cotyledons Leaflike structures (seed leaves) produced by the embryo of flowering plants, the dicots (Magnoliopsida), and the monocots (Liliopsida). They serve to absorb nutrients in the seed until the seedling is able to produce true leaves and begin photosynthesis. In monocots, the embryo has a single cotyledon, while in dicots, the embryo has two cotyledons.

See also DICOT; MONOCOT.

countercurrent exchange The effect caused when two fluids move past each other in opposite directions and facilitate the efficient exchange of heat, gas, or substance. For example: the passage of heat from one blood vessel to another; rete mirabile, the countercurrent exchange structure of capillaries that allows gas uptake in a fish swim bladder; the kidney nephron loop, a tubular section of nephron between the proximal and distal convoluted tubules where water is conserved and urine concentrates by a countercurrent exchange system; and the upper airway where, upon expiration, heat and moisture are retained and given up to relatively cool and dry inspired gases.

Cournand, André-Frédéric (1895–1988) French *Physiologist* André-Frédéric Cournand was born in Paris on September 24, 1895, to Jules Cournand, a stomatologist, and his wife Marguérite Weber. He received his early education at the Lycée Condorcet, received a bachelor's degree at the Faculté des Lettres of the Sorbonne in 1913, and received a diploma of physics, chemistry, and biology of the Faculté des Sciences the following year.

He began medical studies in 1914, but served in the French Army from 1915 to 1918, returning to medical studies at the Interne des Hôpitaux de Paris in 1925. He received an M.D. from the Faculté de Médecine de Paris in May 1930 and secured a residency in the Tuberculosis (later Chest) Service of the Columbia University Division at Bellevue Hospital, New York. He became chief resident of this service and conducted research on the physiology and physiopathology of respiration under the guidance of Dickinson W. RICHARDS. He became an American citizen in 1941 and retired from Columbia in 1964.

Together, Cournand and Richards collaborated in clinical lung and heart research. They perfected a procedure introduced by Werner Forssmann and called Forssmann's procedure, now called cardiac catheterization (a tube is passed into the heart from a vein at the elbow). This made it possible to study the functioning of the diseased human heart and to make more accurate diagnoses of the underlying anatomic defects. They also used the catheter to examine the pulmonary artery, improving the diagnosis of lung diseases as well. He shared the Nobel Prize in physiology or medicine with Dickinson W. Richards and Werner FORSSMANN for their discoveries concerning heart catheterization and circulatory changes in 1956.

Cournand served on the editorial boards of many medical and physiological publications, including *Circulation, Physiological Reviews, The American Journal of Physiology,* and also *Journal de Physiologie* and *Revue Française d'Etúdes Cliniques et Biologiques*. He was a member of numerous scientific organizations and received awards for his work. He died on February 19, 1988, at Great Barrington, Massachusetts.

court (lek) The area defended by individual males within an area where birds gather for display and courtship.

covalent bond A region of relatively high electron density between nuclei that arises at least partly from sharing of electrons and gives rise to an attractive force and characteristic internuclear distance.

crista The inner membrane of mitochondrion, where respiration takes place; location of the electron transport chain and enzymes that catalyze ATP synthesis. Also the term applied to sensory cells within an ear's semicircular canal that detect fluid movement. Also means crest, such as the *crista galli,* the comb on a rooster.

Croll, James (1821–1890) British *Carpenter, Physicist* James Croll was born in Cargill, Perthshire, Scotland, on January 2, 1821. He was the son of David Croll, a stonemason from Little Whitefield, Perthshire, and Janet Ellis of Elgrin. He received an elementary school education until he was 13 years old. His knowledge of science was the result of vigilance, since he was

self-taught. On September 11, 1848, he married Isabella MacDonald, daughter of John MacDonald.

Croll started his career as a carpenter apprenticed to a wheelwright when he was young; then he became a joiner at Banchory and opened a shop in Elgin. In 1852, he opened a temperance hotel in Blairgowrie, and later, in 1853, became an insurance agent for the Safety Light Assurance Company ending up in Leicester.

His first book, *The Philosophy of Theism,* was published in 1857 and based on the influence of the metaphysics of Jonathan Edward. However due to an injury, he ended up obtaining a job as a janitor at Anderson's College and Museum in Glasgow in 1859. Being a janitor gave him enough free time after his daily chores to utilize the museum's extensive library. There, he would spend the night reading books on physics, including the works of Joseph A. Adhémar, the French mathematician, who noted in 1842 that the Earth's orbit is elliptical rather than spherical. Adhémar proposed in his book *Revolutions de la Mer, Deluges Periodics* (Revolutions of the sea, periodic floods) that the precession of the equinoxes produced variations in the amount of solar radiation striking the planet's two hemispheres during the winter time (insolation), and this, along with gravity effects from the sun and moon on the ice caps, is what produced ice ages alternately in each hemisphere during a 26,000-year cycle. Precession is the slow gyration of Earth's axis around the pole of the ecliptic, caused mainly by the gravitational pull of the sun, moon, and other planets on Earth's equatorial bulge. Croll also read about the new calculations of the Earth's orbit by French astronomer Urbain Jean Joseph Leverrier (a discoverer of the planet Neptune).

Croll decided to work on the origins of the ice ages, since he did not agree with the prevailing attitude that they were leftover relics from the biblical Great Flood, and additionally he found errors in Adhémar's work. Croll came to the conclusion that the overriding force changing climate and creating the ice ages on Earth was due to variations in insolation, which is the rate of delivery of solar radiation per unit of horizontal surface, i.e., the sunlight hitting the Earth.

Croll first realized that Adhémar did not take into account the shape of the Earth's orbit that varied over time and its effect on precession, so he calculated the eccentricity over several million years. This eccentricity (the distance between the center of an eccentric and its axis), in this case the degree of Earth's elliptic orbit, he proposed, varied on a time scale of about 100,000 years. Since variations in eccentricity only produced small changes in the annual radiation budget of Earth, and not enough to force an ice age, Croll developed the idea of climatic feedbacks, such as changes in surface albedo (reflection). He predicted that the last ice age was over about 80,000 years ago.

During the 1860s, he published his theories in a number of papers: "On the Physical Cause of Changes of Climate during Geological Epochs" (1864); "The Eccentricity of the Earth's Orbit" (1866, 1867); "Geological Time and Date of Glacial and Miocene Periods" (1868); "The Physical Cause of the Motion of Glaciers" (1869, 1870); "The Supposed Greater Loss of Heat by the Southern Hemisphere" (1869); "Evolution by Force Impossible: A New Argument against Materialism" (1877). During this time he was the keeper of maps and correspondence at the Scottish Geological Survey starting in 1867, where he mingled with some of the best geologists of the time until he retired in 1880.

In 1875 he published *Climate & Time in Their Geological Relations,* where he summed up his research on the ancient condition of the Earth. On January 6, 1876, he was elected a fellow of the Royal Society of London. Charles Darwin was among the many supporters of his nomination. He received an LL.D. (law degree) that year from St. Andrews College. While his main interests were in the field of paleoclimate change, he also put forth theories about ocean currents and their effects on climate during modern times.

However, some of his thoughts and ideas were wrong. For example, Croll believed that ice ages varied in the hemispheres, and his estimated age for the last ice advance ending 80,000 to 100,000 years ago was wrong. It ended between 14,000 and 10,000 years ago, as research currently shows. Because of these errors, Croll fell out of vogue until 1912, when Yugoslav geologist Milutin Milankovitch revised Croll's theories in his book, *Canon of Insolation.*

Croll published close to 90 papers on a variety of subjects, such as "Ocean Currents" (1870, 1871, 1874); "Change of Obliquity of Ecliptic: Its Effect on Climate" (1867); "Physical Cause of Submergence during Glacial Epoch" (1866, 1874); "Boulder Clay of Caithness & Glaciation of North Sea" (1870); "Method of Determining Mean Thickness of Sedimentary Rocks" (1871);

and "What Determines Molecular Motion? The Fundamental Problem of Nature" (1872).

A famous debate on the nature of deep-sea circulation between Croll and Irish scientist William Carpenter during the 1860s to 1880s was well discussed in the literature and around scientific circles via correspondence. In 1885, he published *Climate and Cosmology* to answer critics of his earlier work *Climate & Time in Their Geological Relation*. Five years later, plagued by ill health his whole life, he died in Perth on December 15, at age 69, shortly after publishing a small book called *The Philosophical Basis of Evolution*.

Cro-Magnon An early group of *Homo sapiens* (humans) that lived in Europe around 40,000 years ago.

crossing over A process during meiosis when alleles on homologous chromosomes (chromosomes that pair with each other at meiosis) switch places, increasing the possible combinations of alleles and thus increasing the variability of the whole genome. Also called recombination.

See also RECOMBINANT.

cross-pollination When pollen from the anther of a flower of one plant is transferred to the flowers (stigma) of a different plant.

See also POLLINATION.

cross-reactivity The ability of an immunoglobulin, specific for one antigen, to react with a second antigen. A measure of relatedness between two different antigenic substances.

Crustacea All crustaceans have two pairs of antennae, a pair of mandibles, a pair of compound eyes (usually on stalks), two pair of maxillae on their heads, and a pair of appendages on each body segment (head, thorax, and abdomen). There are about 30,000 species of this subphylum within five classes (Remipedia, Cephalocarida, Branchiopoda, Maxillopoda, and Malacostraca). Includes lobsters, crabs, crayfish, shrimp, copepods, isopods, barnacles, and others. Many of them are important economic species for human consumption.

cryptic Describes the ability to conceal or camouflage.

cryptic coloration A camouflage technique whereby an organism matches its background, concealing itself from predators or prey, e.g., the peppered moth.

See also MIMICRY.

crystal field Crystal field theory is the theory that interprets the properties of COORDINATION entities on the basis that the interaction of the LIGANDs and the CENTRAL ATOM is a strictly ionic or ion-dipole interaction resulting from electrostatic attractions between the central atom and the ligands. The ligands are regarded as point negative (or partially negative) charges surrounding a central atom; covalent bonding is completely neglected. The splitting or separation of energy levels of the five degenerate d-orbitals in a transition metal, when the metal is surrounded by ligands arranged in a particular geometry with respect to the metal center, is called the crystal field splitting.

C-terminal amino acid residue *See* AMINO ACID RESIDUE.

Curie relation *See* MAGNETIC SUSCEPTIBILITY.

cuticle A protective impermeable waxy substance formed from the polymer cutan that covers the outside of leaves, stems, and fruits and forms the protective layer of arthropods.

cyanobacteria Bacteria, formerly known as blue-green algae; aquatic and photosynthetic organisms that live in water and manufacture their own food. Their fossils go back more than 3.5 billion years, making them the oldest known species, and they are the contributors to the origin of plants.

See also ALGAE.

cybernetics The science that studies the methods to control behavior and communication in animals (and machines).

cyclic AMP (cAMP; 3',5'-AMP) Cyclic adenosine monophosphate. A compound synthesized from ATP (by the enzyme adenylyl cyclase) in living cells that acts as an intercellular and extracellular second messenger mediating peptide and amine hormones.

cyclic electron flow Two photosystems are present in the thylakoid membrane of chloroplasts: photosystem I and photosystem II. The two photosystems work together during the light reactions of photosynthesis. The light-induced flow of electrons beginning with and returning to photosystem I to produce ATP without production of NADPH (nicotine adenine dinucleotide phosphate with hydrogen) is cyclic electron flow. The generation of ATP by this process is called noncyclic photophosphorylation.

cyclin A protein found in dividing cells that activates protein kinases (cyclin-dependent protein kinases), a type of enzyme that adds or removes a phosphate group from a target protein and controls the progression of one phase of the cell cycle to the next. The concentration of the cyclin increases and decreases during the cell cycle.

cyclin-dependent kinase A protein kinase, an enzyme involved in regulating cell growth and division, that must be attached to cyclin to become activated.

cytochrome A HEME protein that transfers electrons and exhibits intense absorption bands (the α and β bands, the α band having the longer wavelength) between 510 and 615 nm in the reduced form. Cytochromes are designated types *a, b, c,* or *d,* depending on the position of the α band, which depends on the type of heme. The iron undergoes oxidation–reduction between oxidation states Fe(II) and Fe(III). Most cytochromes are hemochromes, in which the fifth and sixth COORDINATION sites in the iron are occupied by strong field LIGANDs, regardless of the oxidation state of iron. Cytochromes can be distinguished by the wavelength of the α band, such as cytochrome *c*-550. Certain specific cytochromes with particular functions are designated with suffixes, such as cytochrome a_1, b_2, etc.

cytochrome-c oxidase An ENZYME, ferrocytochrome-c: dioxygen OXIDOREDUCTASE, CYTOCHROME aa_3. The major respiratory protein of animal and plant MITOCHONDRIA, it catalyzes the oxidation of Fe(II)-cytochrome *c,* and the reduction of dioxygen to water. Contains two HEMEs and three copper atoms, arranged in three centers. Heme a_3 and copper-B form a center that reacts with dioxygen; the second heme is cytochrome *a;* the third site, copper-A, is a dinuclear center.

See also NUCLEARITY.

cytochrome P-450 General term for a group of HEME-containing MONOOXYGENASEs. Named from the prominent absorption band of the Fe(II)-carbonyl complex. The heme comprises PROTOPORPHYRIN IX, and the proximal LIGAND to iron is a cysteine sulfur. Cytochromes P-450 of microsomes in tissues such as liver are responsible for METABOLISM of many XENOBIOTICs, including drugs. Others, such as the mitochondrial ENZYMEs from adrenal glands, are involved in biosynthetic pathways such as those of steroids. The reaction with dioxygen appears to involve higher oxidation states of iron, such as Fe(IV)=O.

See also MITOCHONDRIA.

cytokines Cytokines are soluble glycoproteins released by cells of the immune system (secreted primarily from leukocytes) that act nonenzymatically through specific receptors to regulate immune responses. Cytokines resemble hormones in that they act at low concentrations bound with high affinity to a specific receptor.

cytokinesis The final stage of mitosis, when the parent cell divides equally by cell-wall formation into

two daughter cells by way of a constriction and drawing in of an actin/myosin ring around the center of the cell.

cytoplasm The part of protoplasm in a cell outside of and surrounding the nucleus. The contents of a cell other than the nucleus. Cytoplasm consists of a fluid containing numerous structures, known as organelles, that carry out essential cell functions.

See also CELL.

cytoplasmic determinants Substances distributed in an embryo, but present in an unfertilized egg, that appear in different blastomeres at the initial cleavage stage and influence their development fate.

cytoplasmic streaming The movement and flow of cytoplasm, the living part of a cell outside the nuclear membrane. The primary method of movement of materials within cells, e.g., chloroplasts moving up to the surface of the leaf and then down, which appear to help in photosynthesis.

See also CELL.

cytoskeleton The internal support system and framework of a cell, comprising numerous microfilaments and tubules that branch throughout the cell. The cytoskeleton serves not only as mechanical support but also in transport functions.

See also SKELETON.

cytosol The semifluid portion of the cytoplasm, not including organelles.

cytoxic T cells (T killer cells) Cells that kill target cells bearing appropriate antigen within the groove of an MHC (major histocompatibility complex) class I molecule that is identical to that of the T cell.

D

Dale, Henry Hallett (1875–1968) British *Physiologist* Sir Henry Hallett Dale was born in London on June 9, 1875, to Charles James Dale, a businessman, and Frances Ann Hallett. He attended Tollington Park College in London, Leys School, Cambridge, and in 1894 he entered Trinity College with a scholarship. He graduated through the Natural Sciences Tripos in 1898, specializing in physiology and zoology.

In 1900 he gained a scholarship and entered St. Bartholomew's Hospital, London, for the clinical part of the medical course. He received a B.Ch. at Cambridge in 1903 and became an M.D. in 1909.

He took an appointment as pharmacologist at the Wellcome Physiological Research Laboratories in 1904 and became director of these laboratories in 1906, working for some six years. In 1914, he was appointed director of the department of biochemistry and pharmacology at the National Institute for Medical Research in London, and in 1928 he became the director of this institute, serving until his retirement in 1942, when he became professor of chemistry and a director of the Davy-Faraday Laboratory at the Royal Institution, London.

In 1911, he was the first to identify the compound histamine in animal tissues, and he studied its physiological effects, concluding that it was responsible for some allergic and anaphylactic reactions. After successfully isolating acetylcholine in 1914, he established that it was found in animal tissue, and in the 1930s he showed that it is released at nerve endings in the parasympathetic nervous system, thus establishing acetylcholine's role as a chemical transmitter of nerve impulses.

In 1936 he shared the Nobel Prize in physiology or medicine with his friend German pharmacologist Otto LOEWI for their discoveries in the chemical transmission of nerve impulses.

He was knighted in 1932 and appointed to the Order of Merit in 1944. In addition to numerous articles in medical and scientific journals that record his work, he was the author of *Adventures in Physiology* (1953), and *An Autumn Gleaning* (1954).

Sir Henry was president of the Royal Society (1940–45) and others, and he received many awards. He married his first cousin Ellen Harriet Hallett in 1904. He died on July 23, 1968, in Cambridge.

dalton A unit of measurement of molecular weight based on the mass of one-twelfth the mass of ^{12}C, i.e., 1.656×10^{-24}. A dalton is also called an atomic mass unit, or amu, and is used to measure atomic mass. Protein molecules are express in kilodaltons (kDa). The dalton was named in honor of John Dalton (1766–1844), an English chemist and physicist.

Dam, Henrik (1895–1976) Danish *Biochemist* Carl Peter Henrik Dam was born in Copenhagen on February 21, 1895, to druggist Emil Dam and his wife Emilie (née Peterson), a teacher. He attended the Polytechnic Institute, Copenhagen, and graduated with a

degree in chemistry in 1920. The same year he was appointed assistant instructor in chemistry at the School of Agriculture and Veterinary Medicine, advancing to full instructor in biochemistry at the Physiological Laboratory of the University of Copenhagen in 1923.

In 1925 Dam became assistant professor at the Institute of Biochemistry, Copenhagen University, and three years later was promoted to associate professor until 1941. On submitting a thesis *Nogle Undersøgelser over Sterinernes Biologiske Betydning* (Some investigations on the biological significance of the sterines) to the University of Copenhagen in 1934, he received a Ph.D. in biochemistry.

He discovered vitamin K and its anticoagulant effects while studying the sterol metabolism of chicks in Copenhagen and was awarded the Nobel Prize in physiology or medicine in 1943 for this work.

He conducted research at Woods Hole Marine Biological Laboratories in Massachusetts during the summer and autumn of 1941 and was a senior research associate at the University of Rochester, New York, between 1942 and 1945, and he was an associate member at the Rockefeller Institute for Medical Research in 1945.

Dam was appointed professor of biochemistry at the Polytechnic Institute, Copenhagen, in 1941, though the designation of his chair at the Polytechnic Institute was changed to professor of biochemistry and nutrition in 1950.

After his return to Denmark in 1946, he concentrated his research on vitamin K, vitamin E, fats, cholesterol, and nutritional studies in relation to gallstone formation.

He published over 300 articles in biochemistry and was a member of numerous scientific organizations. Dam died on April 17, 1976.

darling effect The stimulation of reproductive activity by the activity of other members of the species in addition to the mating pair. Also called the Fraser darling effect.

Darwinian fitness The measure of an individual's relative genetic contribution to the gene pool of the next generation; the longer an individual survives and the more it reproduces, the higher the fitness and the higher the chance that a hereditary characteristic will be reproduced.

Darwinism The evolutionary theory advanced by Charles Darwin during the mid-19th century suggesting that present-day species have evolved from simpler ancestors. A newer version of the theory is incorporated as "neo-Darwinism" or "modern synthesis."

day-neutral plant A plant where the length of day is not an influence on development; the plant will flower regardless of day length (photoperiodism). It is now known that it is not the length of the light period, but the length of uninterrupted darkness, that is critical to floral development. Examples are tomato, corn, cucumber, and strawberries.

See also PHOTOPERIODISM.

decapods Crustaceans that have five pairs of walking legs and a well-developed carapace, e.g., shrimps, lobsters, hermit crabs, and crabs.

deciduous A plant, tree, or shrub that sheds its leaves at the end of the growing season.

See also CONIFER.

decomposers A trophic level or group of organisms such as fungi, bacteria, insects, and others that as a group digest or break down organic matter (dead animals, plants, or other organic waste) by ingesting, secreting enzymes or other chemicals, and turning them into simpler inorganic molecules or compounds that are released back into the environment.

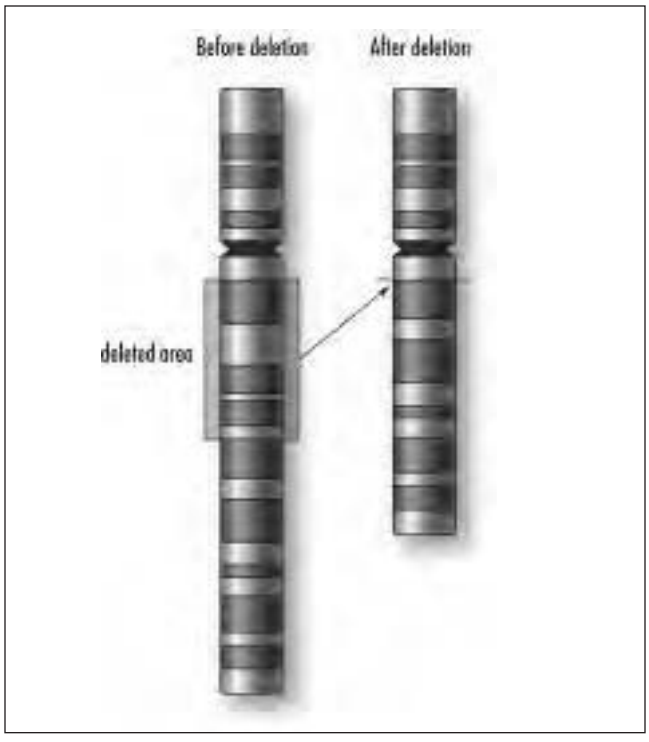
decumbent A plant or part of the plant that is reclining or lying on the ground but with the tip or apex ascending or pointing up. Also called prostrate, as in a prostrate shrub.

dehiscent A fruit or seed capsule that splits open.

dehydration reaction (condensation reaction) A chemical reaction in which two organic molecules become linked to each via COVALENT BONDs with the removal of a molecule of water; common in synthesis reactions of organic chemicals.

dehydrogenase An OXIDOREDUCTASE that catalyzes the removal of hydrogen atoms from a SUBSTRATE.

deletion A type of mutation where an alteration or loss of a segment of DNA occurs from a chromosome as the consequence of transposition, i.e., when DNA is being moved from one position from one genome to another. Such mutations can lead to disease or genetic abnormality. A terminal deletion refers to breakage and loss off the end of a chromosome, while an interstitial deletion is the loss of material from within the chromosome, but between the ends. Examples of deletion are Angelman syndrome, a combination of birth defects caused by inheriting both copies of the No. 15 chromosome from the father, and Prader-Willi syndrome, a combination of birth defects caused by inheriting both copies of the No. 15 chromosome from the mother or by inheriting a deletion of a region in the proximal long arm of chromosome No. 15 from the father. Hypopigmentation, which is unusually lighter hair, eyes, and skin color in relation to other family members, is common in Prader-Willi syndrome, especially in individuals with a partial deletion of the long arm of chromosome 15. Cri du Chat syndrome is a rare combination of birth defects caused by a deletion of chromosome 5p.



A particular kind of mutation, i.e., the loss of a piece of DNA from a chromosome. Deletion of a gene or part of a gene can lead to a disease or abnormality. ***(Courtesy of Darryl Leja, NHGRI, National Institutes of Health)***

deme One or more local populations of a taxon that can interbreed.

demography The scientific inquiry into the vital statistics of populations that includes sizes, age–sex compositions, ratios, distributions, densities, growth, natality, mortality, migration, and other characteristics as well as the causes, characteristics, and consequences of changes in these factors. Because the study seeks those relationships that can be expressed precisely and quantitatively, demographers use quantitative analytical methods, but they turn to other disciplines such as anthropology, sociology, and others to explain them. U.S. Census data are a major source of demography for human studies.

denaturation In DNA denaturation, two strands of DNA are separated as a result of the disruption of the hydrogen bonds following exposure to extreme conditions such as high temperature, chemical treatment, pH changes, salt concentration, and others. Denaturation in proteins by heat, acids, bases, or other means results in a change in the three-dimensional structure of the protein so that it cannot perform its function and becomes biologically inactive.

dendrite The thin extension of a neuron that forms synapses by producing or responding to neurotransmitters. A dendrite forms connections with the axons

of other neurons and transmits nerve impulses toward the cell body. A dendrite is also a branch or treelike figure produced on or in a rock or mineral or a lichen form.

See also NEURON.

dendrochronology Tree-ring dating. The process of determining the age of a tree or wood by counting the number of annual growth rings.

dendrogram A treelike or graphical diagram that summarizes the process of hierarchical clustering showing evolutionary change.

See also CLADISTICS.

dengue (dandy fever) An epidemic disease found in tropical and subtropical regions. Caused by the dengue virus (genus *Flavivirus* [family Flaviviridae]), which is carried by a mosquito of the genus *Aedes* (*Aedes aegypti* or *Aedes albopictus*). First described in 1827 in Zanzibar; an outbreak occurred in Philadelphia in 1780, then called breakbone fever.

denitrification The reduction of nitrates to nitrites, nitrogen monoxide (nitric oxide), dinitrogen oxide (nitrous oxide), and ultimately dinitrogen catalyzed by microorganisms, e.g., facultative AEROBIC soil bacteria under ANAEROBIC conditions.

De-nol Trade name for the potassium salt or mixed ammonium potassium salt of a bismuth citrate complex, used in the treatment of ulcers.

de novo design The design of bioactive compounds by incremental construction of a ligand model within a model of the RECEPTOR or ENZYME-active site, the structure of which is known from X-ray or nuclear magnetic resonance (NMR) data.

density In biology, the number of individuals per unit area or volume.

density-dependent factor An external process or biological factor, such as disease, competition, or predation, that has a greater effect on a population as the population density increases. A dense population living closely together is more likely to have more of its individuals afflicted and affected by disease than a population that is less dense, with individuals living farther apart from one another. The term also refers to a population regulation factor in ecosystems where the communities have many species and where many biological interactions are taking place. The term can also refer to limiting factors that have an increasing effect on a population as the population increases in size.

density-dependent inhibition A process where most normal animal cells stop dividing when they come into contact with each other.

density-independent factor An external process or set of physical factors (weather, flooding, fire, pollution, etc.) that reduces a population, regardless of size. This can occur in areas with few species with few biological interactions. The term applies to limiting factors that affect all populations, regardless of their density.

denticity The number of donor groups from a given LIGAND attached to the same CENTRAL ATOM.

deoxyribonucleic acid (DNA) A high-molecular-mass linear polymer, composed of NUCLEOTIDES containing 2-deoxyribose and linked between positions 3' and 5' by phosphodiester groups. DNA contains the genetic information of organisms. The double-stranded form consists of a DOUBLE HELIX of two complementary chains that run in opposite directions and are held together by hydrogen bonds between pairs of the complementary NUCLEOTIDES. The way the helices are constructed may differ and is usually designated as A, B, Z, etc. Occasionally, alternative structures are found, such as those with Hoogsteen BASE PAIRING.

See also GENETICS.

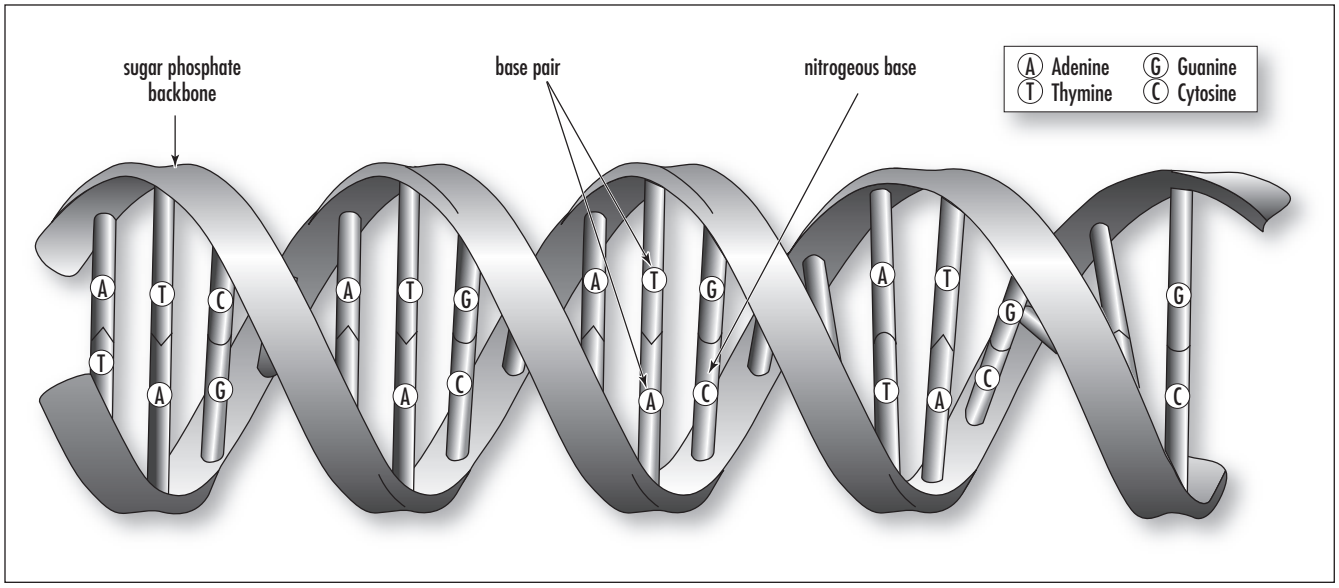
deoxyribose A five-carbon sugar ($C_5H_{10}O_4$) component of DNA. Joins with a phosphate group and base to form a deoxyribose nucleotide, the subunit of nucleic acids.

depolarization A process where a neuron's electrical charge becomes less negative as the membrane potential moves from resting potential (70 mV) toward 0 mV; a decrease in voltage. The loss of membrane polarity is caused by the inside of the cell membrane becoming less negative in comparison to the outside. Depolarization is caused by an influx of NA^+ ions through voltage-gated Na^+ channels in axons.

Depolarization is a reduction in potential that usually ends with more positive and less negative charge. Hyperpolarization is the opposite, an increase in potential that ends with more negative and less positive charge. Repolarization is when the state returns to resting potential. Action potentials are caused by depolarization in nerve cells. An action potential is a one-way, self-renewing wave of membrane depolarization that propagates at rapid speed (up to 120 m/sec) along the length of a nerve axon. Julius Bernstein first proposed the concept of depolarization in 1868.

deposit-feeder A land organism (e.g., earthworm) that eats sediment and processes it through a digestive tract or an aquatic organism (e.g., marine annelid) that ingests bottom sediments such as the sand and mud of a water body. Both digest the microorganisms and other organic matter, with the rest of the material passing through the gut. Examples of deposit feeders are most oligochaetes (earthworms [family Lumbricidae] and small freshwater forms like *Tubifex*), which includes about 3,500 species. Polychaetes (nonselective or selective deposit feeders), such as *Nereis* (common clamworm) and other marine worms such as bloodworms, lugworms, fanworms, and scaleworms, number about 8,000 species. Forms include the sedentary *Arenicola* (lugworm), which is a subsurface (burrow dwelling) deposit feeder, and *Amphrites* (terrebellid), which is a tube-dwelling selective deposit feeder.

dermal tissue system The outside protective covering (skin) of young plants consisting of a waxy type (cuticle) epidermis, a tightly packed single outer layer of cells that protects and reduces water loss. Stomata regulate gases passing in and out of the plant and are usually located on the underside of leaves, and guard cells regulate the opening by changing water pressure within the cell to swell or shrink. Also the outer tissue



DNA is the chemical inside the nucleus of a cell that carries the genetic instructions for making living organisms. ***(Courtesy of Darryl Leja, NHGRI, National Institutes of Health)***