrates, structures that store sperm.
- seminiferous tubules** (sem-ih-nif'er-ous) Coiled tubules in the testes in which spermatogenesis takes place in male vertebrates.
- senescence** (se-nes'cents) The aging process.
- sensory neuron** A neuron that transmits an impulse from a receptor to the central nervous system.
- sensory receptor** A cell (or part of a cell) specialized to detect specific energy stimuli in the environment.
- sepal** (see'pul) One of the outermost parts of a flower, usually leaf-like in appearance, that protect the flower as a bud.
- septum** (pl., *septa*) A cross wall or partition, e.g., the walls that divide a hypha into cells.
- sequencing** See *DNA sequencing*.
- serial endosymbiosis** The hypothesis that certain organelles such as mitochondria and chloroplasts originated as symbiotic prokaryotes that lived inside other, free-living prokaryotic cells.
- serotonin** A neurotransmitter of the biogenic amine group.
- Sertoli cells** (sur-tole'ee) Supporting cells of the tubules of the testis.
- sessile** (ses'sile) Permanently attached to one location, e.g., coral animals.
- setae** (sing., *seta*) Bristlelike structures that aid in annelid locomotion.
- set point** A normal condition maintained by homeostatic mechanisms.
- sex chromosome** Chromosome that plays a role in sex determination.
- sex-influenced trait** A genetic trait that is expressed differently in males and females.
- sex-linked gene** A gene carried on a sex chromosome. In mammals almost all sex-linked genes are borne on the X chromosome, i.e., are X-linked.
- sexual dimorphism** Marked phenotypic differences between the two sexes of the same species.
- sexual isolation** See *behavioral isolation*.
- sexual reproduction** A type of reproduction in which two gametes (usually, but not necessarily, contributed by two different parents) fuse to form a zygote. Compare with *asexual reproduction*.
- sexual selection** A type of natural selection that occurs when individuals of a species vary in their ability to compete for mates; individuals with reproductive advantages are selected over others of the same sex.
- shade avoidance** The tendency of plants that are adapted to high light intensities to grow taller when they are closely surrounded by other plants.
- shared ancestral characters** Traits that were present in an ancestral species that have remained essentially unchanged; suggest a distant common ancestor. Also called *plesiomorphic characters*. Compare with *shared derived characters*.
- shared derived characters** Homologous traits found in two or more taxa that are present in their most recent common ancestor but not in earlier common ancestors. Also called *synapomorphic characters*. Compare with *shared ancestral characters*.
- shoot system** The aboveground portion of a plant, such as the stem and leaves.
- short tandem repeats (STRs)** Molecular markers that are short sequences of repetitive DNA; because STRs vary in length from one individual to another, they are useful in identifying individuals with a high degree of certainty.
- short-day plant** A plant that flowers in response to lengthening nights; also called *long-night plant*. Compare with *long-day*, *intermediate-day*, and *day-neutral plants*.
- short-night plant** See *long-day plant*.
- sickle cell anemia** An inherited form of anemia in which there is abnormality in the hemoglobin beta chains; the inheritance pattern is autosomal recessive.
- sieve tube elements** Cells that conduct dissolved sugar in the phloem of flowering plants.
- sign stimulus** Any stimulus that elicits a fixed action pattern in an animal.
- signal amplification** The process by which a few signaling molecules can effect major responses in the cell; the strength of each signaling molecule is magnified.
- signal transduction** A process in which a cell converts and amplifies an extracellular signal into an intracellular signal that affects some function in the cell. Also see *cell signaling*.
- signaling molecule** A molecule such as a hormone, local regulator, or neurotransmitter that transmits information when it binds to a receptor on the cell surface or within the cell.
- signal-recognition particle (SRP)** A protein-RNA complex that directs the ribosome-mRNA-polypeptide complex to the surface of the endoplasmic reticulum.

- simple fruit** A fruit that develops from a single ovary. Compare with *aggregate*, *accessory*, and *multiple fruits*.
- simplest formula** A type of chemical formula that gives the smallest whole-number ratio of the component atoms. Compare with *molecular formula* and *structural formula*.
- single-strand binding proteins (SSBs)** Proteins involved in DNA replication that bind to single DNA strands and prevent the double helix from re-forming until the strands are copied.
- sink habitat** A lower-quality habitat in which local reproductive success is less than local mortality. Compare with *source habitat*.
- sinoatrial (SA) node** The mass of specialized cardiac muscle in which the impulse triggering the heartbeat originates; the pacemaker of the heart.
- sister chromatids** See *chromatid*.
- sister taxa** Groups of organisms that share a more recent common ancestor with one another than either taxon does with any other group shown on a cladogram.
- skeletal muscle** The voluntary striated muscle of vertebrates, so called because it usually is directly or indirectly attached to some part of the skeleton. Compare with *cardiac muscle* and *smooth muscle*.
- slash-and-burn agriculture** A type of agriculture in which tropical rain forest is cut down, allowed to dry, and burned. The crops that are planted immediately afterward thrive because the ashes provide nutrients; in a few years, however, the soil is depleted and the land must be abandoned.
- slow block to polyspermy** See *cortical reaction*.
- small interfering RNAs (siRNAs)** Double-stranded RNA molecules about 23 nucleotides in length that silence genes at the post-transcriptional level by selectively cleaving mRNA molecules with base sequences complementary to the siRNA.
- small intestine** Portion of the vertebrate digestive tract that extends from the stomach to the large intestine.
- small nuclear ribonucleoprotein complexes (snRNP)** Aggregations of RNA and protein responsible for binding to pre-mRNA in eukaryotes; catalyze the excision of introns and the splicing of exons.
- smooth ER** See *endoplasmic reticulum*.
- smooth muscle** Involuntary muscle tissue that lacks transverse striations; found mainly in sheets surrounding hollow organs, such as the intestine. Compare with *cardiac muscle* and *skeletal muscle*.
- social behavior** Interaction of two or more animals, usually of the same species.
- sociobiology** The branch of biology that focuses on the evolution of social behavior through natural selection.
- sodium–potassium pump** Active transport system that transports sodium ions out of, and potassium ions into, cells.
- soil erosion** The wearing away or removal of soil from the land; although soil erosion occurs naturally from precipitation and runoff, human activities (such as clearing the land) accelerate it.
- solute** A dissolved substance. Compare with *solvent*.
- solvent** Substance capable of dissolving other substances. Compare with *solute*.
- somatic cell** In animals, a cell of the body not involved in formation of gametes. Compare with *germ line cell*.
- somatic nervous system** That part of the vertebrate peripheral nervous system that keeps the body in adjustment with the external environment; includes sensory receptors on the body surface and within the muscles, and the nerves that link them with the central nervous system. Compare with *autonomic nervous system*.
- somatomedins** See *insulin-like growth factors*.
- somatotropin** See *growth hormone*.
- somites** A series of paired blocks of mesoderm that develop on each side of the notochord in cephalochordates and vertebrates. Somites define the segmentation of the embryo, and in vertebrates, they give rise to the vertebrae, ribs, and certain skeletal muscles.
- sonogram** See *ultrasound imaging*.
- soredium** (sor-id'e-um) (pl., *soredia*) In lichens, a type of asexual reproductive structure that consists of a cluster of algal cells surrounded by fungal hyphae.
- sorus** (soh'rus) (pl., *sori*) In ferns, a cluster of spore-producing sporangia.
- source habitat** A good habitat in which local reproductive success is greater than local mortality. Surplus individuals in a source habitat may disperse to other habitats. Compare with *sink habitat*.
- Southern blot** A technique in which DNA fragments, previously separated by gel electrophoresis, are transferred to a nitrocellulose or nylon membrane and detected by autoradiography or chemical luminescence. Compare with *Northern blot* and *Western blot*.
- speciation** Evolution of a new species.
- species** According to the biological species concept, one or more populations whose members are capable of interbreeding in nature to produce fertile offspring and do not interbreed with members of other species. Compare with *evolutionary species concept*.
- species diversity** A measure of the relative importance of each species within a community; represents a combination of species richness and species evenness.
- species richness** The number of species in a community.
- specific epithet** The second part of the name of a species; designates a specific species belonging to that genus.
- specific heat** The amount of heat energy that must be supplied to raise the temperature of 1 g of a substance 1°C.
- specific immune responses** Defense mechanisms that target specific macromolecules associated with a pathogen. Includes cell-mediated immunity and antibody-mediated immunity. Also known as *acquired* or *adaptive immune responses*.
- sperm** The motile male gamete of animals and some plants and protists; also called a *spermatozoan*.
- spermatid** (spur'ma-tid) An immature sperm cell.
- spermatocyte** (spur-mah'toh-site) A meiotic cell that gives rise to spermatids and ultimately to mature sperm cells.
- spermatogenesis** (spur'mah-toh-jen'eh-sis) The production of male gametes (sperm) by meiosis and subsequent cell differentiation. Compare with *oogenesis*.
- spermatozoan** (spur-mah-toh-zoh'un) See *sperm*.
- sphincter** (sfink'tur) A group of circularly arranged muscle fibers, the contractions of which close an opening, e.g., the pyloric sphincter at the exit of the stomach.
- spinal cord** In vertebrates, the dorsal, tubular nerve cord.
- spinal nerves** In vertebrates, the nerves that emerge from the spinal cord.
- spindle** See *mitotic spindle*.
- spine** A leaf that is modified for protection, such as a cactus spine.
- spiracle** (speer'ih-kl) An opening for gas exchange, such as the opening of a trachea on the body surface of an insect.
- spiral cleavage** A distinctive spiral pattern of blastomere production in an early protostome embryo. Compare with *radial cleavage*.
- spirillum** (pl., *spirilla*) A long, rigid, helical bacterium. Compare with *spirochete*, *vibrio*, *bacillus*, and *coccus*.
- spirochete** A long, flexible, helical bacterium. Compare with *spirillum*, *vibrio*, *bacillus*, and *coccus*.
- spleen** An abdominal organ located just below the diaphragm that removes worn-out blood cells and bacteria from the blood and plays a role in immunity.

- spliceosome** A large nucleoprotein particle that catalyzes the reactions that remove introns from pre-mRNA.
- spongy mesophyll** (mez'oh-fil) The loosely arranged mesophyll cells near the lower epidermis in certain leaves. Compare with *palisade mesophyll*.
- spontaneous reaction** See *exergonic reaction*.
- sporangium** (spor-an'jee-um) (pl., *sporangia*) A spore case, found in plants, certain protists, and fungi.
- spore** A reproductive cell that gives rise to individual offspring in plants, fungi, and certain algae and protozoa.
- sporophyll** (spor'oh-fil) A leaflike structure that bears spores.
- sporophyte generation** (spor'oh-fite) The $2n$, spore-producing stage in the life cycle of a plant. Compare with *gametophyte generation*.
- sporozoa** See *apicomplexans*.
- sporozoite** The infective sporelike state in apicomplexans.
- stabilizing selection** Natural selection that acts against extreme phenotypes and favors intermediate variants; associated with a population well adapted to its environment. Compare with *directional selection* and *disruptive selection*.
- stamen** (stay'men) The male part of a flower; consists of a filament and anther.
- standing-water ecosystem** A lake or pond ecosystem.
- starch** A polysaccharide composed of alpha glucose subunits; made by plants for energy storage.
- start codon** The codon AUG, which signals the beginning of translation of messenger RNA. Compare with *stop codon*.
- stasis** Long periods in the fossil record in which there is little or no evolutionary change.
- statocyst** (stat'oh-sist) An invertebrate sense organ containing one or more granules (statoliths); senses gravity and motion.
- statoliths** (stat'uh-liths) Granules of loose sand or calcium carbonate found in statocysts.
- stele** The cylinder in the center of roots and stems that contains the vascular tissue.
- stem cell** A relatively undifferentiated cell capable of repeated cell division. At each division at least one of the daughter cells usually remains a stem cell, whereas the other may differentiate as a specific cell type.
- stereocilia** Hairlike projections of hair cells; microvilli that contain actin filaments.
- sterilization** A procedure that renders an individual incapable of producing offspring; the most common surgical procedures are vasectomy in the male and tubal ligation in the female.
- steroids** (steer'oids) Complex molecules containing carbon atoms arranged in four attached rings, three of which contain six carbon atoms each and the fourth of which contains five, e.g., cholesterol and certain hormones, including the male and female sex hormones of vertebrates.
- stigma** The portion of the carpel where pollen grains land during pollination (and before fertilization).
- stipe** A short stalk or stemlike structure that is a part of the body of certain multicellular algae.
- stipule** (stip'yule) One of a pair of scalelike or leaflike structures found at the base of certain leaves.
- stolon** (stow'lon) An aboveground, horizontal stem with long internodes; stolons often form buds that develop into separate plants, e.g., strawberry; also called *runner*.
- stomach** Muscular region of the vertebrate digestive tract, extending from the esophagus to the small intestine.
- stomata** (sing., *stoma*) Small pores located in the epidermis of plants that provide for gas exchange for photosynthesis; each stoma is flanked by two guard cells, which are responsible for its opening and closing.
- stop codon** Any of the three codons in mRNA that do not code for an amino acid (UAA, UAG, or UGA) but signal the termination of translation. Compare with *start codon*.
- stratosphere** The layer of the atmosphere between the troposphere and the mesosphere. It contains a thin ozone layer that protects life by filtering out much of the sun's ultraviolet radiation.
- stratum basale** (strat'um bah-say'lee) The deepest sublayer of the human epidermis, consisting of cells that continuously divide. Compare with *stratum corneum*.
- stratum corneum** The most superficial sublayer of the human epidermis. Compare with *stratum basale*.
- strobilus** (stroh'bil-us) (pl., *strobili*) In certain plants, a cone-like structure that bears spore-producing sporangia.
- stroke volume** The volume of blood pumped by one ventricle during one contraction.
- stroma** A fluid space of the chloroplast, enclosed by the chloroplast inner membrane and surrounding the thylakoids; site of the reactions of the Calvin cycle.
- stromatolite** (stroh-mat'oh-lite) A columnlike rock that consists of many minute layers of prokaryotic cells, usually cyanobacteria.
- structural formula** A type of chemical formula that shows the spatial arrangement of the atoms in a molecule. Compare with *simplest formula* and *molecular formula*.
- structural isomer** One of two or more chemical compounds having the same chemical formula but differing in the covalent arrangement of their atoms, e.g., glucose and fructose.
- style** The neck connecting the stigma to the ovary of a carpel.
- subsidiary cell** In plants, a structurally distinct epidermal cell associated with a guard cell.
- substance P** A peptide neurotransmitter released by certain sensory neurons in pain pathways; signals the brain regarding painful stimuli; also stimulates other structures, including smooth muscle in the digestive tract.
- substrate** A substance on which an enzyme acts; a reactant in an enzymatically catalyzed reaction.
- succession** The sequence of changes in the species composition of a community over time. See *primary succession* and *secondary succession*.
- sucker** A shoot that develops adventitiously from a root; a type of asexual reproduction.
- sulcus** (sul'kus) (pl., *sulci*) A groove, trench, or depression, especially one occurring on the surface of the brain, separating the convolutions.
- sulphydryl group** Functional group abbreviated —SH; found in organic compounds called thiols.
- sum rule** The rule for combining the probabilities of mutually exclusive events by adding their individual probabilities. Compare with *product rule*.
- summation** The process of adding together excitatory postsynaptic potentials (EPSPs).
- suppressor T cell** T lymphocyte that suppresses the immune response.
- supraorbital ridge** (soop'rah-or'bit-ul) The prominent bony ridge above the eye socket; ape skulls have prominent supraorbital ridges.
- surface tension** The attraction that the molecules at the surface of a liquid may have for one another.
- survivorship** The probability that a given individual in a population or cohort will survive to a particular age; usually presented as a survivorship curve.

- survivorship curve** A graph of the number of surviving individuals of a cohort, from birth to the maximum age attained by any individual.
- suspensor** (suh-spen'sur) In plant embryo development, a multicellular structure that anchors the embryo and aids in nutrient absorption from the endosperm.
- sustainability** See *environmental sustainability*.
- swim bladder** The hydrostatic organ in bony fishes that permits the fish to hover at a given depth.
- symbiosis** (sim-bee-oh'sis) An intimate relationship between two or more organisms of different species. See *commensalism*, *mutualism*, and *parasitism*.
- sympathetic nervous system** A division of the autonomic nervous system; its general effect is to mobilize energy, especially during stress situations; prepares the body for fight-or-flight response. Compare with *parasympathetic nervous system*.
- sympatric speciation** (sim-pa'trik) The evolution of a new species within the same geographic region as the parental species. Compare with *allopatric speciation*.
- symplast** A continuum consisting of the cytoplasm of many plant cells, connected from one cell to the next by plasmodesmata. Compare with *apoplast*.
- synapomorphic characters** See *shared derived characters*.
- synapse** (sin'aps) The junction between two neurons or between a neuron and an effector (muscle or gland).
- synapsis** (sin-ap'sis) The process of physical association of homologous chromosomes during prophase I of meiosis.
- synaptic enhancement** An increase in neurotransmitter release thought to occur as a result of calcium ion accumulation inside the presynaptic neuron.
- synaptic plasticity** The ability of synapses to change in response to certain types of stimuli. Synaptic changes occur during learning and memory storage.
- synaptonemal complex** The structure, visible with the electron microscope, produced when homologous chromosomes undergo synapsis.
- synthetic theory of evolution** See *modern synthesis*.
- systematics** The scientific study of the diversity of organisms and their evolutionary relationships. Taxonomy is an aspect of systematics. See *taxonomy*.
- systemic acquired resistance** A defensive response in infected plants that helps fight infection and promote wound healing.
- systemic anaphylaxis** A rapid, widespread allergic reaction that can lead to death.
- systemic circulation** The part of the circulatory system that delivers blood to and from the tissues and organs of the body. Compare with *pulmonary circulation*.
- systems biology** A field of biology that synthesizes knowledge of many small parts to understand the whole. Also referred to as *integrative biology* or *integrative systems biology*.
- ystole** (sis'tuh-lee) The phase of the cardiac cycle when the heart is contracting. Compare with *diastole*.
- T cell (T lymphocyte)** The type of white blood cell responsible for a wide variety of immune functions, particularly cell-mediated immunity. T cells are processed in the thymus. Compare with *B cell*.
- T cytotoxic cell (T_C)** T lymphocyte that destroys cancer cells and other pathogenic cells on contact. Also known as *CD8 T cell* and *killer T cell*.
- T helper cell (T_H)** T lymphocyte that activates B cells (B lymphocytes) and stimulates T cytotoxic cell production. Also known as *CD4 T cell*.
- T tubules** Transverse tubules; system of inward extensions of the muscle fiber plasma membrane.
- taiga** (tie'gah) See *boreal forest*.
- taproot system** A root system consisting of a prominent main root with smaller lateral roots branching off it; a taproot develops directly from the embryonic radicle. Compare with *fibrous root system*.
- target cell or tissue** A cell or tissue with receptors that bind a hormone.
- TATA box** A component of a eukaryotic promoter region; consists of a sequence of bases located about 30 base pairs upstream from the transcription initiation site.
- taxon** A formal taxonomic group at any level, e.g., phylum or genus.
- taxonomy** (tax-on'ah-mee) The science of naming, describing, and classifying organisms; see *systematics*.
- Tay-Sachs disease** A serious genetic disease in which abnormal lipid metabolism in the brain causes mental deterioration in affected infants and young children; inheritance pattern is autosomal recessive.
- tectorial membrane** (tek-tor'ee-ul) The roof membrane of the organ of Corti in the cochlea of the ear.
- telencephalon** See *forebrain*.
- telolecithal egg** An egg with a large amount of yolk, concentrated at the vegetal pole. Compare with *isolecithal egg*.
- telomerase** A special DNA replication enzyme that can lengthen telomeric DNA by adding repetitive nucleotide sequences to the ends of eukaryotic chromosomes; typically present in cells that divide an unlimited number of times.
- telomeres** The protective end caps of chromosomes that consist of short, simple, noncoding DNA sequences that repeat many times.
- telophase** (teel'oh-faze or tel'oh-faze) The last stage of mitosis and of meiosis I and II when, having reached the poles, chromosomes become decondensed, and a nuclear envelope forms around each group.
- temperate deciduous forest** A forest biome that occurs in temperate areas where annual precipitation ranges from about 75 cm to 125 cm.
- temperate grassland** A grassland characterized by hot summers, cold winters, and less rainfall than is found in a temperate deciduous forest biome.
- temperate rain forest** A coniferous biome characterized by cool weather, dense fog, and high precipitation, e.g., the north Pacific coast of North America.
- temperate virus** A virus that integrates into the host DNA as a prophage.
- temperature** The average kinetic energy of the particles in a sample of a substance.
- temporal isolation** A prezygotic reproductive isolating mechanism in which genetic exchange is prevented between similar species because they reproduce at different times of the day, season, or year.
- tendon** A connective tissue structure that joins a muscle to another muscle, or a muscle to a bone. Tendons transmit the force generated by a muscle.
- tendrils** A leaf or stem that is modified for holding or attaching onto objects.
- tension-cohesion model** The mechanism by which water and dissolved inorganic minerals are thought to be transported in xylem; water is pulled upward under tension because of transpiration while maintaining an unbroken column in xylem because of cohesion; also called *transpiration-cohesion model*.
- teratogen** Any agent capable of interfering with normal morphogenesis in an embryo, thereby causing malformations; examples

include radiation, certain chemicals, and certain infectious agents.

terminal bud A bud at the tip of a stem. Compare with *axillary bud*.

termination (of protein synthesis) The final stage of protein synthesis, which occurs when a termination (stop) codon is reached, causing the completed polypeptide chain to be released from the ribosome. See *initiation* and *elongation*.

termination codon See *stop codon*.

territoriality Behavior pattern in which one organism (usually a male) stakes out a territory of its own and defends it against intrusion by other members of the same species and sex.

tertiary consumer See *carnivore*.

tertiary structure (of a protein) (tur'she-air"ee) The overall three-dimensional shape of a polypeptide that is determined by interactions involving the amino acid side chains. Compare with *primary*, *secondary*, and *quaternary protein structure*.

test A shell.

test cross The genetic cross in which either an F₁ individual, or an individual of unknown genotype, is mated to a homozygous recessive individual.

testis (tes'tis) (pl., *testes*) The male gonad that produces sperm and the male hormone testosterone; in humans and certain other mammals; the testes are located in the scrotum.

testosterone (tes-tos'ter-own) The principal male sex hormone (androgen); a steroid hormone produced by the interstitial cells of the testes; stimulates spermatogenesis and is responsible for primary and secondary sex characteristics in the male.

tetrad The chromosome complex formed by the synapsis of a pair of homologous chromosomes (i.e., four chromatids) during meiotic prophase I; also known as a *bivalent*.

tetrapods (tet'rah-podz) Four-limbed vertebrates: the amphibians, reptiles, birds, and mammals.

thalamus (thal'uh-mus) The part of the vertebrate brain that serves as a main relay center, transmitting information between the spinal cord and the cerebrum.

thallus (thal'us) (pl., *thalli*) The simple body of an alga, fungus, or nonvascular plant that lacks root, stems, or leaves, e.g., a liverwort thallus or a lichen thallus.

theca cells The layer of connective tissue cells that surrounds the granulosa cells in an ovarian follicle; stimulated by luteinizing hormone (LH) to produce androgens, which are converted to estrogen in the granulosa cells.

theory A widely accepted explanation supported by a large body of observations and experiments. A good theory relates facts that appear unrelated; it predicts new facts and suggests new relationships. Compare with *hypothesis*.

therapsids (ther-ap'sidz) A group of mammal-like reptiles of the Permian period; gave rise to the mammals.

thermal stratification The marked layering (separation into warm and cold layers) of temperate lakes during the summer. See *thermocline*.

thermocline (thur'moh-kline) A marked and abrupt temperature transition in temperate lakes between warm surface water and cold deeper water. See *thermal stratification*.

thermodynamics Principles governing energy transfer (often expressed in terms of heat transfer). See *first law of thermodynamics* and *second law of thermodynamics*.

thermoreceptor A sensory receptor that responds to heat.

thigmomorphogenesis (thig"moh-mor-foh-jen'uh-sis) An alteration of plant growth in response to mechanical stimuli, such as wind, rain, hail, and contact with passing animals.

thigmotropism (thig'moh-troh'pizm) Plant growth in response to contact with a solid object, such as the twining of plant tendrils.

threatened species A species in which the population is small enough for it to be at risk of becoming extinct throughout all or part of its range but not so small that it is in imminent danger of extinction. Compare with *endangered species*.

threshold level The potential that a neuron or other excitable cell must reach for an action potential to be initiated.

thrombocytes See *platelets*.

thylakoid lumen See *thylakoids*.

thylakoids (thy'lah-koidz) An interconnected system of flattened, saclike, membranous structures inside the chloroplast.

thymine (thy'meen) A nitrogenous pyrimidine base found in DNA.

thymus gland (thy'mus) An endocrine gland that functions as part of the lymphatic system; processes T cells; important in cell-mediated immunity.

thyroid gland An endocrine gland that lies anterior to the trachea and releases hormones that regulate the rate of metabolism.

thyroid hormones Hormones, including thyroxin, secreted by the thyroid gland; stimulate rate of metabolism.

tidal volume The volume of air moved into and out of the lungs with each normal resting breath.

tight junctions Specialized structures that form between some animal cells, producing a tight seal that prevents materials from passing through the spaces between the cells.

tissue A group of closely associated, similar cells that work together to carry out specific functions.

tissue culture The growth of tissue or cells in a synthetic growth medium under sterile conditions.

tissue engineering A developing technology that is striving to grow human tissues and organs (for transplantation) in cell cultures.

tissue fluid See *interstitial fluid*.

tolerance A decreased response to a drug over time.

Toll-like receptors Cell-surface receptors on phagocytes that recognize certain common features of classes of pathogens. See also *pathogen-associated molecular patterns (PAMPs)*.

tonoplast The membrane surrounding a vacuole.

top-down processes Control of ecosystem function by trophic interactions, particularly from the highest trophic level. Compare *bottom-up processes*.

topoisomerases (toe-poe-eye-sahm'er-ases) Enzymes that relieve twists and kinks in a DNA molecule by breaking and rejoining the strands.

torpor An energy-conserving state of low metabolic rate and inactivity. See *estivation* and *hibernation*.

torsion The twisting of the visceral mass characteristic of gastropod mollusks.

total fertility rate The average number of children born to a woman during her lifetime.

totipotent (toh-ti-poh'tent) A term describing a cell or nucleus that contains the complete set of genetic instructions required to direct the normal development of an entire organism. Compare with *pluripotent*.

trace element An element required by an organism in very small amounts.

trachea (tray'kee-uh) (pl., *tracheae*) (1) Principal thoracic air duct of terrestrial vertebrates; windpipe. (2) One of the microscopic air ducts (or tracheal tubes) branching throughout the body of most terrestrial arthropods and some terrestrial mollusks.

tracheal tubes See *trachea*.

tracheid (tray'kee-id) A type of water-conducting and supporting cell in the xylem of vascular plants.

tract A bundle of nerve fibers within the central nervous system.

transcription The synthesis of RNA from a DNA template.

- transcription factors** DNA-binding proteins that regulate transcription in eukaryotes; include positively acting activators and negatively acting repressors.
- transduction** (1) The transfer of a genetic fragment from one cell to another, e.g., from one bacterium to another, by a virus. (2) In the nervous system, the conversion of energy of a stimulus to electrical signals.
- transfer RNA (tRNA)** RNA molecules that bind to specific amino acids and serve as adapter molecules in protein synthesis. The tRNA anticodons bind to complementary mRNA codons.
- transformation** (1) The incorporation of genetic material into a cell, thereby changing its phenotype. (2) The conversion of a normal cell to a cancer cell (called a malignant transformation).
- transgenic organism** A plant or animal that has foreign DNA incorporated into its genome.
- translation** The conversion of information provided by mRNA into a specific sequence of amino acids in a polypeptide chain; process also requires transfer RNA and ribosomes.
- translocation** (1) The movement of organic materials (dissolved food) in the phloem of a plant. (2) Chromosome abnormality in which part of one chromosome has become attached to another. (3) Part of the elongation cycle of protein synthesis in which a transfer RNA attached to the growing polypeptide chain is transferred from the A site to the P site.
- transmembrane protein** An integral membrane protein that spans the lipid bilayer.
- transmission, neural** The conduction of a neural impulse along a neuron or from one neuron to another.
- transpiration** The loss of water vapor from the aerial surfaces of a plant (i.e., leaves and stems).
- transpiration-cohesion model** See *tension-cohesion model*.
- transport vesicles** Small cytoplasmic vesicles that move substances from one membrane system to another.
- transposon** (tranz-poze'on) A DNA segment that is capable of moving from one chromosome to another or to different sites within the same chromosome; also called a *mobile genetic element*.
- transverse tubules** See *T tubules*.
- triacylglycerol** (try-ace'il-glis'er-ol) The main storage lipid of organisms, consisting of a glycerol combined chemically with three fatty acids; also called *triglyceride*. Compare with *monoacylglycerol* and *diacylglycerol*.
- tricarboxylic acid (TCA) cycle** See *citric acid cycle*.
- trichome** (try'kohm) A hair or other appendage growing out from the epidermis of a plant.
- tricuspid valve** See *atrioventricular valve*.
- triglyceride** See *triacylglycerol*.
- triose** A sugar molecule containing three carbons.
- triplet** A sequence of three nucleotides that serves as the basic unit of genetic information.
- triplet code** The sequences of three nucleotides that compose the codons, the units of genetic information in mRNA that specify the order of amino acids in a polypeptide chain.
- trisomy** (try'sohm-ee) The condition in which each chromosome has two copies, except one, which is present in triplicate; the cell contains one more chromosome than the diploid number. Compare with *monosomy* and *disomy*.
- trochophore larva** (troh'koh-for) A larval form found in mollusks and many polychaetes.
- trophic level** (troh'fik) Each sequential step of matter and energy in a food web, from producers to primary, secondary, or tertiary consumers; each organism is assigned to a trophic level based on its primary source of nourishment.
- trophoblast** (troh'foh-blast) The outer cell layer of a late blastocyst, which in placental mammals gives rise to the chorion and to the fetal contribution to the placenta.
- tropic hormone** (troh'pic) A hormone, produced by one endocrine gland, that targets another endocrine gland.
- tropical dry forest** A tropical forest where enough precipitation falls to support trees but not enough to support the lush vegetation of a tropical rain forest; often occurs in areas with pronounced rainy and dry seasons.
- tropical rain forest** A lush, species-rich forest biome that occurs in tropical areas where the climate is very moist throughout the year. Tropical rain forests are also characterized by old, infertile soils.
- tropism** (troh'pizm) In plants, a directional growth response that is elicited by an environmental stimulus.
- tropomyosin** (troh-poh-my'oh-sin) A muscle protein involved in regulation of contraction.
- true-breeding strain** A genetic strain of an organism in which all individuals are homozygous at the loci under consideration.
- tube feet** Structures characteristic of echinoderms; function in locomotion and feeding.
- tuber** A thickened end of a rhizome that is fleshy and enlarged for food storage, e.g., white potato.
- tubular transport maximum (Tm)** The maximum rate at which a substance is reabsorbed from the renal tubules of the kidney.
- tumor** A mass of tissue that grows in an uncontrolled manner; a neoplasm.
- tumor necrosis factors (TNFs)** Cytokines that kill tumor cells and stimulate immune cells to initiate an inflammatory response.
- tumor suppressor gene** A gene (also known as an *anti-oncogene*) whose normal role is to block cell division in response to certain growth-inhibiting factors; when mutated, may contribute to the formation of a cancer cell. Compare with *oncogene*.
- tundra** (tun'dra) A treeless biome between the boreal forest in the south and the polar ice cap in the north that consists of boggy plains covered by lichens and small plants. Also called *arctic tundra*. Compare with *alpine tundra*.
- tunicates** Chordates belonging to subphylum Urochordata; sea squirts.
- turgor pressure** (tur'gor) Hydrostatic pressure that develops within a walled cell, such as a plant cell, when the osmotic pressure of the cell's contents is greater than the osmotic pressure of the surrounding fluid.
- Turner syndrome** An inherited condition in which only one sex chromosome (an X chromosome) is present in cells; karyotype is designated XO; affected individuals are sterile females.
- tyrosine kinase** An enzyme that phosphorylates the tyrosine part of proteins.
- tyrosine kinase receptor** A plasma membrane receptor that phosphorylates the tyrosine part of proteins; when a ligand binds to the receptor, the conformation of the receptor changes and it may phosphorylate itself as well as other molecules; important in immune function and serves as a receptor for insulin.
- ultimate causes (of behavior)** Evolutionary explanations for why a certain behavior occurs. Compare with *proximate causes of behavior*.
- ultrasound imaging** A technique in which high-frequency sound waves (ultrasound) are used to provide an image (sonogram) of an internal structure.
- ultrastructure** The fine detail of a cell, generally only observable by use of an electron microscope.
- umbilical cord** In placental mammals, the organ that connects the embryo to the placenta.

uniform dispersion The spatial distribution pattern of a population in which individuals are regularly spaced. Compare with *random dispersion* and *clumped dispersion*.

unsaturated fatty acid See *fatty acid*.

upstream promoter elements (UPEs) Components of a eukaryotic promoter, found upstream of the RNA polymerase-binding site; the strength of a promoter is affected by the number and type of UPEs present.

upwelling An upward movement of water that brings nutrients from the ocean depths to the surface. Where upwelling occurs, the ocean is very productive.

uracil (yur'ah-sil) A nitrogenous pyrimidine base found in RNA.

urea (yur-ee'ah) The principal nitrogenous excretory product of mammals; one of the water-soluble end products of protein metabolism.

ureter (yur'ih-tur) One of the paired tubular structures that conducts urine from the kidney to the bladder.

urethra (yoo-ree'thruh) The tube that conducts urine from the bladder to the outside of the body.

uric acid (yoor'ik) The principal nitrogenous excretory product of insects, birds, and reptiles; a relatively insoluble end product of protein metabolism; also occurs in mammals as an end product of purine metabolism.

urinary bladder An organ that receives urine from the ureters and temporarily stores it.

urinary system The body system in vertebrates that consists of kidneys, urinary bladder, and associated ducts.

urochordates A subphylum of chordates; includes the tunicates.

uterine tube (yoo'tur-in) See *oviduct*.

uterus (yoo'tur-us) The hollow, muscular organ of the female reproductive tract in which the fetus undergoes development.

utricle The structure within the vestibule of the vertebrate inner ear that, along with the saccule, houses the receptors of static equilibrium.

vaccine (vak-seen') A commercially produced, weakened or killed antigen associated with a particular disease that stimulates the body to make antibodies.

vacuole (vak'yoo-ole) A fluid-filled, membrane-enclosed sac found within the cytoplasm; may function in storage, digestion, or water elimination.

vagina The elastic, muscular tube, extending from the cervix to its external opening, that receives the penis during sexual intercourse and serves as the birth canal.

valence electrons The electrons in the outer electron shell, known as the *valence shell*, of an atom; in the formation of a chemical bond, an atom can accept electrons into its valence shell or donate or share valence electrons.

van der Waals interactions Weak attractive forces between atoms; caused by interactions among fluctuating charges.

vas deferens (vas def'ur-enz) (pl., *vasa deferentia*) One of the paired sperm ducts that connects the epididymis of the testis to the ejaculatory duct.

vascular cambium A lateral meristem that produces secondary xylem (wood) and secondary phloem (inner bark). Compare with *cork cambium*.

vascular tissue system The tissues specialized for translocation of materials throughout the plant body, i.e., the xylem and phloem.

vasoconstriction Narrowing of the diameter of blood vessels.

vasodilation Expansion of the diameter of blood vessels.

vector (1) Any carrier or means of transfer. (2) Agent, e.g., a plasmid or virus, that transfers genetic information. (3) Agent that transfers a parasite from one host to another.

vegetal pole The yolky pole of a vertebrate or echinoderm egg. Compare with *animal pole*.

vein (1) A blood vessel that carries blood from the tissues toward a chamber of the heart (compare with *artery*). (2) A strand of vascular tissue that is part of the network of conducting tissue in a leaf.

veliger larva The larval stage of many marine gastropods (snails) and bivalves (e.g., clams); often is a second larval stage that develops after the trochophore larva.

ventilation The process of actively moving air or water over a respiratory surface.

ventral Toward the lowermost surface or belly of an animal. Compare with *dorsal*.

ventricle (1) A cavity in an organ. (2) One of the several cavities of the brain. (3) One of the chambers of the heart that receives blood from an atrium.

vernalization (vur'nul-uh-zay'shun) The induction of flowering by a low-temperature treatment.

vertebrates A subphylum of chordates that possess a bony vertebral column; includes fishes, amphibians, reptiles, birds, and mammals.

vesicle (ves'ih-kl) Any small sac, especially a small, spherical, membrane-enclosed compartment, within the cytoplasm.

vessel element A type of water-conducting cell in the xylem of vascular plants.

vestibular apparatus Collectively, the saccule, utricle, and semi-circular canals of the inner ear.

vestigial (ves-tij'ee-ul) Rudimentary; an evolutionary remnant of a formerly functional structure.

vibrio A spirillum (spiral-shaped bacterium) that is shaped like a comma. Compare with *spirillum*, *spirochete*, *bacillus*, and *coccus*.

villus (pl., *villi*) A multicellular, minute, elongated projection from the surface of an epithelial membrane, e.g., villi of the mucosa of the small intestine.

viroid (vy'roid) A tiny, naked, infectious particle consisting only of nucleic acid.

virulence Properties that render an infectious agent pathogenic (and often lethal) to its host. Compare with *avirulence*.

virus A tiny pathogen consisting of a core of nucleic acid usually encased in protein and capable of infecting living cells; a virus is characterized by total dependence on a living host.

viscera (vis'ur-uh) The internal body organs, especially those located in the abdominal or thoracic cavities.

visceral mass The concentration of body organs (viscera) located above the foot in mollusks.

vital capacity The maximum volume of air a person exhales after filling the lungs to the maximum extent.

vitamin A complex organic molecule required in very small amounts for normal metabolic functioning.

vitelline envelope An acellular covering of the eggs of certain animals (e.g., echinoderms), located just outside the plasma membrane.

viviparous (vih-vip'er-us) Bearing living young that develop within the body of the mother. Compare with *oviparous* and *ovoviviparous*.

voltage-activated ion channels Ion channels in the plasma membrane of neurons that are regulated by changes in voltage. Also called *voltage-gated channels*.

vomer nasal organ In mammals, an organ in the epithelium of the nose, made up of specialized chemoreceptor cells that detect pheromones.

vulva The external genital structures of the female.

warning coloration See *aposematic coloration*.

water mold A funguslike protist with a body consisting of a coenocytic mycelium that reproduces asexually by forming motile zoospores and sexually by forming oospores.

water potential Free energy of water; the water potential of pure water is zero and that of solutions is a negative value. Differences in water potential are used to predict the direction of water movement (always from a region of less negative water potential to a region of more negative water potential).

water vascular system Unique hydraulic system of echinoderms; functions in locomotion and feeding.

wavelength The distance from one wave peak to the next; the energy of electromagnetic radiation is inversely proportional to its wavelength.

weathering processes Chemical or physical processes that help form soil from rock; during weathering processes, the rock is gradually broken into smaller and smaller pieces.

Western blot A technique in which proteins, previously separated by gel electrophoresis, are transferred to paper. A specific labeled antibody is generally used to mark the location of a particular protein. Compare with *Southern blot* and *Northern blot*.

white matter Nervous tissue in the brain and spinal cord that contains myelinated axons. Compare with *gray matter*.

wild type The phenotypically normal (naturally occurring) form of a gene or organism.

wobble The ability of some tRNA anticodons to associate with more than one mRNA codon; in these cases the 5' base of the anticodon is capable of forming hydrogen bonds with more than one kind of base in the 3' position of the codon.

work Any change in the state or motion of matter.

X-linked gene A gene carried on an X chromosome.

X-ray diffraction A technique for determining the spatial arrangement of the components of a crystal.

xylem (zy'lem) The vascular tissue that conducts water and dissolved minerals in plants.

XYY karyotype Chromosome constitution that causes affected individuals (who are fertile males) to be unusually tall, with severe acne.

yeast A unicellular fungus (ascomycete) that reproduces asexually by budding or fission and sexually by ascospores.

yolk sac One of the extraembryonic membranes; a pouchlike outgrowth of the digestive tract of embryos of certain vertebrates (e.g., birds) that grows around the yolk and digests it. Embryonic blood cells are formed in the mammalian yolk sac, which lacks yolk.

zero population growth Point at which the birth rate equals the death rate. A population with zero population growth does not change in size.

zona pellucida (pel-loo'sih-duh) The thick, transparent covering that surrounds the plasma membrane of a mammalian ovum.

zooflagellate A unicellular, nonphotosynthetic protozoan that has one or more long, whiplike flagella.

zooplankton (zoh''oh-plank'tun) The nonphotosynthetic organisms present in plankton, e.g., protozoa, tiny crustaceans, and the larval stages of many animals. See *plankton*. Compare with *phytoplankton*.

zoospore (zoh'oh-spore) A flagellated motile spore produced asexually by certain algae, chytrids, and water molds and other protists.

zooxanthellae (zoh''oh-zan-thel'ee) (sing., *zooxanthella*) Endosymbiotic, photosynthetic dinoflagellates found in certain marine invertebrates; their mutualistic relationship with corals enhances the corals' reef-building ability.

zygomycetes (zy''gah-my'seats) Fungi characterized by the production of nonmotile asexual spores and sexual zygospores.

zygosporangium (zy''gah-spor-an'gee-um) A thick-walled sporangium containing a zygospore.

zygospore (zy'gah-spor) A sexual spore produced by a zygomycete.

zygote The $2n$ cell that results from the union of n gametes in sexual reproduction. Species that are not polyploid have haploid gametes and diploid zygotes.

zygotic genes Genes that are transcribed after fertilization, either in the zygote or in the embryo. Compare with *maternal effect genes*.