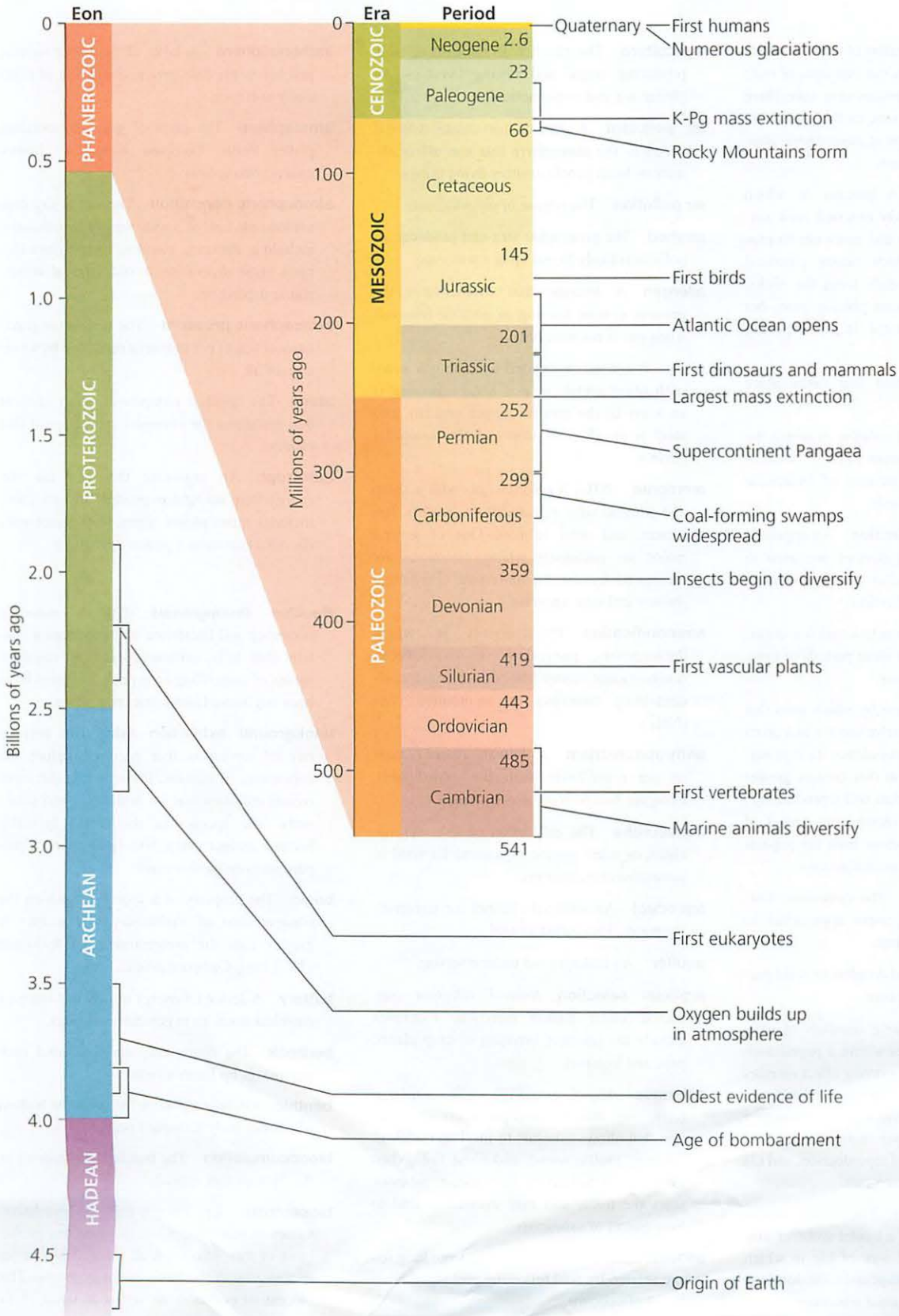


Geologic Time Scale



Glossary

- acid deposition** The settling of acidic or acid-forming pollutants from the *atmosphere* onto Earth's surface. This process may take place by precipitation, fog, gases, or the deposition of dry particles. One type of *atmospheric deposition*. Compare *acid rain*.
- acid mine drainage** A process in which sulfide minerals in newly exposed rock surfaces react with *oxygen* and rainwater to produce sulfuric acid, which causes chemical *runoff* as it *leaches* metals from the rocks. Acid drainage is a natural phenomenon, but mining greatly accelerates it by exposing many new surfaces.
- acid rain** *Acid deposition* that takes place through rain.
- acidic** The property of a *solution* in which the concentration of *hydrogen* (H^+) *ions* is greater than the concentration of hydroxide (OH^-) ions. Compare *basic*.
- active solar energy collection** An approach in which technological devices are used to focus, move, or store *solar energy*. Compare *passive solar energy collection*.
- acute exposure** Exposure to a *toxicant* occurring in high amounts for short periods of time. Compare *chronic exposure*.
- adaptation** (1) The process by which traits that lead to increased reproductive success in a given environment evolve in a *population* through *natural selection*. (2) A trait that confers greater likelihood that an individual will reproduce. (3) With regard to *climate change*, the pursuit of strategies to protect ourselves from the impacts of *climate change*. Compare *mitigation*.
- adaptive management** The systematic testing of different management approaches to improve methods over time.
- aerosols** Very fine liquid droplets or solid particles aloft in the atmosphere.
- age structure** The relative numbers of individuals of different ages within a *population*. Age structure can have a strong effect on rates of population growth or decline and is often expressed as a ratio of age classes, consisting of *organisms* (1) not yet mature enough to reproduce, (2) capable of reproduction, and (3) beyond their reproductive years.
- agricultural revolution** The shift around 10,000 years ago from a hunter-gatherer lifestyle to an agricultural way of life in which people began to grow crops and raise domestic animals. Compare *industrial revolution*.
- agriculture** The practice of cultivating *soil*, producing crops, and raising livestock for human use and consumption.
- air pollutant** A gas or particulate material added to the atmosphere that can affect climate or harm people or other living things.
- air pollution** The release of *air pollutants*.
- airshed** The geographic area that produces air pollutants likely to end up in a waterway.
- allergen** A *toxicant* that overactivates the immune system, causing an immune response when one is not necessary.
- alloy** A substance created by fusing a *metal* with other metals or nonmetals. Bronze is an alloy of the metals copper and tin, and steel is an alloy of iron and the nonmetal *carbon*.
- ammonia** (NH_3) A colorless gas with a sharp and pungent odor, released from *feedlots*, fertilizers, and other sources. One of several major *air pollutants* whose emissions are monitored by the *Environmental Protection Agency* and state agencies.
- ammonification** The process in which decomposers, particularly bacteria, break down organic matter and release compounds containing ammonia or ammonium ions (NH_4^+).
- anthropocentrism** A human-centered view of our relationship with the *environment*. Compare *biocentrism*; *ecocentrism*.
- aquaculture** The cultivation of fish, shrimp, algae, or other aquatic organisms for food in controlled environments.
- aqueduct** An artificial channel for transporting water. Also called a canal.
- aquifer** An underground water reservoir.
- artificial selection** *Natural selection* conducted under human direction. Examples include the selective breeding of crop plants, pets, and livestock.
- asbestos** Any of several types of *mineral* that form long, thin microscopic fibers—a structure that allows asbestos to insulate buildings for heat, muffle sound, and resist fire. When inhaled and lodged in lung tissue, asbestos scars the tissue and may eventually lead to lung cancer or *asbestosis*.
- asbestosis** A disorder resulting from lung tissue scarred by acid following prolonged inhalation of *asbestos*.
- asthenosphere** A layer of the upper *mantle*, just below the *lithosphere*, consisting of especially soft rock.
- atmosphere** The layer of gases surrounding planet Earth. Compare *biosphere*; *hydrosphere*; *lithosphere*.
- atmospheric deposition** The wet or dry deposition onto land of a wide variety of pollutants, including mercury, nitrates, and organochlorines. *Acid deposition* is one type of atmospheric deposition.
- atmospheric pressure** The weight (or gravitational force) per unit area produced by a column of air.
- atom** The smallest component of an *element* that maintains the chemical properties of that *element*.
- autotroph** An organism that can use the *energy* from sunlight to produce its own food. Includes green plants, algae, and cyanobacteria. Also known as a primary producer.
- Bacillus thuringiensis* (Bt)** A naturally occurring soil bacterium that produces a protein that kills certain insects. A common means of controlling crop pests. Its genes have been engineered into some crop plants.
- background extinction rate** The average rate of *extinction* that occurred before the appearance of humans. For example, the *fossil record* indicates that for both birds and mammals, one *species* in the world typically became extinct every 500–1000 years. Compare *mass extinction event*.
- basic** The property of a *solution* in which the concentration of *hydroxide* (OH^-) *ions* is greater than the concentration of *hydrogen* (H^+) ions. Compare *acidic*.
- battery** A device for *energy storage* that employs chemical reactions to generate *electricity*.
- bedrock** The continuous mass of solid rock that makes up Earth's *crust*.
- benthic** Of, relating to, or living on the bottom of a water body. Compare *pelagic*.
- bioaccumulation** The buildup of *toxicants* in the tissues of an animal.
- biocentrism** A *philosophy* that ascribes relative values to actions, entities, or properties on the basis of their effects on *all living things* or on the integrity of the biotic realm in general. The biocentrist evaluates an action in terms of its

- overall impact on living things, including—but not exclusively focusing on—human beings. Compare *anthropocentrism*; *egocentrism*.
- biofuel** Diesel fuel produced by mixing vegetable oil, used cooking grease, or animal fat with small amounts of *ethanol* or methanol (wood alcohol) in the presence of a chemical catalyst. A type of *biofuel*.
- biodiversity** The variety of life across all levels of biological organization, including the diversity of *species*, *genes*, *populations*, *communities*, and *ecosystems*. Also called *biological diversity*.
- biodiversity hotspot** An area that supports an especially great diversity of *species*, particularly species that are *endemic* to the area.
- bioenergy** Energy harnessed from plant and animal matter, including wood from trees, charcoal from burned wood, and combustible animal waste products, such as cattle manure. (*Fossil fuels* are not considered bioenergy sources because their organic matter has not been part of living organisms for millions of years and has undergone considerable chemical alteration since that time.) Also called biomass energy.
- biofuel** Fuel produced from *biomass* sources and used primarily to power automobiles. Examples include *ethanol* and *biodiesel*.
- biogeochemical cycle** See *nutrient cycle*.
- biological control** Control of pests and weeds with organisms that prey on or parasitize them rather than with chemical *pesticides*. Commonly called biocontrol.
- biological diversity** See *biodiversity*.
- biological hazard** Human health hazards that result from ecological interactions among organisms. These include *parasitism* by viruses, bacteria, or other *pathogens*. Compare *infectious disease*; *chemical hazard*; *cultural hazard*; *physical hazard*.
- biomagnification** The magnification of the concentration of *toxicants* in an organism caused by its consumption of other organisms in which toxicants have *bioaccumulated*.
- biomass** (1) In *ecology*, organic material that makes up living organisms; the collective mass of living matter in a given place and time. (2) In energy, organic material derived from living or recently living organisms, containing chemical *energy* that originated with *photosynthesis*.
- biome** A major regional complex of similar plant *communities*; a large *ecological* unit defined by its dominant plant type and vegetation structure.
- biophilia** An inherent love for and fascination with nature and an instinctive desire people have to affiliate with other living things. Defined by biologist E.O. Wilson as “the connections that human beings subconsciously seek with the rest of life.”
- biopower** Power attained by combusting *biomass* sources to generate *electricity*.
- bioprospecting** Searching for organisms that might provide new drugs, medicines, foods, or other products of value or interest.
- bioremediation** A process by which living organisms are used to degrade toxic substances or render them inert. Generally plants, fungi, or microbes are used to take up specific contaminants from soil or water and then break organic contaminants down into safer compounds or concentrate heavy metals in their tissues.
- biosphere** The cumulative total of all the planet’s living organisms and the nonliving portions of the *environment* they inhabit.
- biosphere reserve** A tract of land with exceptional *biodiversity* that couples preservation with *sustainable development* to benefit local people. Biosphere reserves are designated by UNESCO (the United Nations Educational, Scientific and Cultural Organization) following application by local stakeholders.
- biotechnology** The material application of biological *science* to create products derived from organisms. The creation of *transgenic* organisms is one type of biotechnology.
- birth control** The effort to control the number of children one bears, particularly by reducing the frequency of pregnancy. Compare *contraception*; *family planning*.
- bisphenol A (BPA)** An *endocrine-disrupting chemical* found in plastics.
- boreal forest** A *biome* of northern coniferous forest that stretches in a broad band across much of Canada, Alaska, Russia, and Scandinavia. Also known as *taiga*, boreal forest consists of a limited number of *species* of evergreen trees, such as black spruce, that dominate large regions of forests interspersed with occasional bogs and lakes.
- bottle bill** A law establishing a program whereby consumers pay a deposit on bottles or cans upon purchase—often 5 or 10 cents per container—and then receive a refund when they return them to stores after use. Bottle bills reduce litter, raise *recycling* rates, and decrease the *waste stream*.
- bottleneck** In environmental science, a step in a process that limits the progress of the overall process.
- breakdown product** A compound that results from the degradation of a toxicant.
- brownfield** An area of land whose redevelopment or reuse is complicated by the presence or potential presence of hazardous material.
- campus sustainability** A term describing a wide array of efforts taking place on college and university campuses through which students, faculty, staff, and administrators are working to reduce the environmental impacts and *ecological footprints* of their institutions.
- canopy** The upper level of tree leaves and branches in a *forest*.
- cap-and-trade** An *emissions trading* system in which government sets a cap by determining an allowable level of *pollution* and then issues polluting parties permits to pollute up to this level. A party receives credit for amounts it does not emit and can then sell this credit to other parties.
- captive breeding** The practice of keeping members of *threatened* or *endangered species* in captivity so that their young can be bred and raised in controlled *environments* and subsequently reintroduced into the wild.
- carbohydrate** An *organic compound* consisting of *atoms* of *carbon*, *hydrogen*, and *oxygen*.
- carbon** The chemical *element* with six protons and six neutrons. A key element in *organic compounds*.
- carbon capture and storage** Technologies or approaches to remove *carbon dioxide* from emissions of power plants or other facilities and sequester, or store, it (generally in liquid form) underground under pressure in locations where it will not seep out, in an effort to mitigate *global climate change*.
- carbon cycle** A major *nutrient cycle* consisting of the routes that *carbon atoms* take through the nested networks of environmental *systems*.
- carbon dioxide** (CO₂) A colorless gas used by plants for *photosynthesis*, given off by *respiration*, and released by burning *fossil fuels*. A primary *greenhouse gas* whose buildup contributes to *global climate change*.
- carbon footprint** The cumulative amount of *carbon*, or *carbon dioxide*, that a person or institution emits, and is indirectly responsible for emitting, into the *atmosphere*, contributing to *global climate change*. Compare *ecological footprint*.
- carbon monoxide** (CO) A colorless, odorless gas produced primarily by the incomplete combustion of fuel. An EPA *criteria pollutant*.
- carbon-neutrality** The state in which an individual, business, or institution emits no net carbon to the atmosphere. It may be achieved by reducing carbon emissions or employing *carbon offsets* to offset emissions.
- carbon offset** A voluntary payment to another entity intended to enable that entity to reduce the *greenhouse gas* emissions that one is unable or unwilling to reduce oneself. The payment thus offsets one’s own emissions.
- carbon pricing** The practice of putting a price on the emission of *carbon dioxide*, either through *carbon trading* or a *carbon tax*, as a

means to address *global climate change*. Carbon pricing compensates the public for the external costs of fossil fuel use by shifting costs to emitters and creates financial incentives to reduce emissions.

carbon tax A type of *green tax* charged to entities that pollute by emitting *carbon dioxide*. Carbon taxation is one approach to *carbon pricing* and gives polluters a financial incentive to reduce emissions in an effort to address *global climate change*. Compare *carbon trading*; *fee-and-dividend*; *revenue-neutral carbon tax*.

carbon trading A form of *emissions trading* that focuses on the emission of *carbon dioxide*. In a carbon trading market, emitters buy and sell permits to emit CO₂. Carbon trading is one approach to *carbon pricing* and gives polluters a financial incentive to reduce emissions in an effort to address *global climate change*. Compare *carbon tax*.

carcinogen A chemical or type of radiation that causes cancer.

carrying capacity The maximum *population size* of a given organism that a given *environment* can sustain.

case history Medical approach involving the observation and analysis of individual patients.

Cassandra A worldview (or a person holding the worldview) that predicts doom and disaster as a result of our environmental impacts. Compare *Cornucopian*.

catalytic converter Automotive technology that chemically treats engine exhaust to reduce *air pollution*. Reacts exhaust with metals that convert *hydrocarbons*, CO, and NO_x into *carbon dioxide*, *water vapor*, and *nitrogen gas*.

cellular respiration The process by which a *cell* uses the chemical reactivity of *oxygen* to split glucose into its constituent parts, *water* and *carbon dioxide*, and thereby release chemical energy that can be used to form chemical bonds or to perform other tasks within the cell. Compare *photosynthesis*.

cellulosic ethanol *Ethanol* produced from the cellulose in plant tissues by treating it with enzymes. Techniques for producing cellulosic ethanol are under development because of interest in making ethanol from low-value crop waste (residues such as corn stalks and husks), rather than from the sugars of high-value crops.

chaparral A *biome* consisting mostly of densely thicketed evergreen shrubs occurring in limited small patches. Its "Mediterranean" *climate* of mild, wet winters and warm, dry summers is induced by oceanic influences. In addition to ringing the Mediterranean Sea, chaparral occurs along the coasts of California, Chile, and southern Australia.

character displacement A phenomenon resulting from *competition* among *species* in which competing species evolve characteristics

that better adapt them to specialize on the portion of the resource they use. The species essentially become more different from one another, reducing their competition.

chemical hazard Chemicals that pose human health hazards. These include *toxins* produced naturally, as well as many of the disinfectants, *pesticides*, and other synthetic chemicals that our society produces. Compare *biological hazard*; *cultural hazard*; *physical hazard*.

chemistry The study of the different types of *matter* and how they interact.

chemosynthesis The process by which bacteria in *hydrothermal vents* use the chemical energy of hydrogen sulfide (H₂S) to transform inorganic *carbon* into *organic compounds*. Compare *photosynthesis*.

Chernobyl Site of a nuclear power plant in Ukraine (then part of the Soviet Union), where in 1986 an explosion caused the most severe *nuclear reactor* accident the world has yet seen. The term is also often used to denote the accident itself. Compare *Fukushima Daiichi*; *Three Mile Island*.

chlorofluorocarbon (CFC) A type of *halo-carbon* consisting of only chlorine, fluorine, carbon, and hydrogen. CFCs were used as refrigerants, as fire extinguishers, as propellants for aerosol spray cans, as cleaners for electronics, and for making polystyrene foam. They were phased out under the *Montreal Protocol* because they are *ozone-depleting substances* that destroy stratospheric *ozone*.

chronic exposure Exposure for long periods of time to a *toxicant* occurring in low amounts. Compare *acute exposure*.

citizen science The observation, study, and collection of data for scientific purposes by nonprofessional volunteers. Also called *community science*.

city planning The professional pursuit that attempts to design cities in such a way as to maximize their efficiency, functionality, and beauty. Also known as *urban planning*. Compare *regional planning*.

classical economics Founded by Adam Smith, the study of the behavior of buyers and sellers in a capitalist market economy. Holds that individuals acting in their own self-interest may benefit society provided that their behavior is constrained by the rule of law and by private property rights and operates within competitive markets. Compare *neoclassical economics*.

clay *Sediment* consisting of particles less than 0.002 mm in diameter. Compare *sand*; *silt*.

Clean Air Act U.S. *legislation* to control *air pollution*, first enacted in 1963 and amended multiple times since, most significantly in 1970 and 1990. Funds research into pollution control, sets standards for air quality, encourages emissions standards for automobiles

and for stationary point sources such as industrial plants, imposes limits on emissions from new sources, funds a nationwide air quality monitoring system, enables citizens to sue parties violating the standards, and introduced an *emissions trading* program for *sulfur dioxide*.

clean coal technologies An array of techniques, equipment, and approaches to remove chemical contaminants (such as sulfur) during the process of generating *electricity* from *coal*.

clear-cutting The harnessing of timber by cutting all the trees in an area. Although it is the most cost-efficient method, clear-cutting is also the most ecologically damaging.

climate The pattern of atmospheric conditions that typifies a geographic region over long periods of time (typically years, decades, centuries, or millennia). Compare *weather*.

climate change See *global climate change*.

climate diagram A visual representation of a region's average monthly temperature and *precipitation*. Also known as a climatograph.

climate model A computer program that combines what is known about weather patterns, atmospheric circulation, atmosphere-ocean interactions, and feedback mechanisms, to simulate *climate* processes.

coal A solid blackish *fossil fuel* formed from organic matter (generally woody plant material) that was compressed under very high pressure and with little decomposition, creating dense, solid carbon structures.

coevolution The process by which two or more species evolve in response to one another. Parasites and hosts may coevolve, as may flowering plants and their pollinators.

cogeneration A practice in which the extra heat generated in the production of *electricity* is captured and put to use heating workplaces and homes, as well as producing other kinds of power.

colony collapse disorder A mysterious malady afflicting honeybees, which has destroyed roughly one-third of all honeybees in the United States annually in recent years. Likely caused by chemical *insecticides*, *pathogens* and parasites, *habitat* and resource loss, or combinations of these factors.

command-and-control A top-down approach to policy in which a legislative body or a regulating agency sets rules, standards, or limits and threatens punishment for violations of those limits.

community In *ecology*, an assemblage of *populations* of interacting organisms that live in the same area at the same time.

community-based conservation The practice of engaging local people to conserve land and wildlife in their own region.

- community ecology** The scientific study of patterns of species diversity and interactions among *species*, ranging from one-to-one interactions to complex interrelationships involving entire *communities*.
- community-supported agriculture (CSA)** A system in which consumers pay farmers in advance for a share of their yield, usually in the form of weekly deliveries of produce.
- competition** A species interaction in which multiple organisms seek the same limited resource(s). Competition can take place among members of the same species or among members of different species.
- competitive exclusion** An outcome of interspecific competition in which one *species* excludes another species from resource use entirely.
- compost** A mixture produced when *decomposers* break down organic matter, such as food and crop waste, in a controlled environment.
- composting** The conversion of organic *waste* into mulch or humus by encouraging, in a controlled manner, the natural biological processes of decomposition.
- compound** A *molecule* whose *atoms* are composed of two or more *elements*.
- concentrated solar power (CSP)** A means of generating *electricity* at a large scale by focusing sunlight from a large area onto a smaller area. Several approaches are used.
- concession** The right to extract a resource, granted by a government to a corporation. Compare *conservation concession*.
- confined aquifer** A water-bearing, porous layer of rock, sand, or gravel that is trapped between an upper and lower layer of less permeable substrate, such as clay. The water in a confined aquifer is under pressure because it is trapped between two impermeable layers. Also called an artesian aquifer. Compare *unconfined aquifer*.
- conservation biology** A scientific discipline devoted to understanding the factors, forces, and processes that influence the loss, protection, and restoration of *biodiversity*.
- conservation concession** A type of *concession* in which a conservation organization purchases the right to prevent resource extraction in an area of land, generally to preserve habitat in developing nations.
- conservation ethic** An ethic holding that people should put natural resources to use but that we have a responsibility to manage them wisely. It promotes the prudent, efficient, and sustainable extraction and use of natural resources for the good of present and future generations. Compare *preservation ethic*.
- Conservation Reserve Program** U.S. policy in farm bills since 1985 that pays farmers to stop cultivating highly erodible cropland and instead place it in conservation reserves planted with grasses and trees.
- conservation tillage** *Agriculture* that limits the amount of tilling (plowing, disking, harrowing, or chiseling) of *soil*. Compare *no-till*.
- consumer** An organism that consumes other living organisms.
- consumptive use** Use of *fresh water* in which water is removed from a particular *aquifer* or surface water body and is not returned to it. *Irrigation* for *agriculture* is an example of consumptive use. Compare *non-consumptive use*.
- continental collision** The meeting of two tectonic plates of continental *lithosphere* at a *convergent plate boundary*, wherein the continental *crust* on both sides resists *subduction* and instead crushes together, bending, buckling, and deforming layers of rock and forcing portions of the buckled crust upward, often creating mountain ranges.
- continental shelf** The gently sloping underwater edge of a continent, varying in width from 100 m (330 ft) to 1300 km (800 mi), with an average slope of 1.9 m/km (10 ft/mi).
- contingent valuation** A technique that uses surveys to determine how much people would be willing to pay to protect a resource or to restore it after damage has been done.
- contour farming** The practice of plowing furrows sideways across a hillside, perpendicular to its slope, to help prevent the formation of rills and gullies. The technique is so named because the furrows follow the natural contours of the land.
- contraception** The deliberate attempt to prevent pregnancy despite sexual intercourse. Compare *birth control*.
- control** The portion of an *experiment* in which a *variable* has been left unmanipulated, to serve as a point of comparison with the *treatment*.
- controlled experiment** An *experiment* in which a *treatment* is compared against a *control* in order to test the effect of a *variable*.
- convective circulation** A circular *current* (of air, water, magma, etc.) driven by temperature differences. In the atmosphere, warm air rises into regions of lower *atmospheric pressure*, where it expands and cools and then descends and becomes denser, replacing warm air that is rising. The air picks up heat and moisture near ground level and prepares to rise again, continuing the process.
- Convention on Biological Diversity** A 1992 international treaty that aims to conserve *biodiversity*, use biodiversity in a *sustainable* manner, and ensure the fair distribution of biodiversity's benefits.
- Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES)** A 1973 treaty facilitated by the *United Nations* that protects *endangered* species by banning the international transport of their body parts.
- conventional law** International law that arises from *conventions*, or treaties, that nations agree to enter into. Compare *customary law*.
- convergent evolution** The evolutionary process by which very unrelated species acquire similar traits as they adapt to similar selective pressures from similar environments.
- convergent plate boundary** The area where tectonic plates converge or come together. Can result in *subduction* or *continental collision*. Compare *divergent plate boundary*; *transform plate boundary*.
- coral** Tiny marine animals that build *coral reefs*. Corals attach to rock or existing reef and capture passing food with stinging tentacles. They also derive nourishment from photosynthetic symbiotic algae known as *zooxanthellae*.
- coral reef** A mass of calcium carbonate composed of the skeletons of tiny colonial marine organisms called *corals*.
- core** The innermost part of Earth, made up mostly of iron, that lies beneath the *crust* and *mantle*.
- Coriolis effect** The apparent deflection of north-south air *currents* to a partly east-west direction, caused by the faster spin of regions near the equator than of regions near the poles as a result of Earth's rotation.
- Cornucopian** A worldview (or a person holding the worldview) that we will find ways to make Earth's natural resources meet all our needs indefinitely and that human ingenuity will see us through any difficulty. Compare *Cassandra*.
- correlation** Statistical association (positive or negative) among variables. The association may be causal or may occur by chance.
- corridor** A passageway of protected land established to allow animals to travel between islands of protected *habitat*.
- cost-benefit analysis** A method commonly used in *neoclassical economics* in which estimated costs for a proposed action are totaled and then compared to the sum of benefits estimated to result from the action.
- covalent bond** A type of chemical bonding where atoms share electrons in chemical bonds. An example is a water molecule, which forms when an oxygen atom shares electrons with two hydrogen atoms.
- cradle-to-cradle** An approach to *waste management* and industrial design in which the materials from products are recovered and reused to create new products.
- criteria pollutant** One of six *air pollutants*—carbon monoxide, sulfur dioxide, nitrogen

- dioxide, tropospheric ozone, particulate matter, and *lead*—for which the *Environmental Protection Agency* has established maximum allowable concentrations in ambient outdoor air because of the threats they pose to human health.
- crop rotation** The practice of alternating the kind of crop grown in a particular field from one season or year to the next.
- cropland** Land that people use to raise plants for food and fiber.
- crude oil** Oil in its natural state, as it occurs once extracted from the ground but before processing and refining.
- crust** The lightweight outer layer of the Earth, consisting of *rock* that floats atop the malleable *mantle*, which, in turn, surrounds a mostly iron *core*.
- cultural hazard** Human health hazards that result from the place we live, our socioeconomic status, our occupation, or our behavioral choices. These include choosing to smoke cigarettes, or living or working with people who do. Also known as *lifestyle hazard*. Compare *biological hazard*; *chemical hazard*; *physical hazard*.
- culture** The overall ensemble of knowledge, beliefs, values, and learned ways of life shared by a group of people.
- current** The flow of a liquid or gas in a certain direction.
- customary law** International law that arises from long-standing practices, or customs, held in common by most *cultures*. Compare *conventional law*.
- dam** Any obstruction placed in a river or stream to block the flow of water so that water can be stored in a *reservoir*. Dams are built to prevent floods, provide drinking water, facilitate *irrigation*, and generate *electricity*.
- Darwin, Charles** (1809–1882) English naturalist who proposed the concept of *natural selection* as a mechanism for *evolution* and as a way to explain the great variety of living things. Compare *Wallace*; *Alfred Russel*.
- data** Information, generally quantitative information.
- debt-for-nature swap** A transaction in which a conservation organization pays off a portion of a developing nation's international debt in exchange for a promise by the nation to set aside reserves, fund environmental education, and better manage protected areas.
- decomposer** An organism, such as a fungus or bacterium, that breaks down leaf litter and other nonliving matter into simple constituents that can be taken up and used by plants. Compare *detritivore*.
- deep-well injection** A *hazardous waste* disposal method in which a well is drilled deep beneath an area's *water table* into porous rock below an impervious *soil* layer. Wastes are then injected into the well so that they will be absorbed into the porous rock and remain deep underground, isolated from *groundwater* and human contact. Compare *surface impoundment*.
- deforestation** The clearing and loss of *forests*.
- demographer** A social scientist who studies the size; density; distribution; age structure; sex ratio; and rates of birth, death, immigration, and emigration of human populations. See *demography*.
- demographic fatigue** An inability on the part of governments to address overwhelming challenges related to population growth.
- demographic transition** A theoretical *model* of economic and cultural change that explains the declining death rates and birth rates that occurred in Western nations as they became industrialized. The model holds that industrialization caused these rates to fall naturally by decreasing mortality and by lessening the need for large families. Parents would thereafter choose to invest in quality of life rather than quantity of children.
- demography** A *social science* that applies the principles of *population ecology* to the study of statistical change in human *populations*.
- denitrifying bacteria** Bacteria that convert the nitrates in *soil* or water to gaseous *nitrogen* and release it back into the *atmosphere*.
- density-dependent** The condition of a *limiting factor* whose effects on a *population* become stronger or weaker depending on the *population density*. Compare *density-independent*.
- density-independent** The condition of a *limiting factor* whose effects on a *population* are independent of (not affected by) *population density*. Compare *density-dependent*.
- deoxyribonucleic acid (DNA)** A double-stranded *nucleic acid* composed of four nucleotides, each of which contains a sugar (deoxyribose), a phosphate group, and a nitrogenous base. DNA carries the hereditary information for living organisms and is responsible for passing traits from parents to offspring. Compare *ribonucleic acid (RNA)*.
- dependent variable** The *variable* that is affected by manipulation of the *independent variable* in an *experiment*.
- deposition** The arrival of eroded *soil* at a new location. Compare *erosion*.
- desalination** The removal of salt from seawater to generate fresh water for human use. Also known as *desalinization*.
- descriptive science** Research in which scientists gather basic information about organisms, materials, systems, or processes that are not yet well known. Compare *hypothesis-driven science*.
- desert** The driest *biome* on Earth, with annual *precipitation* of less than 25 cm. Because deserts have relatively little vegetation to insulate them from temperature extremes, sunlight readily heats them in the daytime, but daytime heat is quickly lost at night, so temperatures vary widely from day to night and from season to season.
- desertification** A form of *land degradation* in which more than 10% of a land's productivity is lost due to *erosion*, soil compaction, forest removal, *overgrazing*, drought, *salinization*, *climate* change, water depletion, or other factors. Severe desertification can result in the expansion of desert areas or creation of new ones. Compare *land degradation*; *soil degradation*.
- detritivore** An organism, such as a millipede or soil insect, that scavenges the waste products or dead bodies of other community members. Compare *decomposer*.
- development** The use of natural resources for economic advancement (as opposed to simple subsistence, or survival).
- directional drilling** A drilling technique (e.g., for oil or natural gas) in which a drill bores down vertically and then bends horizontally to follow layered deposits for long distances from the drilling site. This technique enables extracting more *fossil fuels* with less environmental impact on the surface.
- discounting** A practice in *neoclassical economics* by which short-term costs and benefits are granted more importance than long-term costs and benefits. Future effects are thereby "discounted," because the idea is that an impact far in the future should count much less than one in the present.
- disturbance** An event that affects environmental conditions rapidly and drastically, resulting in changes to the *community* and *ecosystem*. A disturbance can be natural or may be caused by people.
- divergent plate boundary** The area where tectonic plates push apart from one another as *magma* rises upward to the surface, creating new *lithosphere* as it cools and spreads. A prime example is the Mid-Atlantic Ridge. Compare *convergent plate boundary*; *transform plate boundary*.
- dose** The amount of *toxicant* a test animal receives in a dose-response test. Compare *response*.
- dose-response analysis** A set of experiments that measure the *response* of test animals to different *doses* of a *toxicant*. The response is generally quantified by measuring the proportion of animals exhibiting negative effects.
- dose-response curve** A curve that plots the *response* of test animals to different *doses* of a *toxicant*, as a result of *dose-response analysis*.

downwelling In the ocean, the flow of warm surface water toward the ocean floor. Downwelling occurs where surface *currents* converge. Compare *upwelling*.

drainage basin See *watershed*.

Dust Bowl An area that loses huge amounts of *topsoil* to wind *erosion* as a result of drought and/or human impact. First used to name the region in the North American Great Plains severely affected by drought and topsoil loss in the 1930s. The term is now also used to describe that historical event and others like it.

dynamic equilibrium The state reached when processes within a *system* are moving in opposing directions at equivalent rates so that their effects balance out.

e-waste See *electronic waste*.

earthquake A release of energy that occurs as Earth relieves accumulated pressure between masses of *lithosphere* and that results in shaking at the surface.

ecocentrism A philosophy that considers actions in terms of their damage or benefit to the integrity of whole ecological systems, including both living and nonliving elements. For an ecocentrist, the well-being of an individual is less important than the long-term well-being of a larger integrated ecological system. Compare *anthropocentrism* and *biocentrism*.

ecolabeling The practice of designating on a product's label how the product was grown, harvested, or manufactured so that consumers can judge which brands use more sustainable processes.

ecological economics A school of *economics* that applies the principles of *ecology* and *systems* thinking to the description and analysis of *economies*. Compare *environmental economics*; *neoclassical economics*.

ecological footprint A concept that measures the cumulative area of biologically productive land and water required to provide the resources a person or population consumes and to dispose of or recycle the waste the person or population produces. The total area of Earth's biologically productive surface that a given person or population "uses" once all direct and indirect impacts are summed together.

ecological modeling The practice of constructing and testing *models* that aim to explain and predict how ecological *systems* function.

ecological restoration The practice of attempting to reverse the effects of human disruption of ecological systems and to restore *communities* to their condition before the disruption. This practice applies principles of *restoration ecology*.

ecologist A scientist who studies *ecology*.

ecology The *science* that deals with the distribution and abundance of organisms, the interactions among them, and the interactions between organisms and their nonliving *environments*.

economic growth An increase in an economy's activity—that is, an increase in the production and consumption of goods and services.

economics The study of how we decide to use scarce resources to satisfy demand for *goods* and *services*.

economy A social *system* that converts resources into *goods* and *services*.

ecosystem In *ecology*, an assemblage of all organisms and nonliving entities that occur and interact in a particular area at the same time.

ecosystem diversity The number and variety of ecosystems in a particular area. One way to express *biodiversity*. Related concepts consider the geographic arrangement of *habitats*, *communities*, or *ecosystems* at the landscape level, including the sizes, shapes, and interconnectedness of patches of these entities.

ecosystem ecology The scientific study of how the living and nonliving components of *ecosystems* interact.

ecosystem services Processes that naturally result from the normal functioning of ecological systems and from which human beings draw benefits. Examples include nutrient cycling, air and water purification, climate regulation, *pollination*, waste recycling, and more.

ecosystem-based management The attempt to manage the harvesting of resources in ways that minimize impact on the *ecosystems* and ecological processes that provide the resources.

ecotone A transitional zone where *ecosystems* meet.

ecotourism Tourism involving natural areas and outdoor recreation. Often viewed as providing financial incentives for conservation efforts.

ED₅₀ (effective dose–50%) The amount of a *toxicant* it takes to affect 50% of a *population* of test animals. Compare *LD₅₀*; *threshold dose*.

edge effect An impact on organisms, populations, or communities that results because conditions along the edge of a habitat fragment differ from conditions in the interior.

El Niño An exceptionally strong warming of the eastern Pacific Ocean that occurs every 2–8 years and depresses local fish and bird *populations* by altering the marine *food web* in the area. Originally, the name that Spanish-speaking fishermen gave to an unusually warm surface *current* that sometimes arrived near the Pacific coast of South America around Christmastime. Compare *La Niña*.

El Niño–Southern Oscillation (ENSO) A systematic shift in atmospheric pressure, sea surface temperature, and ocean circulation in the tropical Pacific Ocean. ENSO cycles give rise to *El Niño* and *La Niña* conditions.

electricity A secondary form of *energy* that can be transferred over long distances and applied for a variety of uses.

electrolysis A process in which electrical current is passed through a *compound* to release *ions*. Electrolysis offers one way to produce *hydrogen* for use as fuel: Electrical current is passed through water, splitting the water *molecules* into hydrogen and *oxygen atoms*.

electron A negatively charged particle that moves about the nucleus of an *atom*.

electronic waste Discarded electronic products such as computers, monitors, printers, televisions, DVD players, cell phones, and other devices. *Heavy metals* in these products mean that this *waste* may be judged hazardous. Also known as *e-waste*.

element A fundamental type of *matter*; a chemical substance with a given set of properties, which cannot be broken down into substances with other properties. Chemists currently recognize 92 elements that occur in nature, as well as more than 20 others that have been artificially created.

emergent property A characteristic that is not evident in a *system's* components.

eminent domain A policy in which a government pays landowners for their land at market rates and landowners have no recourse to refuse. In eminent domain, courts set aside private property rights to make way for projects judged to be for the public good.

emissions trading The practice of buying and selling government-issued marketable permits to emit pollutants. Under a *cap-and-trade* system, the government determines an acceptable level of *pollution* and then issues permits to pollute. A company receives credit for amounts it does not emit and can then sell this credit to other companies. Compare *cap-and-trade*.

endangered In danger of becoming extinct in the near future.

Endangered Species Act The primary *legislation*, enacted in 1973, for protecting *biodiversity* in the United States. It forbids the government and private citizens from taking actions (such as developing land) that would destroy *threatened* and *endangered* species or their *habitats*, and it prohibits trade in products made from *threatened* and *endangered* species.

endemic Native and restricted to a particular geographic region. An *endemic species* occurs in one area and nowhere else on Earth.

- endocrine-disrupting chemical** A *toxicant* that interferes with the *endocrine (hormone) system*.
- energy** The capacity to change the position, physical composition, or temperature of *matter*; a force that can accomplish work.
- energy conservation** The practice of reducing *energy* use as a way of extending the lifetime of our *fossil fuel* supplies, of being less wasteful, and of reducing our impact on the *environment*. Conservation can result from behavioral decisions or from technologies that demonstrate *energy efficiency*.
- energy efficiency** The ability to obtain a given result or amount of output while using less energy input. Technologies permitting greater energy efficiency are one main route to *energy conservation*.
- energy intensity** A measure of energy use per dollar of *Gross Domestic Product (GDP)*. Lower energy intensity indicates greater efficiency.
- energy storage** The capture and accumulation of *energy* produced at one place or time for use (generally by generation of electricity) at another place or time where or when demand for it is greater.
- enhanced geothermal systems (EGS)** A recently developed approach whereby engineers drill deeply into rock, fracture it, pump in water, and then pump it out once it is heated belowground. This approach would enable us to obtain *geothermal energy* in many locations.
- environment** The sum total of our surroundings, including all of the living things and non-living things with which we interact.
- environmental economics** A school of *economics* that modifies the principles of *neoclassical economics* to address environmental challenges. Most environmental economists believe that we can attain *sustainability* within our current economic systems. Compare *ecological economics*; *neoclassical economics*.
- environmental ethics** The application of *ethical standards* to environmental questions and to relationships between people and nonhuman entities.
- environmental health** The study of environmental factors that influence human health and quality of life and the health of *ecological* systems essential to environmental quality and long-term human well-being.
- environmental history** The scholarly study of how people have interacted with the natural world through time, including both how humans have affected the *environment* and how the *environment* has affected society.
- environmental impact statement (EIS)** A report of results from detailed scientific studies that assess the potential effects on the *environment* that would likely result from a development project or other action undertaken by the government.
- environmental justice** The fair and equitable treatment of all people with respect to environmental policy and practice, regardless of their income, race, or ethnicity. This principle is a response to the perception that minorities and the poor suffer more pollution than the majority and the more affluent.
- environmental literacy** A basic understanding of Earth's physical and living systems and how we interact with them. Some people take the term further and use it to refer to a deeper understanding of society and the environment or a commitment to advocate for *sustainability*.
- environmental policy** *Public policy* that pertains to human interactions with the *environment*. Environmental policy generally aims to regulate resource use or reduce *pollution* to promote human well-being or protect natural systems.
- Environmental Protection Agency (EPA)** An administrative agency of the U.S. government charged with conducting and evaluating research, monitoring environmental quality, setting standards, enforcing those standards, assisting the states in meeting standards and goals for environmental protection, and educating the public.
- environmental science** The scientific study of how the natural world functions, how our *environment* affects us, and how we affect our environment.
- environmental studies** An academic *environmental science* program that emphasizes the social sciences as well as the natural sciences.
- environmental toxicology** The study of *toxicants* that come from or are discharged into the *environment*, including the study of health effects on humans, other animals, and *ecosystems*.
- environmentalism** A social movement dedicated to protecting the natural world and, by extension, people from undesirable changes brought about by human action.
- epidemiological study** A study that involves large-scale comparisons among groups of people, usually contrasting a group known to have been exposed to some *toxicant* and a group that has not.
- EROI** An abbreviation for "energy returned on investment." The ratio determined by dividing the quantity of *energy* returned from a process by the quantity of energy invested in the process. Higher EROI ratios mean that more energy is produced from each unit of energy invested. Compare *net energy*.
- erosion** The removal of material from one place and its transport to another by the action of wind or water. Compare *deposition*.
- estuary** An area where a river flows into the ocean, mixing *fresh water* with saltwater.
- ethanol** The alcohol in beer, wine, and liquor, produced as a *biofuel* by fermenting biomass, generally from *carbohydrate*-rich crops such as corn or sugarcane.
- ethical standard** A criterion that helps differentiate right from wrong.
- ethics** The academic study of good and bad, right and wrong. The term can also refer to a person's or group's set of moral principles or values.
- European Union (EU)** Political and economic organization formed after World War II to promote Europe's economic and social progress. As of 2019, the EU consisted of 28 member nations.
- eutrophic** Term describing a water body that has high-nutrient and low-oxygen conditions. Compare *oligotrophic*.
- eutrophication** The process of *nutrient* enrichment, increased production of organic matter, and subsequent *ecosystem* degradation in a water body.
- evaporation** The conversion of a substance from a liquid to a gaseous form.
- even-aged** Condition of timber plantations—generally *monocultures* of a single *species*—in which all trees are of the same age. Most *ecologists* view plantations of even-aged stands more as crop *agriculture* than as ecologically functional *forests*. Compare *uneven-aged*.
- evolution** Genetically based change in *populations* of organisms across generations. Changes in *genes* may lead to changes in the appearance, physiology, and/or behavior of organisms across generations, often by the process of *natural selection*.
- executive order** Specific legal instructions for a U.S. government agency issued directly by the president.
- experiment** An activity designed to test the validity of a *hypothesis* by manipulating *variables*. See *controlled experiment*.
- exponential growth** The increase of a *population* (or of anything) by a fixed percentage each year. This results in a J-shaped curve on a graph. Compare *logistic growth*.
- external cost** A cost borne by someone not involved in an economic transaction. Examples include harm to citizens from *water pollution* or *air pollution* discharged by nearby factories.
- extinction** The disappearance of an entire *species* from Earth. Compare *extirpation*.
- extirpation** The disappearance of a particular *population* from a given area, but not the entire *species* globally. Compare *extinction*.
- exurb** A region surrounding a city and beyond the suburbs, generally inhabited by affluent individuals seeking even more space than the suburbs provide.

- family planning** The effort to plan the number and spacing of one's children to offer children and parents the best quality of life possible.
- farmers' market** A market at which local farmers and food producers sell fresh, locally grown items.
- fee-and-dividend** A *carbon tax* program in which proceeds from the tax are paid to consumers as a tax refund or "dividend." This strategy seeks to prevent consumers from losing money if polluters pass their costs along to them.
- feedback loop** A circular process in which a *system's* output serves as input to that same system. See *negative feedback loop*; *positive feedback loop*.
- feed-in tariff** A payment made by a utility to a business or homeowner who produces *electricity* (generally from renewable sources) and feeds it into the electrical grid. Feed-in tariff systems are set up—and rates are set—by governments, generally as a means of encouraging *renewable energy*. Compare *net metering*.
- feedlot** A huge indoor or outdoor pen designed to deliver *energy-rich* food to animals living at extremely high densities. Also called a factory farm or concentrated animal feeding operation.
- fertilizer** A substance that promotes plant growth by supplying essential *nutrients* such as *nitrogen* or *phosphorus*. See also *inorganic fertilizer*; *organic fertilizer*.
- first law of thermodynamics** The physical law stating that *energy* can change from one form to another, but cannot be created or lost. The total energy in the universe remains constant and is said to be conserved.
- flooding** The spillage of water over a river's banks due to heavy rain or snowmelt.
- floodplain** The region of land over which a river has historically wandered and periodically floods.
- flux** The movement of nutrients among *reservoirs* in a *nutrient cycle*.
- food chain** A linear series of feeding relationships. As organisms feed on one another, energy is transferred from lower to higher *trophic levels*. Compare *food web*.
- food security** The guaranteed availability of an adequate, safe, nutritious, and reliable food supply to all people at all times.
- food web** A visual representation of feeding interactions within an *ecological community* that shows an array of relationships between organisms at different *trophic levels*. Compare *food chain*.
- forensic science** The scientific analysis of evidence to make an identification or answer a question relating to a crime or an accident. Often called forensics.
- forest** Any ecosystem characterized by a high density of trees.
- forest type** A category of *forest* defined by its predominant tree *species*.
- forestry** The professional management of *forests*.
- fossil** The remains, impression, or trace of an animal or plant of past geologic ages that has been preserved in rock or *sediments*.
- fossil fuel** A *nonrenewable natural resource*, such as *crude oil*, *natural gas*, or *coal*, produced by the decomposition and compression of organic matter from ancient life. Fossil fuels have provided most of society's *energy* since the *industrial revolution*.
- fossil record** The cumulative body of *fossils* worldwide, which paleontologists study to infer the history of past life on Earth.
- fracking** See *hydraulic fracturing*.
- Frank R. Lautenberg Chemical Safety for the 21st Century Act** U.S. legislation, enacted in 2016, that updates the *Toxic Substances Control Act* and directs the EPA to monitor and regulate industrial chemicals.
- free rider** A party that fails to invest in conserving resources, controlling *pollution*, or carrying out other responsible activities and instead relies on the efforts of other parties to do so. For example, a factory that fails to control its emissions gets a "free ride" on the efforts of other factories that do.
- fresh water** Water that is relatively pure, holding very few dissolved salts.
- fuel cell** An *energy storage* device that can store and transport energy to produce *electricity*, much as a *battery* can. A *hydrogen* fuel cell generates electricity by the input of hydrogen fuel and *oxygen*, producing only water as a waste product.
- Fukushima Daiichi** Japanese nuclear power plant severely damaged by the tsunami associated with the March 2011 Tohoku earthquake that rocked Japan. Most radiation drifted over the ocean away from population centers, but the event was history's second most serious nuclear accident. Compare *Chernobyl*; *Three Mile Island*.
- full cost accounting** An accounting approach that attempts to summarize all costs and benefits by assigning monetary values to entities without market prices and then generally subtracting costs from benefits. Examples include the *Genuine Progress Indicator* and the Happy Planet Index. Also called true cost accounting.
- fundamental niche** The full *niche* of a *species*. Compare *realized niche*.
- gene** A stretch of *DNA* that represents a unit of hereditary information.
- gene editing** An array of new methods allowing scientists in the lab to change particular stretches of *DNA* in the genome of a target organism in order to express desirable traits in the organism. More targeted and direct than recombinant DNA technology. CRISPR is one common method. Also called genome editing.
- General Mining Act of 1872** U.S. law that legalized and promoted *mining* by private individuals on public lands for just \$5 per acre, subject to local customs, with no government oversight.
- generalist** A *species* that can survive across a wide array of *habitats* or that can use a wide array of resources. Compare *specialist*.
- genetic diversity** A measure of the differences in *DNA* composition among individuals within a given *species*.
- genetic engineering** Any process scientists use to manipulate an organism's genetic material in the lab by adding, deleting, or changing segments of its *DNA*.
- genetically modified food** Food derived from a *genetically modified organism*. Often abbreviated as GM food.
- genetically modified organism** (GMO) An organism that has been *genetically engineered*, often using recombinant DNA technology.
- gentrification** The transformation of a neighborhood to conditions (such as expensive housing and high-end shops and restaurants) that cater to wealthier people. Often results in longtime lower-income residents being "priced out" of their homes or apartments.
- Genuine Progress Indicator** (GPI) An *economic* indicator that attempts to differentiate between desirable and undesirable economic activity. The GPI accounts for benefits such as volunteerism and for costs such as environmental degradation and social upheaval. Compare *Gross Domestic Product* (GDP).
- geoengineering** Any of a suite of proposed strategies to cool Earth's climate by removing carbon dioxide from the atmosphere or reflecting sunlight away from Earth's surface. Such ideas are controversial and are not ready to implement.
- geographic information system** (GIS) Computer software that takes multiple types of data (for instance, on geology, hydrology, vegetation, animal species, and human development) and overlays them on a common set of geographic coordinates. GIS is used to create a complete picture of a landscape and to analyze how elements of the different datasets are arrayed spatially and how they may be correlated. A common tool of geographers, landscape ecologists, resource managers, and conservation biologists.
- geology** The scientific study of Earth's physical features, processes, and history.
- geothermal energy** Thermal *energy* that arises from beneath Earth's surface, ultimately from the radioactive decay of elements amid high pressures deep underground. Can be used

to generate electrical power in power plants, for direct heating via piped water, or in *ground-source heat pumps*.

global climate change Systematic change in aspects of Earth's *climate*, such as temperature, *precipitation*, and storm intensity. Generally refers today to the current warming trend in global temperatures and the many climatic changes associated with it. Compare *global warming*.

global warming An increase in Earth's average surface temperature. The term is most frequently used in reference to the pronounced warming trend of recent decades. Global warming is one aspect of *global climate change* and in turn drives other components of climate change.

globalization The ongoing process by which the world's societies have become more interconnected, linked in many ways by diplomacy, commercial trade, and communication technologies.

Great Pacific Garbage Patch A portion of the North Pacific *gyre* where currents concentrate plastics and other floating debris that pose danger to marine organisms.

green building (1) A structure that minimizes the ecological footprint of its construction and operation by using sustainable materials, using minimal energy and water, reducing health impacts, limiting pollution, and recycling waste. (2) The pursuit of constructing or renovating such buildings.

green-collar job A job resulting from an employment opportunity in a more sustainably oriented *economy*, such as a job in *renewable energy*.

Green New Deal A nonbinding resolution introduced to the U.S. House of Representatives in 2019 that put forth ambitious goals for addressing climate change and meeting social justice goals by converting the U.S. economy to renewable energy and creating green energy jobs.

Green Revolution An intensification of the industrialization of *agriculture* in the developing world in the latter half of the 20th century that dramatically increased crop yields produced per unit area of farmland. Practices include devoting large areas to *monocultures* of crops specially bred for high yields and rapid growth; heavy use of *fertilizers*, *pesticides*, and *irrigation* water; and sowing and harvesting on the same parcel of land more than once per year or per season.

green tax A levy on environmentally harmful activities and products aimed at providing a market-based incentive to correct for *market failure*. Compare *subsidy*.

greenbelt A long and wide corridor of park land, often encircling an entire urban area.

greenhouse effect The warming of Earth's surface and *atmosphere* (especially the *troposphere*) caused by the *energy* emitted by *greenhouse gases*.

greenhouse gas A gas that absorbs infrared radiation released by Earth's surface and then warms the surface and *troposphere* by emitting *energy*, thus giving rise to the *greenhouse effect*. Greenhouse gases include *carbon dioxide* (CO₂), water vapor, *ozone* (O₃), nitrous oxide (N₂O), halocarbon gases, and *methane* (CH₄).

greenwashing A public relations effort by a corporation or institution to mislead customers or the public into thinking it is acting more sustainably than it actually is.

greenway A strip of park land that connects parks or neighborhoods; often located along a river, stream, or canal.

Gross Domestic Product (GDP) The total monetary value of final goods and services produced in a country each year. GDP sums all economic activity, whether good or bad, and does not account for benefits such as volunteerism or for *external costs* such as environmental degradation and social upheaval. Compare *Genuine Progress Indicator* (GPI).

gross primary production The *energy* that results when *autotrophs* convert solar energy (sunlight) to energy of chemical bonds in sugars through *photosynthesis*. Autotrophs use a portion of this production to power their own metabolism, which entails oxidizing *organic compounds* by *cellular respiration*. Compare *net primary production*.

ground-source heat pump A pump that harnesses *geothermal energy* from near-surface sources of earth and water to heat and cool buildings. Operates on the principle that temperatures belowground are less variable than temperatures aboveground.

groundwater Water held in *aquifers* underground. Compare *surface water*.

gyre An area of the ocean where currents converge and floating debris accumulates.

Haber-Bosch process A process to synthesize ammonia on an industrial scale. Developed by German chemists Fritz Haber and Carl Bosch, the process has enabled humans to double the natural rate of *nitrogen fixation* on Earth and thereby increase *agricultural* productivity, but it has also dramatically altered the *nitrogen cycle*.

habitat The specific *environment* in which an organism lives, including both biotic (living) and abiotic (nonliving) elements.

habitat fragmentation The process by which an expanse of natural *habitat* becomes broken up into discontinuous fragments, often as a result of farming, logging, road building, or other types of human development and land use.

habitat selection The process by which organisms select *habitats* from among the range of options they encounter.

habitat use The process by which organisms use *habitats* from among the range of options they encounter.

half-life The amount of time it takes for one-half the atoms of a *radioisotope* to emit radiation and decay. Different radioisotopes have different half-lives, ranging from fractions of a second to billions of years.

halocarbon A class of human-made chemical *compounds* derived from simple *hydrocarbons* in which *hydrogen* atoms are replaced by halogen atoms such as bromine, fluorine, or chlorine. Many halocarbons are *ozone-depleting substances* or *greenhouse gases*.

harmful algal bloom A *population* explosion of toxic algae caused by excessive *nutrient* concentrations.

hazardous waste Liquid or solid *waste* that is toxic, chemically reactive, flammable, or corrosive. Compare *industrial solid waste*; *municipal solid waste*.

heat capacity A measure of the heat energy required to increase the temperature of a given amount of a substance by a given amount.

herbicide A synthetic chemical used to kill plants. Compare *insecticide*, *pesticide*.

herbivory A species interaction in which animals consume plants.

heterotroph An organism that consumes other organisms. Includes most animals, as well as fungi and microbes that decompose organic matter. Also known as a *consumer*.

homeostasis The tendency of a *system* to maintain constant or stable internal conditions.

humus A dark, spongy, crumbly mass of material made up of complex organic compounds, resulting from the partial decomposition of organic matter.

hurricane A type of cyclonic storm that forms over the ocean but can do damage upon its arrival on land.

hydraulic fracturing A process to extract shale gas or tight oil, in which a drill is sent deep underground and angled horizontally into a shale formation; water, sand, and chemicals are pumped in under great pressure, fracturing the rock; and gas migrates up through the drilling pipe as sand holds the fractures open. Also called hydrofracking or simply *fracking*.

hydrocarbon An *organic compound* consisting solely of *hydrogen* and *carbon atoms*.

hydroelectric power The generation of *electricity* using the *kinetic energy* of moving water, generally by using turbines within dams. Also called *hydropower*.

- hydrogen** The chemical *element* with one proton. The most abundant element in the universe. Also, a possible fuel for our future economy.
- hydrogen bond** A weakly attractive interaction between *molecules* due to the attraction of partial positive and partial negative charges.
- hydrologic cycle** The flow of water—in liquid, gaseous, and solid forms—through our biotic and abiotic *environment*.
- hydroponics** The practice of growing plants without soil. In hydroponic systems, nutrients are supplied to plant roots directly via water-based solutions, generally inside sealed greenhouses. Used most often with leafy greens and tomatoes.
- hydropower** See *hydroelectric power*.
- hydrosphere** All water—salt or fresh, liquid, ice, or vapor—in surface bodies, underground, and in the *atmosphere*. Compare *biosphere*; *lithosphere*.
- hypothesis** A statement that attempts to explain a phenomenon or answer a *scientific* question. Compare *theory*.
- hypothesis-driven science** Research in which scientists pose questions that seek to explain how and why things are the way they are. Generally proceeds in a somewhat structured manner, using *experiments* to test *hypotheses*. Compare *descriptive science*.
- hypoxia** The condition of extremely low dissolved *oxygen* concentrations in a body of water.
- igneous rock** One of the three main categories of rock. Formed from cooling *magma*. Granite and basalt are examples of igneous rock. Compare *metamorphic rock*; *sedimentary rock*.
- incineration** A controlled process of burning solid *waste* for disposal in which mixed garbage is combusted at very high temperatures. Compare *sanitary landfill*.
- independent variable** The *variable* that a scientist manipulates in an *experiment*.
- indoor air pollution** *Air pollution* that occurs indoors.
- industrial agriculture** *Agriculture* that uses large-scale mechanization and *fossil fuel* combustion, enabling farmers to replace horses and oxen with faster and more powerful means of cultivating, harvesting, transporting, and processing crops. Other aspects include large-scale *irrigation* and the use of *inorganic fertilizers*. Use of chemical *herbicides* and *insecticides* reduces *competition* from weeds and *herbivory* by insects. Compare *traditional agriculture*.
- industrial ecology** A holistic approach to industry that integrates principles from engineering, chemistry, *ecology*, *economics*, and other disciplines and seeks to redesign industrial *systems* so as to reduce resource inputs and minimize inefficiency.
- industrial revolution** The shift beginning in the mid-1700s from rural life, animal-powered agriculture, and manufacturing by artisans to an urban-centered society powered by *fossil fuels*. Compare *agricultural revolution*.
- industrial smog** “Gray-air” *smog* caused by the incomplete combustion of *coal* or oil when burned. Compare *photochemical smog*.
- industrial solid waste** Nonliquid *waste* that is not especially hazardous and that comes from production of consumer goods, mining, *petroleum* extraction and *refining*, and *agriculture*. Compare *hazardous waste*; *municipal solid waste*.
- industrial stage** The third stage of the *demographic transition* model, characterized by falling birth rates that close the gap with falling death rates and reduce the rate of *population* growth. Compare *pre-industrial stage*; *post-industrial stage*; *transitional stage*.
- infant mortality rate** The number of deaths of infants under 1 year of age per 1000 live births in a population.
- infectious disease** A disease in which a pathogen attacks a host. Compare *noninfectious disease*.
- inorganic fertilizer** A *fertilizer* that consists of mined or synthetically manufactured mineral supplements. Inorganic fertilizers are generally more susceptible than *organic fertilizers* to *leaching* and *runoff* and may be more likely to cause unintended off-site impacts.
- insecticide** A synthetic chemical used to kill insects. Compare *herbicide*; *pesticide*.
- instrumental value** Value ascribed to something for the pragmatic benefits it brings us if we put it to use. Also called utilitarian value.
- integrated pest management** (IPM) The use of multiple techniques in combination to achieve long-term suppression of pests, including *biological control*, use of *pesticides*, close monitoring of *populations*, *habitat* alteration, *crop rotation*, *transgenic* crops, alternative tillage methods, and mechanical pest removal.
- intercropping** Planting different types of crops in alternating bands or other spatially mixed arrangements.
- interdisciplinary** Involving or borrowing techniques from multiple traditional fields of study and bringing together research results from these fields into a broad synthesis.
- Intergovernmental Panel on Climate Change** (IPCC) An international panel of *climate* scientists and government officials established in 1988 by the *United Nations Environment Programme* and the World Meteorological Organization. The IPCC’s mission is to assess and synthesize scientific research on *global climate change* and to offer guidance to the world’s policymakers, primarily through periodic published reports.
- intertidal** Of, relating to, or living along shorelines between the highest reach of the highest *tide* and the lowest reach of the lowest tide.
- intrinsic value** Value ascribed to something for its intrinsic worth; the notion that the thing has a right to exist and is valuable for its own sake. Also called inherent value.
- introduced species** A species introduced by human beings from one place to another (whether intentionally or by accident). Some introduced species may become *invasive species*.
- invasive species** A *species* that spreads widely and rapidly becomes dominant in a *community*, interfering with the community’s normal functioning.
- inversion layer** A band of air in which temperature rises with altitude (i.e., in which the normal direction of temperature change is inverted). Cool air at the bottom of the inversion layer is denser than the warm air above, so it resists vertical mixing and remains stable. A key feature of a *temperature inversion*.
- ion** An electrically charged *atom* or combination of atoms.
- ionic bond** A type of chemical bonding where electrons are transferred between atoms, creating oppositely charged ions that bond due to their differing electrical charges. Table salt, sodium chloride, is formed by the bonding of positively charged sodium ions with negatively charged chloride ions.
- ionizing radiation** A high-energy form of radiation that can damage the cells of living things. Sources of this radiation include the sun and radioactive particles from *nuclear energy* and natural sources.
- IPAT model** A formula that represents how humans’ total impact (*I*) on the *environment* results from the interaction among three factors: *population* (*P*), affluence (*A*), and technology (*T*).
- irrigation** The artificial provision of water to support *agriculture*.
- island biogeography theory** *Theory* initially applied to oceanic islands to explain how *species* come to be distributed among them. Researchers have increasingly applied the theory to islands of *habitat* (patches of one type of habitat isolated within “seas” of others). Aspects of the theory include *immigration* and *extinction* rates, the effect of island size, and the effect of distance from the mainland. Full name is the equilibrium theory of island biogeography.
- isotope** One of several forms of an *element* having differing numbers of *neutrons* in the nucleus of its *atoms*. Chemically, isotopes of an element behave almost identically, but they have different physical properties because they differ in mass.

kelp Large brown algae, or seaweed, that can form underwater “forests,” providing habitat for marine organisms.

keystone species A *species* that has an especially far-reaching effect on a *community*.

kinetic energy *Energy* of motion. Compare *potential energy*.

Kyoto Protocol An international agreement drafted in 1997 that called for reducing, by 2012, emissions of six *greenhouse gases* to levels lower than their levels in 1990. It was extended to 2020 until a replacement treaty can be reached. An outgrowth of the *United Nations Framework Convention on Climate Change*.

La Niña An exceptionally strong cooling of surface water in the equatorial Pacific Ocean that occurs every 2–8 years and has widespread climatic consequences. Compare *El Niño*.

lab-grown meat Animal muscle tissue cultivated in a lab through *in vitro* tissue culture, to provide meat for people to eat, without the impacts of livestock agriculture. Still new, expensive, and developing, but holds promise. Also called cultured meat.

land degradation A general deterioration of land that diminishes its productivity and biodiversity, impairs the functioning of its ecosystems, and reduces the ecosystem services the land can offer us. Compare *soil degradation*; *desertification*.

land trust A local or regional organization that preserves lands valued by its members. In most cases, land trusts purchase land outright with the aim of preserving it in its natural condition.

landfill gas A mix of gases, consisting of roughly half *methane*, that is produced by anaerobic decomposition deep inside *landfills*.

landscape ecology The study of how landscape structure affects the abundance, distribution, and interaction of organisms. This approach to the study of organisms and their *environments* at the landscape scale focuses on broad geographic areas that include multiple *ecosystems*.

landslide The collapse and downhill flow of large amounts of rock or soil. A severe and sudden form of *mass wasting*.

lava *Magma* that is released from the *lithosphere* and flows or spatters across Earth’s surface.

law of conservation of matter The physical law stating that *matter* may be transformed from one type of substance into others, but that it cannot be created or destroyed.

LD₅₀ (lethal dose–50%) The amount of a *toxicant* it takes to kill 50% of a *population* of test animals. Compare *ED₅₀*; *threshold dose*.

leachate Liquid that results when substances from waste dissolve in water as rainwater

percolates downward. Leachate may sometimes seep through liners of a *sanitary landfill* and leach into the *soil* underneath.

leaching The process by which *minerals* dissolved in a liquid (usually water) are transported to another location (generally downward through *soil horizons*).

lead (Pb) A heavy metal that may be ingested through water or paint or that may enter the *atmosphere* as a particulate pollutant through combustion of leaded gasoline or other processes. Atmospheric lead deposited on land and water can enter the *food chain*, accumulate within body tissues, and cause *lead poisoning* in animals and people. An EPA *criteria pollutant*.

lead poisoning Poisoning by ingestion or inhalation of the heavy metal *lead*, causing an array of maladies including damage to the brain, liver, kidney, and stomach; learning problems and behavioral abnormalities; anemia; hearing loss; and even death. Lead poisoning can result from drinking water that passes through old lead pipes or ingesting dust or chips of old lead-based paint.

Leadership in Energy and Environmental Design (LEED) The leading set of standards for certification of a *green building*.

legislation A law or laws passed by Congress (or state legislatures).

Leopold, Aldo (1887–1949) American scientist, scholar, philosopher, and author. His book *The Land Ethic* argued that humans should view themselves and the land itself as members of the same *community* and that humans are obligated to treat the land ethically.

levee A long raised mound of earth erected along a river bank to protect against floods by holding rising water in the main channel. Synonymous with *dike*.

life-cycle analysis A quantitative analysis of inputs and outputs across the entire life cycle of a product—from its origins, through its production, transport, sale, and use, and finally its disposal—in an attempt to judge the sustainability of the process and make it more ecologically efficient.

life expectancy The average number of years that individuals in particular age groups are likely to continue to live.

light pollution Pollution from urban or suburban lights that obscures the night sky, impairing people’s visibility of stars.

limiting factor A physical, chemical, or biological characteristic of the *environment* that restrains *population* growth.

lipids A class of chemical compounds that do not dissolve in water and are used in organisms for energy storage, for structural support, and as key components of cellular membranes.

lithosphere The outer layer of Earth, consisting of *crust* and uppermost *mantle* and located just above the *asthenosphere*. More generally, the solid part of Earth, including the rocks, *sediment*, and *soil* at the surface and extending down many miles underground. Compare *atmosphere*; *biosphere*; *hydrosphere*.

loam *Soil* with a relatively even mixture of *clay*-, *silt*-, and *sand*-sized particles.

logistic growth The pattern of population growth that results as a *population* at first grows exponentially and then is slowed and finally brought to a standstill at *carrying capacity* by *limiting factors*. This results in an S-shaped curve on a graph. Compare *exponential growth*.

macromolecule A very large molecule, such as a *protein*, *nucleic acid*, *carbohydrate*, or *lipid*.

macronutrient Elements and compounds required in relatively large amounts by organisms. Examples include *nitrogen*, *carbon*, and *phosphorus*.

magma Molten, liquid rock.

malnutrition The condition of impaired health due to an imbalance of *nutrients* in the diet. Includes both *undernutrition* and *overnutrition*.

mangrove A tree with a unique type of roots that curve upward to obtain *oxygen*, which is lacking in the mud in which they grow, or that curve downward to serve as stilts to support the tree in changing water levels. Mangrove forests grow on the coastlines of the tropics and subtropics.

mantle The malleable layer of rock that lies beneath Earth’s *crust* and surrounds a mostly iron *core*.

marine protected area (MPA) An area of the ocean set aside to protect marine life from fishing pressures. An MPA may be protected from some human activities but be open to others. Compare *marine reserve*.

marine reserve An area of the ocean designated as a “no-fishing” zone, allowing no extractive activities. Compare *marine protected area*.

market failure The failure of markets to take into account the *environment’s* positive effects on *economies* (e.g., *ecosystem services*) or to reflect the negative effects of economic activity on the environment and thereby on people (*external costs*).

mass extinction event The *extinction* of a large proportion of the world’s *species* in a very short time period due to some extreme and rapid change or catastrophic event. Earth has seen five mass extinction events during the past half-billion years.

mass transit A public transportation system for a metropolitan area that moves large numbers of people at once. Buses, trains, subways, streetcars, trolleys, and light rail are types of mass transit.

mass wasting The downslope movement of soil and rock due to gravity. Compare *landslide*.

materials recovery facility (MRF) A *recycling* facility where items are sorted, cleaned, shredded, and prepared for reprocessing into new items.

matter All material in the universe that has mass and occupies space. See *law of conservation of matter*.

maximum sustainable yield The maximal harvest of a particular *renewable natural resource* that can be accomplished while still keeping the resource available for the future.

melt-down The accidental melting of the uranium fuel rods inside the core of a *nuclear reactor*, causing the release of radiation.

meta-analysis A scientific analysis that gathers together results from all scientific studies on a particular research question and statistically analyzes their data for significant patterns or trends that hold across all of them together. An analysis of analyses.

metal A type of chemical *element*, or a mass of such an element, that typically is lustrous, opaque, and malleable and that can conduct heat and electricity. Some *alloys*, such as brass or steel, are also referred to as metals in everyday language.

metamorphic rock One of the three main categories of rock. Formed by great heat and/or pressure that reshapes crystals within the rock and changes its appearance and physical properties. Common metamorphic rocks include marble and slate. Compare *igneous rock*; *sedimentary rock*.

metapopulation A network of subpopulations, most of whose members stay within their respective landscape *patches*, but some of whom move among patches or mate with members of other patches.

methane hydrate An ice-like solid consisting of molecules of *methane* embedded in a crystal lattice of water molecules. Most is found in sediments on the continental shelves and in the Arctic. Methane hydrate is an unconventional *fossil fuel*.

micronutrient Elements and compounds required in relatively small amounts by organisms. Examples include zinc, copper, and iron.

microplastics Small pieces of plastic, typically less than 5 mm in size.

migration The movements of individuals between populations of organisms.

Milankovitch cycle One of three types of variations in Earth's rotation and orbit around the sun that result in slight changes in the relative amount of solar radiation reaching Earth's surface at different latitudes. As the cycles proceed, they change the way solar radiation is distributed over Earth's surface and contribute to changes in *atmospheric* heating and circulation that have triggered *glaciations* and other changes in *climate*.

mineral A naturally occurring solid *element* or inorganic *compound* with a crystal structure, a defined chemical composition, and distinct physical properties. Compare *ore*; *rock*.

mining (1) In the broad sense, the extraction of any resource that is nonrenewable on the time-scale of our society (such as *fossil fuels* or *groundwater*). (2) In relation to *mineral* resources, the systematic removal of *rock*, *soil*, or other material for the purpose of extracting minerals of economic interest.

mitigation The pursuit of strategies to lessen the severity of climate change, notably by reducing emissions of greenhouse gases. Compare *adaptation*.

model A simplified representation of a complex natural process, designed by scientists to help understand how the process occurs and to make predictions.

molecule A combination of two or more *atoms*.

monoculture The uniform planting of a single crop over a large area. Characterizes *industrial agriculture*. Compare *polyculture*.

Montreal Protocol International treaty ratified in 1987 in which 180 (now 197) nations agreed to restrict production of *chlorofluorocarbons* (CFCs) in an effort to halt stratospheric *ozone* depletion. It is a protocol of the Vienna Convention for the Protection of the Ozone Layer. The Montreal Protocol is widely considered the most successful effort to date in addressing a global *environmental* problem.

mosaic In *landscape ecology*, a spatial configuration of *patches* arrayed across a landscape.

mountaintop removal mining A large-scale form of *coal* mining in which entire mountaintops are blasted away so as to extract the resource. Although economically efficient, large volumes of rock and soil generally slide downhill, causing extensive impacts on surrounding *ecosystems* and human residents.

Muir, John (1838–1914) Scottish immigrant to the United States who eventually settled in California and made the Yosemite Valley his wilderness home. Today, he is most strongly associated with the *preservation ethic*. Muir argued that nature deserved protection for its own *intrinsic value* (an *ecocentrist* argument) but also claimed that nature facilitated human happiness and fulfillment (an *anthropocentrist* argument).

multiple use A principle guiding management policy for *national forests* specifying that forests be managed for recreation, wildlife habitat, mineral extraction, water quality, and other uses, as well as for timber extraction.

municipal solid waste Nonliquid *waste* that is not especially hazardous and that comes from homes, institutions, and small businesses. Compare *hazardous waste*; *industrial solid waste*.

mutagen A *toxicant* that causes *mutations* in the DNA of organisms.

mutation An accidental change in DNA that may range in magnitude from the deletion, substitution, or addition of a single nucleotide to a change affecting entire sets of chromosomes. Mutations provide the raw material for evolutionary change.

mutualism A species interaction in which all participating organisms benefit from their interaction. Compare *parasitism*.

National Environmental Policy Act (NEPA) A U.S. law enacted on January 1, 1970, that created an agency called the Council on Environmental Quality and requires that an *environmental impact statement* be prepared for any major federal action.

national forest An area of forested public land managed by the U.S. Forest Service. The system consists of 191 million acres (more than 8% of the nation's land area) in many tracts spread across all but a few states.

National Forest Management Act *Legislation* passed by the U.S. Congress in 1976 mandating that plans for renewable resource management be drawn up for every *national forest*. These plans were to be explicitly based on the concepts of *multiple use* and *maximum sustainable yield* and be open to broad public participation.

national park A scenic area set aside for recreation and enjoyment by the public and managed by the National Park Service. The U.S. national park system today numbers more than 400 sites totaling 84 million acres and includes national historic sites, national recreation areas, national wild and scenic rivers, and other areas.

national wildlife refuge An area of public land set aside to serve as a haven for wildlife and also sometimes to encourage hunting, fishing, wildlife observation, photography, environmental education, and other uses. The system of more than 560 sites is managed by the U.S. Fish and Wildlife Service.

natural capital Earth's accumulated wealth of *natural resources* and *ecosystem services*.

natural gas A *fossil fuel* consisting primarily of *methane* (CH₄) and including varying amounts of other volatile hydrocarbons.

natural resource Any of the various substances and *energy* sources that we take from our environment and that we need in order to survive.

natural sciences Academic disciplines that study the natural world. Compare *social sciences*.

natural selection The process by which traits that enhance survival and reproduction are passed on more frequently to future generations of organisms than traits that do not, thereby modifying the genetic makeup of populations through time. Natural selection acts on genetic variation and is a primary driver of *evolution*.

negative feedback loop A *feedback loop* in which output of one type acts as input that moves the *system* in the opposite direction. The input and output essentially neutralize each other's effects, stabilizing the system. Compare *positive feedback loop*.

neoclassical economics A mainstream economic school of thought that explains market prices in terms of consumer preferences for units of particular commodities and that uses *cost-benefit analysis*. Compare *classical economics*; *ecological economics*; *environmental economics*.

neonicotinoid A new class of chemical *insecticide*. Neonicotinoids are sprayed on plants or used to coat seeds. When seeds are treated, the poison becomes systemic throughout the plant, dispersing through its tissues as it grows and making the tissues toxic to insects.

net energy The quantitative difference between *energy* returned from a process and *energy* invested in the process. Positive net *energy* values mean that a process produces more energy than is invested. Compare *EROI*.

net metering Process by which homeowners or businesses with *photovoltaic* systems or *wind turbines* can sell their excess *solar energy* or *wind power* to their local utility. Whereas *feed-in tariffs* award producers with prices above market rates, net metering offers market-rate prices.

net primary production The *energy* or biomass that remains in an ecosystem after *autotrophs* have metabolized enough for their own maintenance through *cellular respiration*. Net primary production is the energy or biomass available for consumption by *heterotrophs*. Compare *gross primary production*; *secondary production*.

net primary productivity The rate at which *net primary production* is produced. See *productivity*; *gross primary production*; *net primary production*; *secondary production*.

neurotoxin A *toxicant* that assaults the nervous system. Neurotoxins include heavy metals, *pesticides*, and some chemical weapons developed for use in war.

neutron An electrically neutral (uncharged) particle in the nucleus of an *atom*.

new forestry A set of *ecosystem-based management* approaches for harvesting timber that explicitly mimic natural disturbances. For instance, "sloppy clear-cuts" that leave a variety of trees standing mimic the changes a *forest* might experience if hit by a severe windstorm.

new urbanism An approach among architects, planners, and developers that seeks to design neighborhoods in which homes, businesses, schools, and other amenities are within walking distance of one another so that families can meet most of their needs close to home without the use of a car.

niche The functional role of a *species* in a *community*.

nitrification The conversion by bacteria of ammonium ions (NH_4^+) first into nitrite ions (NO_2^-) and then into nitrate ions (NO_3^-).

nitrogen The chemical *element* with seven *protons* and seven *neutrons*. The most abundant element in the *atmosphere*, a key element in *macromolecules*, and a crucial plant *nutrient*.

nitrogen cycle A major *nutrient cycle* consisting of the routes that *nitrogen atoms* take through the nested networks of environmental *systems*.

nitrogen dioxide (NO_2) A foul-smelling reddish brown gas that contributes to *smog* and *acid deposition*. It results when atmospheric *nitrogen* and *oxygen* react at the high temperatures created by combustion engines. An EPA *criteria pollutant*.

nitrogen fixation The process by which inert *nitrogen* gas combines with *hydrogen* to form ammonium ions (NH_4^+), which are chemically and biologically active and can be taken up by plants.

nitrogen-fixing bacteria Bacteria that live independently in the soil or water, or those that form *mutualistic* relationships with many types of plants and provide *nutrients* to the plants by converting gaseous *nitrogen* to a usable form.

nitrogen oxide (NO_x) One of a family of compounds that includes nitric oxide (NO) and *nitrogen dioxide* (NO_2).

no-till *Agriculture* that does not involve tilling (plowing, disking, harrowing, or chiseling) the *soil*. The most intensive form of *conservation tillage*.

noise pollution Undesired ambient sound.

nonconsumptive use Use of *fresh water* in which the water from a particular *aquifer* or surface water body either is not removed or is removed only temporarily and then returned. The use of water to generate electricity in hydroelectric *dams* is an example. Compare *consumptive use*.

nongovernmental organization (NGO) An organization not affiliated with any national

government, and frequently international in scope, that pursues a particular mission or advocates for a particular cause.

noninfectious disease A disease that develops as a result of the interaction of an individual organism's genes, lifestyle, and environmental exposures, rather than by pathogenic infection. Compare *infectious disease*.

nonmarket value A value that is not usually included in the price of a *good* or *service*.

non-point source A diffuse source of *pollutants*, often consisting of many small sources. Compare *point source*.

nonrenewable natural resources *Natural resources* that are in limited supply and are formed much more slowly than we use them. Compare *renewable natural resources*.

North Atlantic Deep Water (NADW) The deep portion of the *thermohaline circulation* in the northern Atlantic Ocean.

not-in-my-backyard (NIMBY) Syndrome in which people do not want something (e.g., a polluting facility) near where they live, even if they may want or need the thing to exist somewhere.

novel community An ecological *community* composed of a novel mixture of organisms, with no current analog or historical precedent. Also known as a no-analog community.

nuclear energy The *energy* that holds together *protons* and *neutrons* within the nucleus of an *atom*. Several processes, each of which involves transforming *isotopes* of one *element* into isotopes of other elements, can convert nuclear energy into thermal energy, which is then used to generate *electricity*. See also *nuclear fission*; *nuclear power*; *nuclear reactor*.

nuclear fission The conversion of the *energy* within an *atom's* nucleus to usable thermal energy by splitting apart atomic nuclei. Compare *nuclear fusion*.

nuclear fusion The conversion of the *energy* within an *atom's* nucleus to usable thermal energy by forcing together the small nuclei of lightweight *elements* under extremely high temperature and pressure. Developing a commercially viable method of nuclear fusion remains an elusive goal.

nuclear power The use of *nuclear energy* to generate *electricity*, accomplished using *nuclear fission* within *nuclear reactors* in power plants.

nuclear reactor A facility within a nuclear power plant that initiates and controls the process of *nuclear fission* to generate *electricity*.

nucleic acid A *macromolecule* that directs the production of *proteins*. Includes *DNA* and *RNA*.

nutrient An *element* or *compound* that organisms consume and require for survival.

- nutrient cycle** The comprehensive set of cyclical pathways by which a given *nutrient* moves through the *environment*.
- ocean acidification** The process by which today's oceans are becoming more *acidic* (attaining lower *pH*) as a result of increased *carbon dioxide* concentrations in the atmosphere. Ocean acidification occurs as ocean water absorbs carbon dioxide from the air and forms carbonic acid. This process impairs the ability of corals and other organisms to build exoskeletons of calcium carbonate, imperiling coral reefs and the many organisms that depend on them.
- ocean thermal energy conversion** (OTEC) An *energy* source (not yet commercially used) that involves harnessing the solar radiation absorbed by tropical ocean water by strategically manipulating the movement of warm surface water and cold deep water.
- oil** A *fossil fuel* produced by the slow underground conversion of *organic compounds* by heat and pressure. Oil is a mixture of hundreds of different types of *hydrocarbon* molecules characterized by *carbon* chains of different lengths. Compare *crude oil*; *petroleum*.
- oil sands** *Fossil fuel* deposits that can be mined from the ground, consisting of moist sand and clay containing 1–20% bitumen. Oil sands represent *crude oil* deposits that have been degraded and chemically altered by water erosion and bacterial decomposition. Also called *tar sands*.
- oil shale** *Sedimentary rock* filled with kerogen that can be processed to produce liquid *petroleum*. Oil shale is formed by the same processes that form *crude oil* but occurs when kerogen was not buried deeply enough or subjected to enough heat and pressure to form oil.
- oligotrophic** Term describing a water body that has low-nutrient and high-oxygen conditions. Compare *eutrophic*.
- open pit mining** A *mining* technique that involves digging a gigantic hole and removing the desired *ore* along with waste *rock* that surrounds the ore.
- ore** A *mineral* or grouping of minerals from which we extract *metals*.
- organic agriculture** *Agriculture* that uses no synthetic *fertilizers* or *pesticides* but instead relies on biological approaches such as *composting* and *biological control*.
- organic compound** A *compound* made up of *carbon atoms* (and, generally, *hydrogen atoms*) joined by covalent bonds and sometimes including other *elements*, such as *nitrogen*, *oxygen*, *sulfur*, or *phosphorus*. The unusual ability of carbon to build elaborate *molecules* has resulted in millions of different organic compounds showing various degrees of complexity.
- organic fertilizer** A *fertilizer* made up of natural materials (largely the remains or wastes of organisms), such as animal manure, crop residues, charcoal, fresh vegetation, and *compost*. Compare *inorganic fertilizer*.
- outdoor air pollution** *Air pollution* that occurs outdoors. Also called ambient air pollution.
- overgrazing** The consumption by too many animals of plant cover, impeding plant regrowth and the replacement of *biomass*. Overgrazing can worsen damage to *soils*, natural *communities*, and the land's productivity for further grazing.
- overnutrition** A condition of excessive food intake in which people receive more than their daily needs of calories, proteins, vitamins, minerals, or carbohydrates. Compare *undernutrition*; *malnutrition*.
- overshoot** The amount by which humanity's resource use, as measured by its *ecological footprint*, has surpassed Earth's long-term capacity to support human life.
- oxygen** The chemical *element* with eight *protons* and eight *neutrons*. A key *element* in the *atmosphere* that is produced by *photosynthesis*.
- ozone-depleting substance** One of a number of airborne chemicals, such as *halocarbons*, that destroy *ozone* molecules and thin the *ozone layer* in the *stratosphere*.
- ozone hole** Term popularly used to describe the thinning of the stratospheric *ozone layer* that has been occurring over Antarctica each year as a result of *chlorofluorocarbons (CFCs)* and other *ozone-depleting substances*.
- ozone layer** A portion of the *stratosphere*, roughly 15–35 km (9–22 mi) above sea level, that contains most of the *ozone* in the *atmosphere*.
- paradigm** A dominant philosophical and theoretical framework within a scientific discipline.
- parasitism** A species interaction in which one organism, the parasite, depends on another, the host, for nourishment or some other benefit while simultaneously doing the host harm. Compare *mutualism*; *predation*.
- parent material** The base geologic material in a particular location.
- Paris Agreement** An international agreement reached in 2015 that called for limiting global temperature rise to 2.0°C (3.6°F) above pre-industrial levels and attempting to keep the rise below 1.5°C (2.7°F). Each nation proposed its own strategies for reducing its *greenhouse gas* emissions. An outgrowth of the *United Nations Framework Convention on Climate Change*.
- particulate matter** Solid or liquid particles small enough to be suspended in the *atmosphere* and able to damage respiratory tissues when inhaled. Includes *primary pollutants*, such as dust and soot, as well as *secondary pollutants*, such as sulfates and nitrates. An EPA *criteria pollutant*.
- passive solar energy collection** An approach in which buildings are designed and building materials are chosen to maximize direct absorption of sunlight in winter and to keep the interior cool in the summer. Compare *active solar energy collection*.
- patch** In *landscape ecology*, spatial areas within a landscape. Depending on a researcher's perspective, patches may consist of habitat for a particular organism, or communities, or ecosystems. An array of patches forms a *mosaic*.
- pathogen** A parasite that causes disease in its host.
- pathway inhibitor** A *toxicant* that interrupts vital biochemical processes in organisms by blocking one or more steps in important biochemical pathways. Compounds in the *herbicide* atrazine kill plants by blocking key steps in the process of *photosynthesis*.
- peak oil** Term used to describe the point of maximum production of *petroleum* in the world (or for a given nation), after which oil production declines. It is expected to be roughly the midway point of extraction of the world's oil supplies.
- peer review** The process by which a scientific manuscript submitted for publication in an academic journal is examined by specialists in the field, who provide comments and criticism (generally anonymously) and judge whether the work merits publication in the journal.
- pelagic** Of, relating to, or living between the surface and floor of the ocean. Compare *benthic*.
- pest** A pejorative term for any organism that damages crops that we value. The term is subjective and defined by our own economic interests and is not biologically meaningful. Compare *weed*.
- pesticide** A substance (generally a synthetic chemical) used to kill insects (called an *insecticide*), plants (called an *herbicide*), or fungi (called a *fungicide*).
- petroleum** See *oil*. However, the term is also used to refer to both *oil* and *natural gas* together.
- pH** A measure of the concentration of *hydrogen ions* in a *solution*. The pH scale ranges from 0 to 14: A solution with a pH of 7 is neutral; solutions with a pH below 7 are *acidic*, and those with a pH higher than 7 are *basic*. Because the pH scale is logarithmic, each step on the scale represents a 10-fold difference in hydrogen ion concentration.
- phosphorus cycle** A major *nutrient cycle* consisting of the routes that *phosphorus atoms* take through the nested networks of environmental systems.

photic zone In the ocean or a freshwater body, the well-lit top layer of water where *photosynthesis* occurs.

photochemical smog "Brown-air" smog formed by light-driven reactions of *primary pollutants* with normal atmospheric *compounds* that produce a mix of more than 100 different chemicals, *tropospheric ozone* often being the most abundant among them. Compare *industrial smog*.

photosynthesis The process by which *autotrophs* produce their own food. Sunlight powers a series of chemical reactions that convert *carbon dioxide* and water into sugar (glucose), thus transforming low-quality *energy* from the sun into high-quality *energy* the organism can use. Compare *cellular respiration*.

photovoltaic cell A device designed to collect sunlight and directly convert it to electrical *energy*. Light striking one of a pair of metal plates in the cell causes the release of *electrons*, which are attracted by electrostatic forces to the opposing plate. The flow of electrons from one plate to the other creates an electrical current. The basis of PV solar technology.

phthalates A class of endocrine-disrupting chemicals found in fire retardants and plasticizers.

phylogenetic tree A treelike diagram that represents the history of divergence of *species* or other taxonomic groups of organisms.

physical hazard Physical processes that occur naturally in our environment and pose human health hazards. These include discrete events such as *earthquakes*, *volcanic eruptions*, fires, floods, blizzards, *landslides*, hurricanes, and droughts, as well as ongoing natural phenomena such as ultraviolet radiation from sunlight. Compare *biological hazard*; *chemical hazard*; *cultural hazard*.

Pinchot, Gifford (1865–1946) The first professionally trained American forester, Pinchot helped establish the U.S. Forest Service. Today, he is the person most closely associated with the *conservation ethic*.

pioneer species A *species* that arrives earliest following an ecological *disturbance*, beginning the ecological process of *succession* in a terrestrial or aquatic *community*.

placer mining A *mining* technique that involves sifting through material in modern or ancient riverbed deposits, generally using running water to separate lightweight mud and gravel from heavier *minerals* of value.

plate tectonics The process by which Earth's surface is shaped by the extremely slow movement of tectonic plates, or sections of *crust*. Earth's surface includes about 15 major tectonic plates. Their interaction gives rise to processes that build mountains, cause *earthquakes*, and otherwise influence the landscape.

poaching The illegal killing of wildlife, usually for meat or body parts.

point source A specific spot—such as a factory—where large quantities of *air pollutants* or *water pollutants* are discharged. Compare *non-point source*.

policy A formal set of general plans, principles, rules, or guidelines that are intended to guide decision making and that may direct individual, organizational, or societal behavior.

pollination The process by which male sex cells of a flowering plant (pollen) fertilize female sex cells of a flowering plant (ova, or egg cells). This may occur by wind, or it may result from a plant-animal interaction in which one organism (e.g., a bee or a hummingbird) transfers pollen from flower to flower.

polluter-pays principle Principle specifying that the party responsible for producing *pollution* should pay the costs of cleaning up the pollution or mitigating its impacts.

polybrominated diphenyl ethers (PBDEs) Synthetic compounds that provide fire-retardant properties and are used in a diverse array of consumer products, including computers, televisions, plastics, and furniture. Released during production, disposal, and use of products, these chemicals persist and accumulate in living tissue and appear to be *endocrine-disrupting chemicals*.

polyculture The planting of multiple crops in a mixed arrangement or in close proximity. An example is some traditional Native American farming that mixed maize, beans, squash, and peppers. Compare *monoculture*.

polymer A chemical *compound* or mixture of compounds consisting of long chains of repeated *molecules*. Important biological molecules, such as *DNA* and *proteins*, are examples of polymers.

population A group of organisms of the same *species* that live in the same area at the same time. Species are often composed of multiple populations.

population density The number of individuals within a *population* per unit area. Compare *population size*.

population distribution The spatial distribution of organisms in an area. Three common patterns are random, uniform, and clumped.

population ecology The scientific study of the quantitative dynamics of population change and the factors that affect the distribution and abundance of members of a *population*.

population growth rate The rate of change in a *population's* size per unit time (generally expressed in percent per year), taking into account births, deaths, immigration, and emigration. Compare *rate of natural increase*.

population size The number of individual organisms present at a given time in a *population*.

positive feedback loop A *feedback loop* in which output of one type acts as input that moves the *system* in the same direction. The input and output drive the system further toward one extreme or another. Compare *negative feedback loop*.

post-industrial stage The fourth and final stage of the *demographic transition* model, in which both birth and death rates have fallen to a low level and remain stable there, and *populations* may even decline slightly. Compare *industrial stage*; *pre-industrial stage*; *transition stage*.

potential energy *Energy* of position. Compare *kinetic energy*.

precautionary principle The idea that one should not undertake a new action until the ramifications of that action are well understood.

precipitation Water that condenses out of the *atmosphere* and falls to Earth in droplets or crystals.

precision agriculture The use of technology to precisely monitor crop conditions, crop needs, and resource use to maximize production while minimizing waste of resources.

predation A species interaction in which one *species* (the predator) searches for, captures, and ultimately kills its prey. Compare *parasitism*.

prediction A specific statement, generally arising from a *hypothesis*, that can be tested directly and unequivocally.

pre-industrial stage The first stage of the *demographic transition* model, characterized by conditions that defined most of human history. In pre-industrial societies, both death rates and birth rates are high. Compare *industrial stage*; *post-industrial stage*; *transitional stage*.

prescribed fire The practice of burning areas of *forest* or grassland under carefully controlled conditions to improve the health of *ecosystems*, return them to a more natural state, reduce fuel loads, and help prevent uncontrolled catastrophic fires.

preservation ethic An ethic holding that we should protect the natural *environment* in a pristine, unaltered state. Compare *conservation ethic*.

primary forest Natural *forest* uncut by people. Compare *secondary forest*.

primary pollutant A hazardous substance, such as soot or *carbon monoxide*, that is emitted into the *troposphere* directly from a source. Compare *secondary pollutant*.

primary production The conversion of solar energy to the energy of chemical bonds in sugars during *photosynthesis*, performed by *autotrophs*. Compare *secondary production*.

primary source A source that presents novel information and stands on its own. Compare *secondary source*.

- primary succession** A stereotypical series of changes as an ecological *community* develops over time, beginning with a lifeless substrate. In terrestrial *systems*, primary succession begins when a bare expanse of rock, *sand*, or *sediment* becomes newly exposed to the atmosphere and *pioneer species* arrive. Compare *secondary succession*.
- primary treatment** A stage of *wastewater* treatment in which contaminants are physically removed. Wastewater flows into tanks in which sewage solids, grit, and particulate matter settle to the bottom. Greases and oils float to the surface and can be skimmed off. Compare *secondary treatment*.
- probability** A quantitative description of the likelihood of a certain outcome.
- producer** An organism that uses energy from sunlight to produce its own food. Includes green plants, algae, and cyanobacteria.
- productivity** The rate at which plants convert solar energy (sunlight) to *biomass*. *Ecosystems* whose plants convert solar energy to biomass rapidly are said to have high productivity. See *net primary productivity*; *gross primary production*; *net primary production*.
- protein** A *macromolecule* made up of long chains of amino acids.
- proton** A positively charged particle in the nucleus of an *atom*.
- proven recoverable reserve** The amount of a given *fossil fuel* in a deposit that is technologically and economically feasible to remove under current conditions.
- proxy indicator** A source of indirect evidence that serves as a proxy, or substitute, for direct measurement and that sheds light on past climate. Examples include data from ice cores, sediment cores, tree rings, packrat middens, fossilized foraminifera, and coral reefs.
- public policy** *Policy* made by governments, including those at the local, state, federal, and international levels; it may consist of *legislation*, *regulations*, orders, incentives, and practices intended to advance societal well-being. See also *environmental policy*.
- public trust doctrine** A legal philosophy that holds that natural resources such as air, water, soil, and wildlife should be held in trust for the public and that government should protect them from exploitation by private interests. This doctrine has its roots in ancient Roman law and in the Magna Carta.
- pumped storage** A technique used to generate *hydroelectric power*, in which water is pumped from a lower reservoir to a higher reservoir when power demand is weak and prices are low. When demand is strong and prices are high, water is allowed to flow downhill through a turbine, generating *electricity*. Compare *run-of-river*; *storage*.
- pycnocline** A zone of the ocean beneath the surface in which density increases rapidly with depth.
- radiative forcing** The amount of change in thermal energy that a factor (such as a *greenhouse gas* or an *aerosol*) causes in influencing Earth's temperature. Positive forcing warms Earth's surface, whereas negative forcing cools it.
- radioactive** The quality by which some *isotopes* "decay," changing their chemical identity as they shed atomic particles and emit high-energy radiation.
- radioisotope** A radioactive *isotope* that emits subatomic particles and high-energy radiation as it "decays" into progressively lighter isotopes until becoming a stable isotope.
- radon** A highly *toxic*, radioactive, colorless gas that seeps up from the ground in areas with certain types of bedrock and that can build up inside basements and homes with poor air circulation.
- rainshadow effect** The process by which arid regions are formed in the "rainshadow" of a mountain range. As moist air is blown over a mountain range, the air releases precipitation as it rises and cools; once the air has passed over the mountains, it is depleted of moisture, creating the arid rainshadow region.
- rangeland** Land used for grazing livestock. Also called pastureland.
- rate of natural increase** The rate of change in a *population's* size resulting from birth and death rates alone, excluding migration. Compare *population growth rate*.
- REACH** Program of the European Union that shifts the burden of proof for testing chemical safety from national governments to industry and requires that chemical substances produced or imported in amounts of over 1 metric ton per year be registered with a new European Chemicals Agency. *REACH*, which stands for Registration, Evaluation, Authorisation, and Restriction of Chemicals, went into effect in 2007.
- realized niche** The portion of the *fundamental niche* that is fully realized (used) by a *species*.
- rebound effect** The phenomenon by which gains in efficiency from better technology are partly offset when people engage in more energy-consuming behavior as a result. This common psychological effect can sometimes reduce conservation and efficiency efforts substantially.
- recharge zone** An area where water infiltrates Earth's surface and reaches an *aquifer* below.
- reclamation** The act of restoring a *mining* site to an approximation of its pre-mining condition. To reclaim a site, companies are required to remove all mining structures, replace *overburden*, fill in mine shafts, and replant the area with vegetation.
- recovery** Waste management strategy composed of *recycling* and *composting*.
- recycling** The process by which materials are collected and then broken down and reprocessed to manufacture new items.
- Red List** An updated list of *species* facing high risks of *extinction*. The list is maintained by the International Union for the Conservation of Nature (IUCN).
- red tide** A *harmful algal bloom* consisting of algae that produce reddish pigments that discolor surface waters.
- Reducing Emissions from Deforestation and Forest Degradation** A proposed international program, still being developed, to encourage the conservation of *forests* globally for the purpose of reducing *greenhouse gas* emissions to control *climate change*. A key mechanism is the transfer of funds from wealthy nations to poorer forest-rich nations. Initially abbreviated as REDD, the program became known as REDD+ as it expanded in scope.
- refining** The process of separating *molecules* of the various *hydrocarbons* in *crude oil* into different-sized classes and transforming them into various fuels and other petrochemical products.
- regime shift** A fundamental shift in the overall character of an ecological community, generally occurring after some extreme *disturbance*, and after which the community may not return to its original state. Also known as a phase shift.
- regional planning** Planning across regions to maximize efficiency, functionality, and beauty in ways similar to *city planning*, but across broader geographic areas and usually in concert with multiple municipal governments. Compare *city planning*; *urban planning*.
- regulation** A specific rule issued by an administrative agency based on the more broadly written statutory law passed by Congress (or state legislatures) and enacted by the president (or governor). Regulations are intended to achieve the objectives of the *legislation* from which they derive.
- regulatory taking** The deprivation of a property's owner, by means of a law or *regulation*, of most or all economic uses of that property.
- relative humidity** The ratio of water vapor that air contains at a given temperature to the maximum amount it could contain at that temperature.
- relativist** An ethicist who maintains that *ethics* do and should vary with social context. Compare *universalist*.

- renewable natural resources** *Natural resources* that are virtually unlimited or that are replenished by the *environment* over relatively short periods (hours to weeks to years). Compare *nonrenewable natural resources*.
- replacement fertility** The *total fertility rate (TFR)* that maintains a stable *population size*.
- reproductive window** The portion of a woman's life between sexual maturity and menopause during which she may become pregnant.
- reserves-to-production ratio** The total remaining reserves of a *fossil fuel* divided by the annual rate of production (extraction and processing). Abbreviated as R/P ratio.
- reservoir** (1) An artificial water body behind a dam that stores water for human use. (2) A location in which nutrients in a *biogeochemical cycle* remain for a period of time before moving to another reservoir. Can be living or nonliving entities. Compare *flux*; *residence time*.
- residence time** (1) In a *biogeochemical cycle*, the amount of time a nutrient typically remains in a given *reservoir* before moving to another. Compare *flux*. (2) In the *atmosphere*, the amount of time a gas molecule or a *pollutant* typically remains aloft.
- resilience** The ability of an ecological *community* to change in response to disturbance but later return to its original state. Compare *resistance*.
- resistance** The ability of an ecological *community* to remain stable in the presence of a disturbance. Compare *resilience*.
- Resource Conservation and Recovery Act** U.S. law (enacted in 1976 and amended in 1984) that specifies, among other things, how to manage *sanitary landfills* to protect against environmental contamination. Often abbreviated as RCRA.
- resource management** Strategic decision making about how to extract resources so that resources are used wisely and conserved for the future.
- resource partitioning** The process by which *species* adapt to *competition* by evolving to use slightly different resources, or to use shared resources in different ways, thus minimizing interference with one another.
- response** The type or magnitude of negative effects an animal exhibits in response to a *dose* of *toxicant* in a *dose-response analysis*. Compare *dose*.
- restoration ecology** The study of both the historical conditions of ecological *communities* as they existed before humans altered them and the restoration of those same ecological communities to such earlier conditions. Principles of restoration ecology are applied in the practice of *ecological restoration*.
- revenue-neutral carbon tax** A type of *fee-and-dividend* program in which funds from the *carbon tax* that a government collects are disbursed to citizens in the form of payments or tax refunds. It is "revenue-neutral" because the government neither gains nor loses revenue in the end.
- revolving door** The movement of individuals working in the private sector to government agencies that regulate that particular portion of the private sector, or vice versa. May create conflicts of interest.
- ribonucleic acid (RNA)** A usually single-stranded *nucleic acid* composed of four nucleotides, each of which contains a sugar (ribose), a phosphate group, and a nitrogenous base. RNA carries the hereditary information for living organisms and is responsible for passing traits from parents to offspring. Compare *deoxyribonucleic acid (DNA)*.
- risk** The mathematical probability that some harmful outcome (for instance, injury, death, *environmental damage*, or *economic loss*) will result from a given action, event, or substance.
- risk assessment** The quantitative measurement of *risk*, together with the comparison of risks involved in different activities or substances.
- risk management** The process of considering information from scientific *risk assessment* in light of economic, social, and political needs and values, to make decisions and design strategies to minimize *risk*.
- rock** A solid aggregation of *minerals*.
- rock cycle** The very slow process in which *rocks* and the *minerals* that make them up are heated, melted, cooled, broken, and reassembled, forming *igneous*, *sedimentary*, and *metamorphic* rocks.
- run-of-river** Any of several methods used to generate *hydroelectric power* without greatly disrupting the flow of river water. Run-of-river approaches eliminate much of the *environmental* impact of large *dams*. Compare *pumped storage*; *storage*.
- runoff** The water from *precipitation* that flows into streams, rivers, lakes, and ponds, and (in many cases) eventually to the ocean.
- salinization** The buildup of salts in surface *soil* layers.
- salt marsh** Flat land that is intermittently flooded by the ocean where the *tide* reaches inland. Salt marshes occur along temperate coastlines and are thickly vegetated with grasses, rushes, shrubs, and other herbaceous plants.
- salvage logging** The removal of dead trees following a natural disturbance. Although it may be economically beneficial, salvage logging can be ecologically destructive because *snags* provide food and shelter for wildlife and
- because removing timber from recently burned land can cause *erosion* and damage to *soil*.
- sand** *Sediment* consisting of particles 0.005–2.0 mm in diameter. Compare *clay*; *silt*.
- sanitary landfill** A site at which solid waste is buried in the ground or piled up in large mounds for disposal, designed to prevent the waste from contaminating the *environment*. Compare *incineration*.
- savanna** A *biome* characterized by grassland interspersed with clusters of acacias and other trees. Savanna is found across parts of Africa (where it was the ancestral home of our *species*), South America, Australia, India, and other dry tropical regions.
- science** (1) A systematic process for learning about the world and testing our understanding of it. (2) The accumulated body of knowledge that arises from this dynamic process.
- scientific method** A formalized method for testing ideas with observations that involves a more-or-less consistent series of interrelated steps.
- scrubber** Technology to chemically treat gases produced in combustion so as to reduce smokestack emissions. These devices typically remove hazardous components and neutralize acidic gases, such as *sulfur dioxide* and hydrochloric acid, turning them into water and salt.
- second law of thermodynamics** The physical law stating that the nature of *energy* tends to change from a more-ordered state to a less-ordered state; that is, *entropy* increases.
- secondary forest** *Forest* that has grown back after *primary forest* has been cut. Consists of second-growth trees.
- secondary pollutant** A hazardous substance produced through the reaction of primary pollutants with one another or with other constituents of the *atmosphere*. Compare *primary pollutant*.
- secondary production** The total *biomass* that *heterotrophs* generate by consuming *autotrophs*. Compare *primary production*.
- secondary source** A source that presents information about primary sources. Compare *primary source*.
- secondary succession** A stereotypical series of changes as an *ecological community* develops over time, beginning when some *disturbance* disrupts or dramatically alters an existing community. Compare *primary succession*.
- secondary treatment** A stage of *wastewater* treatment in which biological means are used to remove contaminants remaining after *primary treatment*. Wastewater is stirred up in the presence of *aerobic* bacteria, which degrade organic pollutants in the water. The wastewater then passes to another settling tank, where remaining solids drift to the bottom. Compare *primary treatment*.

- sediment** The eroded remains of *rocks*.
- sedimentary rock** One of the three main categories of rock. Formed when dissolved *minerals* seep through *sediment* layers and act as a kind of glue, crystallizing and binding together sediment particles. Sandstone and shale are examples of sedimentary rock. Compare *igneous rock*; *metamorphic rock*.
- seed bank** A storehouse for samples of seeds representing the world's crop diversity.
- seed-tree** Timber harvesting approach that leaves small numbers of mature and vigorous seed-producing trees standing so that they can reseed a logged area.
- selection system** Method of timber harvesting whereby single trees or groups of trees are selectively cut while others are left, creating an *uneven-aged* stand.
- septic system** A *wastewater* disposal method, common in rural areas, consisting of an underground tank and series of drainpipes. Wastewater runs from the house to the tank, where solids precipitate out. The water proceeds downhill to a drain field of perforated pipes laid horizontally in gravel-filled trenches, where microbes decompose the remaining waste.
- sex ratio** The proportion of males to females in a *population*.
- shale gas** Natural gas trapped deep underground in tiny bubbles dispersed throughout formations of shale, a type of sedimentary rock. Shale gas is often extracted by *hydraulic fracturing*.
- shale oil** A liquid form of petroleum extracted from deposits of *oil shale*.
- shelterbelt** A row of trees or other tall perennial plants that are planted along the edges of farm fields to break the wind and thereby minimize wind *erosion*.
- shelterwood** Timber harvesting approach that leaves small numbers of mature trees in place to provide shelter for seedlings as they grow.
- sick building syndrome** A building-related illness produced by indoor *pollution* in which the specific cause is not identified.
- silicon** The chemical *element* with 14 *protons* and 14 *neutrons*. An abundant element in rocks in Earth's crust.
- silt** *Sediment* consisting of particles 0.002–0.005 mm in diameter. Compare *clay*; *sand*.
- sink** In a *nutrient cycle*, a *reservoir* that accepts more *nutrients* than it releases.
- sinkhole** An area where the ground has given way with little warning as a result of subsidence caused by depletion of water from an *aquifer*.
- slash-and-burn** A mode of agriculture frequently used in the tropics in which natural vegetation is cut and then burned, adding nutrition to the soil, before farming begins. Generally farmers move on to another plot once the soil fertility is depleted.
- SLOSS** Abbreviation for "single large or several small." The debate over whether it is better to make reserves large in size and few in number or many in number but small in size.
- smart growth** A *city planning* concept in which a community's growth is managed in ways intended to limit *sprawl* and maintain or improve residents' quality of life.
- smelting** A process in which *ore* is heated beyond its melting point and combined with other *metals* or chemicals to form metal with desired characteristics. Steel is created by smelting iron ore with carbon, for example.
- smog** Term popularly used to describe unhealthy mixtures of air *pollutants* that often form over urban and industrial areas as a result of fossil fuel combustion. See *industrial smog*; *photochemical smog*.
- snag** A dead tree that is still standing. Snags are valuable for wildlife.
- social cost of carbon** An estimate of the total economic cost of damages resulting from the emission of *carbon dioxide* (from *fossil fuel* burning, *deforestation*, etc.) and resulting *global climate change*, on a per-ton basis. Estimates vary widely, but the U.S. government has recently used an estimate of roughly \$40/ton CO₂.
- social sciences** Academic disciplines that study human interactions and institutions. Compare *natural sciences*.
- socially responsible investing** Investing in companies that have met criteria for environmental or social sustainability.
- soil** A complex plant-supporting *system* consisting of disintegrated rock, organic matter, air, water, *nutrients*, and microorganisms.
- soil degradation** A deterioration of soil quality and decline in soil productivity, resulting primarily from forest removal, cropland agriculture, and *overgrazing* of livestock. Compare *land degradation*; *desertification*.
- soil horizon** A distinct layer of *soil*.
- soil profile** The cross-section of a *soil* as a whole, including all *soil horizons* from the surface to the *bedrock*.
- solar energy** Energy from the sun. Solar energy is perpetually renewable and may be harnessed in several ways.
- solution mining** A *mining* technique in which a narrow borehole is drilled deep into the ground to reach a *mineral* deposit, and water, acid, or another liquid is injected down the borehole to *leach* the resource from the surrounding rock and dissolve it in the liquid. The resulting solution is then sucked out, and the desired resource is isolated.
- source** In a *nutrient cycle*, a *reservoir* that releases more *nutrients* than it accepts.
- source reduction** The reduction of the amount of material that enters the *waste stream* to avoid the costs of disposal and *recycling*, help conserve resources, minimize *pollution*, and save consumers and businesses money.
- specialist** A *species* that can survive only in a narrow range of *habitats* or that depends on very specific resources. Compare *generalist*.
- speciation** The process by which new *species* are generated. In one common mechanism, *allopatric speciation*, species form in the aftermath of the physical separation of populations over some geographic distance.
- species** A distinct type of organism. A *population* or group of populations of a particular type of organism whose members uniquely share certain characteristics and can breed freely with one another and produce fertile offspring. Different biologists may have different approaches to diagnosing species boundaries.
- species coexistence** An outcome of interspecific competition in which no competing *species* fully excludes others and the species continue to live side by side.
- species diversity** The number and variety of *species* in a given region.
- species-area curve** A graph showing how number of *species* varies with the geographic area of a landmass or water body. Number of species commonly doubles as area increases 10-fold.
- sprawl** The unrestrained spread of urban or suburban development outward from a city center and across the landscape. Often specified as growth in which the area of development outpaces *population* growth.
- steady-state economy** An *economy* that does not grow or shrink but remains stable.
- storage** Technique used to generate *hydroelectric power*, in which large amounts of water are impounded in a reservoir behind a concrete *dam* and then passed through the dam to turn *turbines* that generate *electricity*. Compare *pumped storage*; *run-of-river*.
- stratosphere** The layer of the *atmosphere* above the *troposphere*; it contains the *ozone layer* and extends 11–50 km (7–31 mi) above sea level.
- strip mining** The use of heavy machinery to remove huge amounts of earth to expose *coal* or *minerals*, which are mined out directly. Compare *subsurface mining*.
- subcanopy** The middle level of trees in a *forest*, beneath the *canopy*.
- subduction** The *plate tectonic* process by which denser *crust* slides beneath lighter crust at a *convergent plate boundary*. Often results in *volcanism*.

- subsidy** A government grant of money or resources to a private entity, intended to support and promote an industry or activity. A tax break is one type of subsidy. Compare *green tax*.
- subsurface mining** Method of *mining* underground deposits of *coal*, *minerals*, or fuels, in which shafts are dug deeply into the ground and networks of tunnels are dug or blasted out to follow coal seams. Compare *strip mining*.
- suburb** A smaller community located at the outskirts of a city.
- succession** A stereotypical series of changes in the composition and structure of an *ecological community* through time. See *primary succession*; *secondary succession*.
- sulfur dioxide** (SO₂) A colorless gas that can result from the combustion of *coal*. In the *atmosphere*, it may react to form sulfur trioxide and sulfuric acid, which may return to Earth in *acid deposition*. An EPA *criteria pollutant*.
- Superfund** A program administered by the *Environmental Protection Agency* in which experts identify sites polluted with hazardous chemicals, protect *groundwater* near these sites, and clean up the *pollution*. Established by the Comprehensive Environmental Response Compensation and Liability Act (CERCLA) in 1980.
- surface impoundment** (1) A disposal method for *hazardous waste* or mining waste in which waste in liquid or slurry form is placed into a shallow depression lined with impervious material such as clay and allowed to evaporate, leaving a solid residue on the bottom. (2) The site of such disposal. Compare *deep-well injection*.
- surface water** Water located atop Earth's surface. Compare *groundwater*.
- sustainability** A guiding principle of *environmental science* entailing conserving resources, maintaining functional ecological systems, and developing long-term solutions such that Earth can sustain our civilization and all life for the future, allowing our descendants to live at least as well as we have lived.
- sustainable agriculture** *Agriculture* that can be practiced in the same way and in the same place far into the future. Sustainable agriculture does not deplete *soils* faster than they form, nor does it reduce the clean water, genetic diversity, pollinators, and other resources essential to long-term crop and livestock production.
- sustainable development** Development that satisfies our current needs without compromising the future availability of *natural capital* or our future quality of life.
- Sustainable Development Goals** A set of 17 goals for *sustainable development* for humanity globally, agreed to by representatives of the world's nations at the United Nations in 2015.
- sustainable forest certification** A form of *ecolabeling* that identifies timber products that have been produced using *sustainable* methods. The Forest Stewardship Council (FSC) and several other organizations issue such certification.
- symbiosis** A relationship between different *species* of organisms that live in close physical proximity. People most often use the term "symbiosis" when referring to a *mutualism*, but symbiotic relationships can be either parasitic or mutualistic.
- synergistic effect** An interactive effect (as of *toxicants*) that is more than or different from the simple sum of their constituent effects.
- system** A network of relationships among a group of parts, elements, or components that interact with and influence one another through the exchange of *energy*, matter, and/or information.
- tailings** Portions of *ore* left over after *metals* have been extracted in *mining*.
- tar sands** See *oil sands*.
- temperate deciduous forest** A *biome* consisting of midlatitude *forests* characterized by broad-leaved trees that lose their leaves each fall and remain dormant during winter. These forests occur in areas where *precipitation* is spread relatively evenly throughout the year: much of Europe, eastern China, and eastern North America.
- temperate grassland** A *biome* whose vegetation is dominated by grasses and that features more extreme temperature differences between winter and summer and less *precipitation* than *temperate deciduous forests*. Also known as *steppe* or *prairie*.
- temperate rainforest** A *biome* consisting of tall coniferous trees; cooler and less *species-rich* than *tropical rainforest* and milder and wetter than *temperate deciduous forest*.
- temperature inversion** A departure from the normal temperature distribution in the *atmosphere*, in which a pocket of relatively cold air occurs near the ground, with warmer air above it. The cold air, denser than the air above it, traps *pollutants* near the ground and can thereby cause a buildup of *smog*. Also called a thermal inversion.
- teratogen** A *toxicant* that causes harm to the unborn, resulting in birth defects.
- terracing** The cutting of level platforms, sometimes with raised edges, into steep hillsides to contain water from *irrigation* and *precipitation*. Terracing transforms slopes into series of steps like a staircase, enabling farmers to cultivate hilly land while minimizing their loss of *soil* to *water erosion*.
- theory** A widely accepted, well-tested explanation of one or more cause-and-effect relationships that has been extensively validated by a great amount of research. Compare *hypothesis*.
- thermodynamics** Study of the relationships between different types of energy.
- thermohaline circulation** A worldwide system of ocean currents in which warmer, fresher water moves along the surface and colder, saltier water (which is denser) moves deep beneath the surface.
- thin-film solar cell** A photovoltaic material compressed into an ultra-thin lightweight sheet that may be incorporated into various surfaces to produce photovoltaic solar power.
- threatened** Likely to become *endangered* soon.
- Three Mile Island** Nuclear power plant in Pennsylvania that in 1979 experienced a partial *meltdown*. The term is often used to denote the accident itself, the most serious *nuclear reactor* malfunction that the United States has thus far experienced. Compare *Chernobyl*; *Fukushima Daiichi*.
- threshold dose** The amount of a *toxicant* at which it begins to affect a *population* of test animals. Compare *ED₅₀*; *LD₅₀*.
- tidal energy** *Energy* harnessed by erecting a *dam* across the outlet of a tidal basin. Water flowing with the incoming or outgoing *tide* through sluices in the dam turns turbines to generate *electricity*.
- tide** The periodic rise and fall of the ocean's height at a given location, caused by the gravitational pull of the moon and sun.
- topsoil** That portion of the *soil* that is most nutritive for plants and is thus of the most direct importance to *ecosystems* and to *agriculture*. A *soil horizon* also known as the A horizon.
- tornado** A type of cyclonic storm in which warm air rises quickly in a funnel, potentially lifting up soil and objects and threatening life and great damage to property.
- total fertility rate** (TFR) The average number of children born per female member of a *population* during her lifetime.
- toxic air pollutant** An *air pollutant* known to cause cancer, reproductive defects, or neurological, developmental, immune system, or respiratory problems in humans or to cause substantial ecological harm by affecting the health of nonhuman animals and plants. The *Clean Air Act* identifies 187 toxic air pollutants, ranging from the heavy metal mercury to *volatile organic compounds* (VOCs) such as benzene and methylene chloride.
- Toxic Substances Control Act** (TSCA) A 1976 U.S. law that directs the *Environmental*

- Protection Agency* to monitor thousands of industrial chemicals and gives the EPA authority to regulate and ban substances found to pose excessive risk.
- toxicant** A substance that acts as a poison to humans or wildlife.
- toxicity** The degree of harm a chemical substance can inflict.
- toxicology** The scientific field that examines the effects of poisonous chemicals and other agents on humans and other organisms.
- toxin** A *toxic* chemical stored or manufactured in the tissues of living organisms. For example, a chemical that plants use to ward off *herbivores* or that insects use to deter predators.
- traditional agriculture** *Agriculture* in which human and animal muscle power, along with hand tools and simple machines, performs the work of cultivating, harvesting, storing, and distributing crops. Compare *industrial agriculture*.
- tragedy of the commons** The process by which publicly accessible resources open to unregulated use tend to become damaged and depleted through overuse. The term was coined by Garrett Hardin and is widely applicable to resource issues.
- transform plate boundary** The area where two tectonic plates meet and slip and grind alongside one another, creating *earthquakes*. For example, the Pacific Plate and the North American Plate rub against each other along California's San Andreas Fault. Compare *convergent plate boundary*; *divergent plate boundary*.
- transgene** A *gene* that has been extracted from the *DNA* of one organism and transferred into the *DNA* of an organism of another *species*.
- transgenic** Term describing an organism that contains a *transgene*, or *DNA* from another *species*.
- transit-oriented development** A development approach in which compact communities in the *new urbanism* style are arrayed around stops on a major rail transit line.
- transitional stage** The second stage of the *demographic transition* model, which occurs during the transition from the *pre-industrial stage* to the *industrial stage*. It is characterized by declining death rates but continued high birth rates. See also *post-industrial stage*. Compare *industrial stage*; *post-industrial stage*; *pre-industrial stage*.
- transpiration** The release of water vapor by plants through their leaves.
- treatment** The portion of an *experiment* in which a *variable* has been manipulated in order to test its effect. Compare *control*.
- triple bottom line** An approach to sustainability that attempts to meet environmental, economic, and social goals simultaneously.
- trophic cascade** A series of changes in the *population* sizes of organisms at different *trophic levels* in a *food chain*, occurring, for example, when predators at high trophic levels indirectly promote populations of organisms at low trophic levels by keeping species at intermediate trophic levels in check. Trophic cascades may become apparent when a top predator is eliminated from a system.
- trophic level** Rank in the feeding hierarchy of a *food chain*. Organisms at higher trophic levels consume those at lower trophic levels.
- tropical dry forest** A *biome* that consists of deciduous trees and occurs at tropical and subtropical latitudes where wet and dry seasons each span about half the year. Widespread in India, Africa, South America, and northern Australia. Also known as *tropical deciduous forest*.
- tropical rainforest** A *biome* characterized by year-round rain and uniformly warm temperatures. Tropical rainforests have dark, damp interiors; lush vegetation; and highly diverse biotic communities. Found in Central America, South America, Southeast Asia, west Africa, and other tropical regions.
- troposphere** The bottommost layer of the *atmosphere*; it extends to 11 km (7 mi) above sea level.
- tropospheric ozone** *Ozone* that occurs in the *troposphere*, where it is a *secondary pollutant* created by the interaction of sunlight, heat, *nitrogen oxides*, and volatile *carbon-containing* chemicals. A major component of *photochemical smog*, it can injure living tissues and cause respiratory problems. An EPA *criteria pollutant*. Also called ground-level ozone.
- tsunami** An immense swell, or wave, of ocean water triggered by an *earthquake*, *volcano*, or *landslide* that can travel long distances across oceans and inundate coasts.
- tundra** A *biome* that is nearly as dry as *desert* but is located at very high latitudes along the northern edges of Russia, Canada, and Scandinavia. Extremely cold winters with little daylight and moderately cool summers with lengthy days characterize this landscape of lichens and low, scrubby vegetation.
- unconfined aquifer** A water-bearing, porous layer of rock, *sand*, or gravel that lies atop a less permeable substrate. The water in an unconfined aquifer is not under pressure because there is no impermeable upper layer to confine it. Compare *confined aquifer*.
- undernutrition** A condition of insufficient nutrition in which people receive fewer calories, proteins, vitamins, minerals, or carbohydrates than are needed on a daily basis for a healthy diet. Compare *overnutrition*; *malnutrition*.
- understory** The layer of a *forest* consisting of small shrubs and trees above the forest floor and below the *subcanopy*, usually shaded by foliage above it.
- uneven-aged** Term describing stands consisting of trees of different ages. Uneven-aged stands more closely approximate a natural *forest* than do *even-aged* stands.
- United Nations** (UN) Organization founded in 1945 to promote international peace and to cooperate in solving international economic, social, cultural, and humanitarian problems.
- United Nations Framework Convention on Climate Change** An international treaty signed in 1992 outlining a plan to reduce emissions of *greenhouse gases*. Gave rise to the *Kyoto Protocol*.
- universalist** An ethicist who maintains that there exist objective notions of right and wrong that hold across cultures and situations. Compare *relativist*.
- upwelling** In the ocean, the flow of cold, deep water toward the surface. Upwelling occurs in areas where surface *currents* diverge. Compare *downwelling*.
- uranium** The chemical *element* with 92 *protons* and 92 *neutrons*. Uranium is used as a fuel source to produce electricity with *nuclear energy*.
- urban ecology** A scientific field of study that views cities explicitly as *ecosystems*. Researchers in this field apply the fundamentals of *ecosystem ecology* and *systems science* to urban areas.
- urban growth boundary** A line on a map established to separate areas zoned to be high density and urban from areas intended to remain low density and rural. The aim is to control *sprawl*, revitalize cities, and preserve the rural character of outlying areas.
- urban heat island effect** The phenomenon whereby a city becomes warmer than outlying areas because of the concentration of heat-generating buildings, vehicles, and people and because buildings and dark paved surfaces absorb heat and release it at night.
- urban planning** See *city planning*. Compare *regional planning*.
- urbanization** A population's shift from rural living to city and suburban living.
- variable** In an *experiment*, a condition that can change. See *dependent variable* and *independent variable*.

vector An organism that transfers a *pathogen* to its host. An example is a mosquito that transfers the malaria pathogen to humans.

volatile organic compound (VOC) One of a large group of potentially harmful organic chemicals used in industrial processes. One of several major *air pollutants* whose emissions are monitored by the *Environmental Protection Agency* and state agencies.

volcano A site where molten rock, hot gas, or ash erupts through Earth's surface, often creating a mountain over time as cooled *lava* accumulates.

Wallace, Alfred Russel (1823–1913) English naturalist who proposed, independently of *Charles Darwin*, the concept of *natural selection* as a mechanism for *evolution* and as a way to explain the great variety of living things.

waste Any unwanted material or substance that results from a human activity or process.

waste management Strategic decision making to minimize the amount of *waste* generated, to maximize the *recovery* of discarded materials, and to dispose of waste safely and effectively.

waste stream The flow of *waste* as it moves from its sources toward disposal destinations.

waste-to-energy facility An incinerator that uses heat from its furnace to boil water to create steam that drives *electricity* generation or that fuels heating systems.

wastewater Any water that is used in households, businesses, industries, or public facilities and is drained or flushed down pipes, as well as the polluted *runoff* from streets and storm drains.

water A *compound* composed of two hydrogen atoms bonded to one oxygen atom, denoted by the chemical formula H_2O .

water pollution The release of matter or *energy* into waters that causes undesirable

impacts on the health and well-being of humans or other organisms. Water pollution can be physical, chemical, or biological.

water table The upper limit of *groundwater* held in an *aquifer*.

waterlogging The saturation of *soil* by water, in which the *water table* is raised to the point that water bathes plant roots. Waterlogging deprives roots of access to gases, essentially suffocating them and damaging or killing the plants.

watershed The entire area of land from which water drains into a given river. Also called *drainage basin*.

wave energy *Energy* harnessed from the motion of ocean waves. Many designs for machinery to harness wave energy have been invented, but so far, few are operating commercially.

weather The local physical properties of the *troposphere*, such as temperature, pressure, humidity, cloudiness, and wind, over relatively short time periods (typically minutes, hours, days, or weeks). Compare *climate*.

weathering The process by which rocks and *minerals* are broken down, turning large particles into smaller particles. Weathering may proceed by physical, chemical, or biological means.

weed A pejorative term for any plant that competes with our crops. The term is subjective and defined by our own economic interests and is not biologically meaningful. Compare *pest*.

wetland A system in which the soil is saturated with water and that generally features shallow standing water with ample vegetation. These biologically productive systems include freshwater marshes, swamps, bogs, and seasonal wetlands such as vernal pools.

wilderness area Federal land that is designated off-limits to development of any kind but is open to public recreation, such as hiking, nature study, and other activities that have minimal impact on the land.

wildland-urban interface A region where urban or suburban development meets forested or undeveloped lands.

wind farm A development involving a group of *wind turbines*.

wind power A source of *renewable energy*, in which *kinetic energy* from the passage of wind through *wind turbines* is used to generate *electricity*.

wind turbine A mechanical assembly that converts the wind's *kinetic energy*, or energy of motion, into electrical energy.

work When a force acts on an object, causing it to be displaced (to move in space).

World Bank Institution founded in 1944 that serves as one of the globe's largest sources of funding for economic development, including such major projects as *dams*, *irrigation* infrastructure, and other undertakings.

world heritage site A location internationally designated by the *United Nations* for its cultural or natural value. There are more than 1000 such sites worldwide.

World Trade Organization (WTO) Organization based in Geneva, Switzerland, that represents multinational corporations and promotes free trade by reducing obstacles to international commerce and enforcing fairness among nations in trading practices.

worldview A way of looking at the world that reflects a person's (or a group's) beliefs about the meaning, purpose, operation, and essence of the world.

xeriscaping Landscaping using plants that are adapted to arid conditions.

zoning The practice of classifying areas for different types of development and land use.

zooxanthellae Symbiotic algae that inhabit the bodies of *corals* and produce food through *photosynthesis*.