
Glossary

Accessory pigment A colored molecule that absorbs light energy and transfers it to a reaction center of chlorophyll for use in photosynthesis

Acritarch The general term for unicellular fossils whose relationship are uncertain; many are regarded as resistant cyst stages of planktonic algae, often prasinophyceans or dinoflagellates.

Actinomycetes Group of gram-positive, sporeforming, prokaryotic microorganisms belonging to the bacteria, which grow as slender branched filaments (hyphae). They are found in soil, river muds and lake bottoms and include many species (e.g. *Streptomyces*) that produce antibiotics.

Active oxygen Strongly oxidizing oxygen that functions to maintain life by generating energy within the body to sustain the organism through respiration.

Adrenal cortical hormone Category of steroidal hormones secreted from the adrenal cortex.

Adrenocorticotropic hormone, adrenocorticotropin (ACTH) Polypeptide hormone synthesized by anterior pituitary and which acts on adrenal cortex, stimulating its growth and the synthesis and release of adrenocortical steroids. Also has effects on other tissues, stimulating lipid breakdown and release of fatty acids from fat cells.

Adventitious bud Bud that forms in a place where buds typically do not form, including on leaves and roots or between stem joints.

Adventive embryo Embryo that forms from plant somatic cells through the same morphological changes as in fertilization.

Agar A sulfated polygalactan extracted from walls of various red algae that is used as a gelling agent.

AIDS Disease of diminished immune functioning caused by infection with the human immunodeficiency virus (HIV).

Akinete A thick-walled spore that functions in asexual reproduction, frequently serving as a resistant stage that undergoes a period of dormancy.

Albino An animal in which pigment formation is absent or a plant lacking chromophores. This mutation results in a genetic lack of ability to synthesize pigments.

Algaenans Decay-resistant polymers of unbranched hydrocarbons present in the cell walls of some algae.

Algal bloom (bloom) Visible growth of planktonic algae, often associated with nutrient-enriched waters.

Alginic acids Polysaccharides (a mixture of mannuronic and guluronic acids) extracted from the walls of brown algae for industrial applications; may occur in the salt form (alginates or algin).

Aliasing Sampling problem resulting from the too-infrequent collection of samples.

Alkaloid Any of a group of nitrogen containing organic bases found in plants and which are toxic or physiologically active in vertebrates, such as caffeine, morphine, nicotine, strychnine.

Alkylating agents Highly reactive organic chemicals (e.g. mustard gas) that attach alkyl groups to bases in DNA, and to other molecules. They are potent mutagens as well as causing damage to tissues.

Allele Genes corresponding to allelomorph characteristics that are located on corresponding sites on homologous chromosomes (i.e., corresponding gene loci). Multiple allelomorphs have groups of corresponding genes (multiple alleles). The relationships between alleles arising from mutation and regular (wild-type) genes may be categorized as follows: (1) amorphs, in which the mutant gene does not possess any of the normal gene's trait expression functions; (2) hypomorphs, in which the mutant gene's functioning is not qualitatively different from the normal gene's, but is quantitatively lesser; (3) antimorphs, in which the mutant gene functions in a direction opposite that of the normal gene; and (4) neomorphs, in which mutation results in functions entirely unrelated to those of the wild-type gene. The various relationships among these serve as the basis for determining complete or incomplete dominance in hetero individuals, as well as traits such as gene redundancy.

Allelism test A form of complementarity testing to examine whether mutants with similar phenotypes are the results of mutation at the same gene locus. Pairs of chromosomes with each of the mutant genes are inserted in the same cell to test whether the wild-type traits are expressed. If the test shows the two mutants exhibiting a wild-type phenotype due to complementarity, it can be determined that there is no allelism, and the two are mutations at different gene loci. If the same test shows no complementarity and a mutant type, it can be determined that

allelism is present and the two are mutations at the same gene locus. This is a simple means of determining whether genetic loci are the same or different.

Allelism A state in which a gene involved in particular phenotype is an allele at a specific gene locus. In cases involving neighboring genes with very similar functions (multiple gene families), it is not possible to use genetic exchange to test whether a single gene locus has different gene types (alleles) or non-alleles at different gene loci. The allelism ratio is the percentage of alleles (identical gene loci) for two genes randomly chosen from among these alleles and non-alleles. The term “lethal allelism” refers to groups of genes that exhibit lethality due to phenotype.

Allelomorph Phenotype expressed as a result of an allele; in wild types, this refers to traits governed by mutant alleles. When two or more wild-type alleles are recognized, they are referred to as multiple alleles. Wild-type traits are typically dominant and mutant traits recessive (allelomorphic character).

Alloenzymes are variant forms of an enzyme that are coded by different alleles at the same locus.

Allophycocyanin A type of phycobiliprotein produced by cyanobacteria (except chlorophyll a and b-containing taxa), glaucophytes, red algae, and cryptomonads.

Alloxanthin A xanthophyll pigment that is characteristic of photosynthetic cryptomonads.

Alternation of generation A life history type in which there are two (or more, in some red algae) multicellular stages that can be distinguished by type of reproductive cell produced and sometimes also be morphological features.

Alveolata A eukaryotic super group that includes ciliates,

Amoeba A unicellular organism that generates motions via cellular projections

Amoeboid A type of cell organization in which a wall is absent and the protoplasm undergoes rapid shape changes

Amphiesma The covering of dinoflagellate cells, which, in addition to an overlying plasma membrane, consists of membranous alveoli that may contain little or no material or may contain cellulosic thecal plates of varying thickness.

Amplified restriction fragment length polymorphism (AFLP) Technique in which PCR is used to amplify only a selected part of the genome to analyze polymorphism in the length of the products.

Androspores Flagellate cells of oedogoniales that settle on body cells near oogonia and undergo a few divisions to produce a dwarf male filament, some cells of which produce and release flagellate sperm.

Aneuploid a. Having more or less than an exact multiple of the haploid number of chromosomes or haploid gene dosage; chromosomal abnormalities that disrupt relative gene dosage, such as deletions.

Aneuploidy State in which the number of chromosomes per cell in an individual or line is not a whole-number multiple of the basic number, but includes one or more fewer than the whole-number value, indicating an incomplete genome. Cells or organisms in this state are known as aneuploids. The term dysploid is also used when the basic number is not definitely known.

Angiogenesis factor General term for endogenous factors that induce the formation of new blood vessels. Found in tissues with high metabolism rates such as tumors and membranes, they are secreted from hypoxic macrophage cells on the edges or surfaces of wounds to induce regeneration of blood vessels as part of the healing process.

Angiogenesis n. Development of new blood vessels by sprouting from preexisting vessels.

Anisogamous reproduction Sexual reproduction involving gametes that are flagellate and structurally distinguishable.

Anisogamous A type of sexual reproduction in which gametes are flagellate and structurally distinguishable

Anisogamy A type of sexual reproduction characterized by two types of gametes that differ in size or behavior.

Ankylosing spondylitis Condition of unknown cause that causes joint stiffening and transformation with degenerative inflammatory symptoms in the vertebrae, shoulder joints, and knee joints.

Anoxygenic photosynthesis A type of photosynthesis that occurs in some prokaryotes in which water is not used as a reductant and oxygen is not released.

Anoxygenic Without production of oxygen; for example, use of hydrogen sulfide rather than water as a source of photosynthetic reductant by some cyanobacteria.

Antibiotic Any of a diverse group of organic compounds produced by microorganisms which selectively inhibit the growth of or kill other microorganisms. Many antibiotics are used therapeutically against bacterial and fungal infections in humans and animals.

Anticodon Group of three consecutive bases in tRNA complementary to a codon in mRNA.

Antifreeze protein Proteins secreted in the bodily fluids of fish and arthropods inhabiting polar regions, which function to lower those fluids' freezing point.

- Antigen** Any substance capable of binding specifically to an antibody or a T-cell receptor. An antigen may be unable to induce a specific immune response when administered on its own, but will do so if attached to a suitable carrier
- Apical growth** Growth that occurs by the division of one or more cells located at the tip (apex) of a multicellular body. Apicomplexans, and dinoflagellates, characterized by membrane sacs known as alveoli at the cell periphery.
- Apicoplast** A non-photosynthetic plastid occurring in the cells of most genera of apicomplexans, a group of parasitic protists that are classified in the Alveolata.
- Aplonospore** A nonflagellate spore that has the genetic potential to produce flagella under appropriate conditions; produced by subdivision of a parental cell.
- Apogamy** Form of parthenogenesis in which sporophytes are formed directly outside of egg cells in higher plants without fertilization.
- Apolipoprotein** Protein component of a lipoprotein especially of the lipoproteins that transport lipids in the blood. Apolipoprotein genes are diverse, resulting in differences in blood lipid levels. Genetic problems are known to result in congenital lipid metabolism irregularities.
- Apospory** A type of apomixis in which a diploid gamete is produced from the sporophyte without spore formation.
- Apospory** Form of parthenogenesis in the broad sense; observed in plants.
- Aromatic compounds** Organic compounds with a benzene ring in their molecule (benzene derivatives).
- Asphaltene** High-molecular weight substance in the non-melting component of asphalt petroleum ether that dissolves in the presence of benzene or carbon disulfide.
- Association** Phenomenon in which two or more of the same kind of molecule form two or more bonds due to intramolecular forces, creating a loose, regular aggregate.
- Astaxanthin** A red carotenoid pigment (3,3'-diketo-4,4'-dihydroxy- β -carotene) produced by some green algae that is commercially useful; also known as haematochrome.
- Attaching repellent compounds** Substances that deter sessile marine organisms from attaching to coral reefs, artificial structures, boat hulls, and fishing nets.
- Aureochrome** A blue-light photoreceptor present in diverse photosynthetic stramenopiles.
- Autocolony** A type of asexual reproductive colony that is a miniature of the adult colony; produced by single cells of the adult.

Autopolyploid Organism having more than two sets of homologous chromosomes; polyploidy in which chromosome sets are all derived from a single species.

Autoradiography Technique by which large molecules, cell components or body organs are radioactively labelled and their image recorded on photographic film, producing an autoradiograph or autoradiogram.

Autoreproduction Ability of a gene, virus, or nucleoprotein molecule to synthesize several molecules similar to itself from smaller molecules within the cell.

Autosome Any chromosome other than sex chromosomes. Sex chromosomes, which differ from autosomes in form, traits, and behavior, are also known as heterochromosomes or allosomes. Genetic phenomena governed by autosomal genes are known as autosomal inheritance, which is distinct from sex-linked inheritance.

Autospore A type of nonflagellate spore that lacks the genetic potential to produce flagella

Autotrophic microorganisms Microorganisms that are capable of growing by synthesizing all of their cellular components through CO₂ reduction; contrasted with heterotrophic organisms, which require organic compounds made by other organisms. This distinction is based on carbon assimilation and differs in definition from lithotrophy, a classification in terms of energy acquisition in which organic matter serves as an electron donor. Autotrophic microorganisms are classified into two types according to their means of energy acquisition. Photoautotrophs, which use light, include *Chlorella* and most algae, along with purple and green sulfur bacteria. Chemoautotrophs obtain energy by oxidizing an electron donor through a chemical dark reaction; based on electron donor type, these include ammonium-oxidizing bacteria (e.g., *Nitrosomonas*), nitrous acid-oxidizing bacteria (*Nitrobacter*), sulfur-oxidizing bacteria, iron-oxidizing bacteria (*Thiobacillus*), and hydrogen bacteria (*Alcaligenes*).

Autotrophy Opposite of heterotrophy. Form of nutrition in which organisms synthesize the organic compounds they need to survive by absorbing carbon dioxide, water, and various inorganic salts without requiring organic matter as a source of nutrients. In photoautotrophs such as green plants, carbon assimilation is performed through photosynthesis. In chemoautotrophs such as chemosynthetic bacteria, it occurs through chemosynthesis. Some seaweed experience strong growth in the presence of organic matter (such as vitamins) as a nutrient source, while many require such a supply.

Auxiliary cell In the higher red algae, a cell into which the zygote nucleus or one of its mitotic progeny is deposited and that generates the carposporophyte generation by mitotic proliferation.

Auxospore A cell produced by diatoms that undergoes enlargement, compensating for the reduction in size that often occurs during population growth; commonly also the zygote of diatoms.

Avirulence gene Gene found in some bacterial plant pathogens that determines their ability to cause disease on a host plant containing a corresponding resistance gene. see gene-for-gene resistance.

Avirulent A strain of bacterium, virus or other potential pathogen that does not cause disease.

Bacterivores Organisms that consume bacteria as prey

Bacterivory The process by which cells ingest and digest bacterial prey

Baeocytes (endospores) Spores of cyanobacteria formed by internal division of vegetative cells (compare with exospores)

Base pair (bp) Single pair of complementary nucleotides from opposite strands of the DNA double helix. The number of base pairs is used as a measure of length of a double-stranded DNA.

Base ratio The ratio of the bases (A+T)/(C+G) in DNA, which varies widely from species to species.

β-carotene An accessory carotenoid pigment lacking oxygen that occurs in major algal groups; the source of provitamin-A.

Binary fission The relatively simple process by which prokaryotic cells divide to form two equal-sized progeny cells.

Bioassay A procedure that uses organisms and their responses to estimate the effects of physical and chemical agents in the environment.

Biodiversity Convention Treaty concluded in June 1992 with the aim of preserving biodiversity. The need to protect biodiversity was first raised at the 14th meeting of the Governing Council for the United Nations Environment Programme (UNEP) in 1987. It was later determined that existing treaties were not adequate as a response, and the decision was made to enact a new convention. While the U.S., Japan, and other nations did sign, issues with detailed provisions in the convention resulting in being effectively postponed. At a meeting of signatory nations in November 1994, a discussion was held on the issues that had led to the postponement. Three of them had a particular impact in terms of bioengineering. One concerned the development of a protocol for biostability. Opinions submitted by developing and Northern European countries requested that a protocol be developed to determine the legal regulation of bio-related areas. While an opposition campaign was led by the U.S., Japan, Canada, Australia, and New Zealand, among others, the balance of support was generally in favor of a protocol. In addition to the possibility of advanced economies demanding new regulations if such a protocol is proposed, it may

also serve as a non-tariff barrier on the export of future bio products. The second issue concerns intellectual property rights in connection with technology transfer. While the provisions mentioned the transferring of technology necessary for diversity preservation, they also included language about respecting intellectual property rights. European countries and the U.S. signed on after declaring their interpretation that technology transfers would not extend as far as disregarding intellectual property rights; other countries refused outright. The focus now is shifting to the question of what kind of technology transfer organization is to be created. The third issue concerns the rights of farmers. This includes the rights of farmers in developing countries who have contributed to the preservation and usage of plant gene resources. Developing countries are demanding an international fund be created to distribute the profits earned by advanced economies. The issue was initially addressed by the Food and Agriculture Organization (FAO), but was later taken up with the Biodiversity Convention. Advanced economies are very likely to face payment obligations.

Biofuel Gas such as methane or liquid fuel such as ethanol (ethyl alcohol) made from organic waste material, usually by microbial action.

Bioinformatics Discipline and methodology involving the use of computers to analyze biological data. This approach uses methods derived from statistics, linguistics, mathematics, chemistry, and biochemistry. It often involves structural data and data on nucleic acid and protein sequences; experimental findings from the data are also analyzed. Some data are taken from patient statistics and scientific papers. Bioinformatics research is focused on storage, searching, and analysis of data.

Biological assay The use of the amount of some substance that is essential or detrimental to organismal functions besides survival and growth as an indicator for said phenomena. It is often convenient to use substances that are effective in terms of growth or expression of functions even in very small amounts (such as vitamins and several other growth factors and hormones) as direct indicators for biological effects, rather than resorting to chemical means.

Biological half-life The number of elements and radioactive isotopes within an organism's tissues and organs decreases as a result of metabolism and excretion. The half-life is the time required for the initial amount of radioactive isotopes to decrease by half through these processes.

Biological pump The process by which some of the organic materials produced by marine phytoplankton are transported to deep ocean sediments, where they remain for thousands of years

Biological soil crust The community of organism including bacteria, cyanobacteria, eukaryotic algae, fungi, lichens, and mosses that covers much of the soil surface in arid and semiarid lands.

- Biological species concept** Distinction of species on the basis of breeding incompatibility.
- Bioluminescence** Production of light by living organisms. It is caused by an enzyme catalysed biochemical reaction in which an inactive precursor is converted into a light-emitting chemical.
- Biomass** Total weight, volume or energy equivalent of organisms in a given area; plant materials and animal wastes used as a source of fuel or other industrial products; (3) in biotechnology, the microbial matter in the system.
- Bioreactor** Device designed to produce substances by taking advantage of enzymes' ability to efficiently regulate highly specific reactions at constant temperature and pressure.
- Bioremediation** Biotechnology-based (i.e., microorganism-based) purification of contaminants in the environment.
- Biphasic alternation of generations** A sexual reproductive cycle that involves two body forms that can be distinguished by chromosome level and type of reproductive cell produced.
- Bipolar** A type of centric diatom having elongate shape (i.e., having two poles).
- Blades** A type of algal body in which cells are arranged in flat sheets
- Blastomere** Any one of the cells formed by the first divisions of a fertilized egg.
- Blunt end** End of a double-stranded DNA molecule that lacks a single strand.
- Blunt-end ligation** Technique used in the construction of recombinant DNAs in which any two DNA molecules may be joined.
- Bootstrap value** An estimate of the validity of a branch in a phylogenetic tree that is determined by the number of times the branch appears after the data are repeatedly resampled.
- Bottleneck effect** This occurs in populations where the number of organs experiences a dramatic decline. An example is the increase in mutations of homozygotes due to inbreeding. A decrease in the size of the population results in a large genetic drift effect, lowering the amount of genetic polymorphism observed in that population.
- Brackish water** Water with a moderate saline concentration between those of seawater and freshwater.
- Branched filaments** A type of algal body in which branches emerge from a main filamentous axis.
- Branches** In algae, rows of cells that extend from a main filamentous axis.

- Branching enzyme** Enzyme that catalyses the transfer of a segment of 1,4- α - β -glucan chain to a primary hydroxyl group in a similar chain, forming a branchpoint in a polysaccharide chain.
- Breeding** Process of utilizing the genetic properties of crops or livestock to produce new species with potential benefits for farming or to improve existing varieties.
- Brine shrimp bioassay** The use of the amount of some substance that is essential or detrimental to organismal functions besides survival and growth as an indicator for said phenomena.
- Broodstock** Mature fish raised or kept for breeding purposes.
- Bud** In plants, structure from which shoot, leaf or flower develops; incipient outgrowth, as limb buds in animal embryo, from which limbs develop.
- Budding** Production of buds; method of asexual reproduction common in sponges, coelenterates and some other invertebrates, in which new individuals develop as outgrowths of the parent organism, and may eventually be set free; artificial vegetative propagation by insertion of a bud within the bark of another plant; cell from the parent cell; release of certain animal viruses from the host cell by their envelopment in a piece of plasma membrane which subsequently pinches off from the cell division by the outgrowth of a new cell.
- Byssus** Tuft of strong filaments secreted by the byssogenous gland of certain bivalve molluscs, by which they become attached to substrate; the stalk of certain fungi.
- CAAT box** Conserved sequence in the promoter region of some eukaryotic genes about 70–80 base pairs upstream from the start-point of transcription, and which is involved in control of initiation of transcription.
- Caccolithophorids** Unicellular members of the haptophyte algae that are characterized by a covering of small, ornate calcium carbonate scales.
- Cachectin** A protein also known as tumour necrosis factor. Its entirely separate role as cachectin involves inhibiting enzymes of lipid utilization, disturbing lipid metabolism and causing cachexia (wasting), as in patients with some cancers.
- Cadherins** One of the main families of cell adhesion molecules. They are cell surface proteins that can bind an identical cadherin molecule on another cell in a calcium dependent interaction, causing cells to bind strongly to each other. The family includes the E-cadherins, N-cadherins, P-cadherins and VE-cadherins.
- Callus** Plant tissue that has undergone a healing process following a wound or infection with a pathogen.
- Canal raphe** A tubelike structure extending longitudinally along the valves of some pennate diatoms that opens externally via the raphe slit.

Captive breeding program The capturing of gravedigger beetles in their natural state to for breeding and re-release into the wild.

Carbon concentrating mechanism (CCM) One of several types of processes that result in increasing the concentration of carbon dioxide in the vicinity of rubisco.

Carbon dioxide fixation the pathway incorporating carbon dioxide into carbohydrates which occurs in the stroma of chloroplasts; any reaction in which carbon dioxide is incorporated into organic compounds.

Carbon fixation Conversion of carbon dioxide into organic carbon as a result of the light-independent reactions of photosynthesis.

Carbon sequestration The burial of calcium carbonate or organic carbon such that these materials are not readily converted back to atmospheric carbon dioxide.

Carpogonium The nonmotile female gamete of red algae.

Carpospores In red algae, the spore released from a carposporangium; usually assumed to be diploid.

Carposporophyte (gonimocarp) A multicellular diploid phase in the life cycle of florideophycean red algae that generates carpospores via gonimoblast filaments; in all cases, attached to the female gametophytic body (i.e., not free living).

Carrageenans Mucilaginous sulfated polygalatans in the cell walls of red algae that are extracted for use as gelling agents in the food industry.

Carrying capacity The number of individual organisms that can be supported with available resources.

Cascade Series of enzymatic reactions in which the activated form of one enzyme catalyses the activation of the next, greatly amplifying the initial response.

Cassette model Description of the DNA rearrangements underlying switching of mating type in the yeast *Saccharomyces cerevisiae*, in which the mating-type locus, MAT, can be occupied by either of two genes (a or α) transposed from sites on either side of the locus.

Cation Positively charged ion which moves towards cathode, or negative pole, e.g. K^+ ,

cDNA library Collection (library) of DNA constituting the entirety of cDNA developed through cloning from cell types or specific organisms.

Cell cycle The period between the formation of a cell as one of the products of cell division and its own subsequent division. During this period all cells undergo replication of the DNA. In eukaryotic cells the cell cycle is divided into phases termed G1, S, G2 and M. G1 is the period immediately after mitosis and cell division, when the newly formed cell is in the diploid state and at which growth takes place. S is the phase of DNA synthesis, and is followed by G2, at which time the cell is in a tetraploid state and further cell growth may take place.

Mitosis (M) follows to restore the diploid state, accompanied by cell division. The interphase of the cell cycle comprises the G1, S and G2 phases.

Cell differentiation Process by which descendants of a shared mother cell obtain and maintain their structural and functional characteristics.

Cell fusion Fusing of two cells from different clones to form a single mixed cell. Cell fusion can be achieved relatively easily through use of dead Sendai virus.

Cell fusion The coming together of two cells to form one cell, not necessarily accompanied by fusion of the two cell nuclei.

Cell plate A planar array of vesicles containing cell wall material that assembles during early cytokinesis and gives rise by centrifugal extension to new cross-walls; present in certain green and brown algae and in land plants (embryophytes).

Cell sorting When groups of differentiated cells from multicellular organisms are artificially scattered and mixed together, different cells separate to form different agglomerations. This is known as cell sorting.

Cell-free system Any mixture of cell components reconstituted *in vitro* in which processes such as translation, transcription and DNA replication can be studied.

Central dogma Hypothesis on the interrelationships among the basic functions of DNA, RNA, and proteins. It holds that DNA serves as a model for its own replication and RNA, while RNA is a model for protein translation. The flow of genetic information thus proceeds from DNA to RNA to proteins.

Chambon's rule Splicing is the series of reactions through which unexpressed portions of RNA molecules created through gene transcription are removed and neighboring expressed sequences are linked together. In such cases, the 5' end of the unexpressed portion is typically a GU, while the 3' end is an AG. This is known as Chambon's rule.

Chimera Organism consisting of cells with two or more different genetic properties or tissues from different animal species.

Chi-square test Testing with the chi-square distribution is used to examine the appropriateness of theoretical and actual values calculated based on a specific hypothesis.

Chloroplast Green organelle found in the cytoplasm of the photosynthetic cells of plants and algae, and in which the reactions of photosynthesis take place. A chloroplast is bounded by a double membrane and contains a system of internal membranes (thylakoids) embedded in the matrix or stroma. The thylakoid membranes contain the green pigment chlorophyll and other pigments involved in light collection, electron-transport chains and ATP synthase, and are the site of the light reactions of photosynthesis in which ATP and NADPH are generated. The dark reactions of photosynthesis, in which carbohydrate is

synthesized, take place in the stroma. A chloroplast also possesses a small DNA genome which specifies rRNAs, tRNAs and some chloroplast proteins.

Chromatic adaptation The ability of algae to modify the amounts or proportions of photosynthetic pigments in relation to changes in the light environment.

Chromatography Method of separating molecules within a mixture by repeatedly distributing molecules between mobile and stationary phases. The mobile phase is a liquid or gas, while the solid phase is a solid or liquid-covered solid. The molecular distribution between the two phases is participated in one or more of four basic processes: adsorption, gel filtration, ion exchange, and distribution. These processes result in differences in molecular movement speed according to the mobile phase's motion and the solid phase.

Chromonema Threadlike chromosomes or chromatids from the cell division stage that are the thinnest structures discernible with an optical microscope.

Chromosome set manipulation Technique for manipulating chromosomes in eukaryotic organisms. In plant breeding, this term refers to polyploid breeding. Chromosome from plants and animals are extracted and introduced into different cells to influence them and improve strains.

Chromosome walking Technique for mapping chromosomes from a collection of overlapping restriction fragments. Starting from a known DNA sequence, the overlapping sequences can be detected in other restriction fragments and a map of a particular area gradually built up.

Chromosome Located within the nuclei of eukaryotic cells, chromosomes consist of one or more large double-stranded chains of DNA molecules. Combining with RNA and histones, these DNA chains carry genes that store and transmit an organism's genetic information.

Chondocyte Cell present in the lacunae of cartilage matrix that serves to synthesize and secrete cartilage matrix.

Cilia Motile hair-like outgrowth present on the surface of many eukaryotic cells, which makes whip-like beating movements. The synchronized beating of cilia propels free living unicells (e.g. protozoans) or, as with stationary cells (e.g. of nasal epithelium), produces a flow of material over the cell surface. A cilium is composed of a central core of microtubules (the axoneme) anchored to the cell by a basal body, the whole enclosed in plasma membrane. In multicellular organisms cilia chiefly occur on epithelial cells lining various internal passages; various other hair-like structures, esp. eyelash.

Ciliata Protozoans that use cilia to move by generating water flow.

Ciliate The informal name for a type of alveolate protist characterized by numerous cilia, presence of two types of nuclei (a larger macronucleus and a smaller micronucleus), and a cell mouth (cytostome).

Cladogram Tree-like diagram showing the evolutionary descent of any group of organisms or set of protein or nucleic acid sequences.

Classic food web An early model of the aquatic food web in which large (> 20 μm) phytoplankton are consumed by zooplankton, and zooplankton are consumed by fish in a simple linear food chain.

Cleavage Eggs are fertilized through the combination of a sperm and an oocyte, creating a multicellular structure. To become a multicellular organism, a fertilized egg must go through numerous processes of cell division. Cleavage refers to the cell division that occurs between fertilization and the gastrulation period during which tissue differentiation takes place in earnest. During cleavage, cells experience division without any growth in size terms; as a result, cells gradually decrease in size as cleavage proceeds.

Clinical trial Testing in which a new pharmaceutical, surgical technique, or medical equipment is applied directly to the body to examine its safety and efficacy.

Clone library A collection of bacterial colonies that in aggregate contains clones of the DNA present in an original sample.

Clone Group of genetically identical individuals or cells derived from a single cell by repeated asexual divisions; DNA clone; animal or plant derived from a single somatic cell or cell nucleus is termed a clone of the individual from which the cell or nucleus came; an apomict strain; to isolate a single cell or DNA molecule, and multiply it.

Cloning vector Specially modified plasmid or phage into which “foreign” genes can be inserted for introduction into bacterial or other cells for multiplication.

Cloning Refers to the entire process of obtaining a pure clone by extracting a DNA fragment from a DNA donor or reverse-transcribing RNA to produce DNA and linking it to a vector to introduce it by some means into a host and produce a body with recombinant DNA.

Closed mitosis (intranuclear mitosis) Mitosis that occurs within an intact nuclear envelope; present in many protists.

Cnida Cell organ found in coelenterates.

Coccioid The morphology of unicellular algae that have cell walls and are often, but not always, spherical in shape.

Codominance Case where alleles present in a heterozygous state produce a different phenotype from that produced by either allele in the homozygous state; case where each of a pair of heterozygous alleles is expressed equally and makes an equal contribution to the phenotype.

Codon Sequence of three neighboring nucleotides carrying the code for a specific amino acid in nucleic acid.

Coliphage Any of a number of viruses that proliferate by infecting *E. coli*. Viruses that infect bacteria are known as bacteriophages or simply “phages,” so a coliphage is a phage that infects *E. coli*. Coliphages are the most widely studied of all phages and have had the greatest variety isolated. Most research on phage proliferation mechanisms and phage genetics uses coliphages.

Colloblast Cell on tentacles and pinnae of ctenophores, which carries small globules of adhesive material.

Colloid Gelatinous substance found in some diseased tissues; heterogeneous material composed of submicroscopic particles of one substance dispersed in another substance.

Colonization Invasion of a new habitat by a species; occupation of bare ground by seedlings.

Colony A group formed by microorganisms in a solid medium. Unable to move about freely in solid media, microorganisms accumulate in fixed positions, resulting in agglomerations of millions of organisms that are observable with the unaided eye.

Colony A type of protist body consisting of a group of cells held together by mucilage or cell wall material.

Community biomass Total weight per unit area of the organisms in a community.

Community well-defined assemblage of plants and/or animals, clearly distinguishable from other such assemblages.

Companion cell (Phloem) Single or double strand of DNA complementary to mRNA that can be synthesized from an mRNA model using reverse transcriptase. Like other DNA polymerases, reverse transcriptase requires a suitable primer. Typically, a poly(A) sequence is present at the 3' end of mRNA in eukaryotes, with oligo(dT) used as a primer for this reaction. In higher organisms, genetic replication typically uses cDNA.

Complementary DNA (cDNA) DNA synthesized *in vitro* on an RNA template by reverse transcriptase.

Complementation test Method of testing whether multiple mutations involved in a single phenotype belong to the same functional unit in a gene.

Conceptacle A cavity that contains the reproductive cells of some algae (particularly coralline red algae and fucalean brown algae).

Conchocelis A filamentous, sporophytic phase in the life cycle of bangialean red algae that produces conchospores in conchosporangia; commonly occurs in shells or other calcareous materials.

Conditional mutation Mutation that only produces an effect under certain conditions, as e.g. of temperature or nutritional status.

- Conformation** Three-dimensional arrangement of atoms in a structure.
- Conjugated double bond** Bond that occurs in alternating sequences of double and single bonds. The π electron in a double bond also binds weakly to a single bond, resulting in a bond with characteristics intermediate between the two.
- Conjugation tube** A connection between cells of mating filaments of zygnematalean algae, formed by dissolution of the ends of modified branches, which allows gametes to make contact.
- Conjugation** Mating of zygnematalean green algae involving nonflagellate gametes.
- Connecting cell (connecting filament, ooblast)** In florideophycean red algae, a cell (often long and filament-like) through which a zygote nucleus is transferred from the fertilized carpogonium to an auxiliary cell.
- Connective tissue** Supporting tissues of the animal body, including bone, cartilage, adipose tissue and the fibrous tissues supporting and connecting internal organs. It is derived from the embryonic mesoderm.
- Consensus sequence** The “ideal” form of a DNA sequence, in which the base present in a given position is the base most often found in comparisons of experimentally determined sequence.
- Consistency index** An estimate of the degree of homoplasy (parallel or convergent evolution) in a phylogeny.
- Control experiment** Form of experiment conducted simultaneously within another experiment to determine the effects on the experimental system from factors other than the subject and to eliminate and observe them. When identifying the effects, influences, and significance of some factor or manipulation for a subject, it is often necessary to conduct a control experiment that is identical for conditions other than the factor or manipulation in question, and to compare the results of the two experiments.
- Convergence** Coordinated movement of eyes when focusing on a near point.
- Copepods** Aquatic crustaceans that feed on larger phytoplankton, protozoa, and the juvenile stages of other aquatic crustaceans.
- Coronal cells** The 5 or 10 cells found at the tips of the tubular cells that form an investment around oogonia of charalean green algae.
- Corresponding plant** Set of closely related plants recognized for a particular region when comparing flora from two or more regions. Corresponding plants exist for every classification unit. At the genus level, for example, *Epimedium* and *Eleocharis* in Asia correspond to *Vancouveria* and *Alethusa* in North America. At the species level, the Chinese tulip tree corresponds to the North American tulip tree. Similar relationships exist for animals, as with the gorilla in Africa and the orangutan in Asia.

Cortex In a fleshy algal body, the layer of cells or tissues lying between the epidermis on the outside and the medulla on the inside.

Cosmid Type of cloning vector consisting of a bacterial plasmid into which the cos sequences of phage lambda have been inserted. This both allows the vector to grow as a plasmid in bacterial cells and enables subsequent purification of vector DNA by packaging into phage particles *in vitro*.

Coupling constant Parameter showing the strength of interactions among particles. When used for natural units, an interaction in which the coupling constant has no length dimension is a Type 1 interaction, while an interaction with a length dimension is a Type 2 interaction.

Crossbreeding One of the most basic method of breeding, which uses hybridization. Offspring may not only exhibit combinations of traits from both parents, but also traits superior to either. Many crops and livestock have been bred through this method, including rice, wheat, silkworms, and chickens. The approach is also used in the breeding of useful microorganisms.

Crossing-over Exchange of genetic material between homologous chromosomes at DNA recombination during meiosis. The structure formed during recombination is called a chiasma or crossover and is visible under the light microscope.

Crown gall Form of plant growth that occurs in many dicotyledons and gymnosperms and a small minority of monocotyledons due to infection by the soil bacterium *Agrobacterium tumefaciens*.

Crustacea, crustaceans Subphylum of arthropods, considered as a class in older classifications. They are mainly aquatic, gill-breathing animals, such as crabs, lobsters and shrimps. The body is divided into a head bearing five pairs of appendages (two pairs of pre-oral sensory feelers and three pairs of post-oral feeding appendages) and a trunk and abdomen bearing a variable number of often biramous appendages which serve as walking legs and gills.

Cryophilic algae Algae found in ice and snow environments.

Cryptogams Plants reproducing by spores, such as the mosses and ferns. The term has also been used for plants without flowers, or without true stems, roots or leaves.

Cryptomonads An informal name for members of the phylum Cryptophyta, most of which contain plastids derived from a red alga and which contain the distinctive xanthophyll pigment alloxanthin.

Cultural inheritance Transmission of particular traits and behaviours from generation to generation by learning rather than by genetic inheritance

Culture collection A reference collection of different species and strains of microorganisms or cultured cells.

Cutting Method of asexual reproduction in which part of a plant (branches, leaves, eyes, roots) is removed, uprooted, and germinated.

Cyanelles (cyanellae) A term used for the blue-green plastids of glaucophyte algae.

Cyanobacteria (chloroxybacteria, blue-green algae, cyanophytes)
Photosynthetic bacteria that perform oxygenic photosynthesis.

Cyanobacteria Major group of photosynthetic Bacteria. Although they are prokaryotic, they have an oxygen-evolving type of photosynthesis resembling that of green plants and contain chlorophyll a and phycobilin pigments. Unicellular, filamentous and colonial types are found. They live in aquatic and terrestrial environments, either free-living or in symbiotic associations, as with fungi in lichens. Some species can fix atmospheric nitrogen. Some cyanobacteria produce toxins which can become a health hazard in conditions where cyanobacterial “algal blooms” appear. Known also as the blue-green algae from their previous classification in the plant kingdom as the Cyanophyta or Cyanophyceae.

Cyanophycean starch Polyglycan granules of glycogen that serve as the carbohydrate storage material of cyanobacterial cells.

Cypris Larva in the zoea stage in cirripedia from the Crustacea subphylum of arthropods. Through nauplius-cypris molting, the organism discards its triangular carapace and forms another carapace similar to a bivalve shell. While molting, it forms six pairs of thoracic appendages, which it uses to swim. The first antenna grows forward outside the cell. Like the legs, it transforms to assume locomotion or search capabilities, but immediately adheres to the bottom. The larva subsequent undergoes cypris-adult molting, rotating its body 180° to become a juvenile organism. The thoracic limbs become the adult’s cirri.

Cystatin Substance that inhibits the functioning of protein-degrading enzymes in a cell.

Cytokine Family of small secretion proteins such as interleukins and interferons that bind to the cell membrane in sensitive cells and promote cell division or differentiation.

Cytology Discipline that involves the study of cells as constituents of organisms. Examines the morphological and functional composition of cells in connection with cell physiology, growth, differentiation, heredity, and evolution.

Cytotoxic T cells T cells that differentiate and proliferate due to antigen sensitization, functioning to damage antigen-specific cells.

Dalton (D, Da, dal) mass unit equal (by definition) to one-twelfth of the mass of a single atom of carbon-12, which is ca. 1.66×10^{-27} kg.

Dead zones Coastal ocean regions that are depleted of oxygen and thus life forms as the result of the decay of large populations of phytoplankton due to ocean eutrophication.

Deletion Mutation involving loss of part of a chromosome, or loss of a base or a stretch of bases in a DNA sequence.

Deletion Structural transformation in which part of a chromosome is lost. Known as a terminal deletion when part of the end of a chromosome is lost and an interstitial deletion when a central portion is lost.

Demospongia Class of sponges (Porifera, q.v.) which often have the body wall strengthened by a tangled mass of spongin fibres (e.g. in the bath sponge *Spongia*). They may have silica spicules, in the form of simple needles or a four-armed spicule whose points describe a tetrahedron, or may have no spicules. They are found on shores, and down to depths of more than 5000 m.

Denaturation Alteration in the structural properties of a macromolecule such as a protein or a nucleic acid, leading to loss of function, as a result of heating, change in pH, irradiation, etc. In most cases denaturation refers to the disruption of noncovalent bonding leading to loss of secondary structure (e.g. unfolding of a protein chain or separation of the two strands of a DNA double helix).

Deoxyribonuclease (DNase) Any of various enzymes that cleave DNA into shorter oligonucleotides or degrade it completely into its constituent deoxyribonucleotides.

Development engineering Development engineering, as opposed to genetic or cell engineering, involves the experimental manipulation of early embryos, chiefly in mammals. Goals of development engineering include firstly explicating various phenomena that occur in animal genesis and differentiation and developing disease model animals to study genetic conditions and growth disorders; and secondly serving a practical role in breeding of useful animals (livestock improvement) or using animals to produce organic substances or develop treatments of genetic conditions in humans. Examples of development engineering techniques include nuclear transplantation, chimera production, and the creation of animals with added genes.

Development In biology, the changes that occur as a multicellular organism develops from a single-celled zygote, from the first cleavage of the fertilized ovum until maturity.

Dialysis Separation of large molecules such as proteins from small molecules and ions by the inability of the larger molecules to pass through a semipermeable membrane.

Diazotrophy The ability to convert diatomic, gaseous N₂, gas into ammonium ion, which can be used by cells to produce amino acids.

Dielectric constant Ratio of relative permittivity showing the relative amount of charge a substance is capable of storing when a magnetic field is supplied.

Dielectric materials are regarded as insulators. When two conductors are separated by a dielectric material, they may exist in a state of electrical stress in the absence of a continuous energy supply from outside the system. The dielectric constant is calculated as ϵ/ϵ^0 , where ϵ is the permittivity when a condenser is filled with isotropic material and ϵ^0 is the permittivity for a condenser in a vacuum. The vacuum here is considered a dielectric substance; for water, the dielectric constant is around 80.

Differentiation (cell) Process by which groups of cells or cell clones acquire specialized functional biochemical or morphological characteristics that were not present before.

Differentiation In a general sense, the increasing specialization of organization of the different parts of an embryo as a multicellular organism develops from the undifferentiated fertilized egg; of cells, the development of cells with specialized structure and function from unspecialized precursor cells.

Diffuse growth A type of growth that does not involve a localized point of cell division.

Dinoflagellate A protist that is usually single celled, characteristically possesses saclike alveoli beneath the cell membrane, swims by means of two distinctive flagella (or, if not motile, produces dinospores having such flagella), and may be photosynthetic or not.

Dinosporin A decay-resistant compound deposited at the surfaces of the cells of some dinoflagellates and their cyst stages that allows fossilization to occur.

Diploid Organisms whose cells (apart from the gametes) have two sets of chromosomes, and therefore two copies of the basic genetic complement of the species. Designated 2n. cf. haploid; a diploid organism or cell.

Disease resistance Property found in plants that do not readily develop diseases when attacked by pathogens.

Displacement loop (D-loop) Loop structure that appears when a complementary single strand of DNA links with part of a double strand of DNA. It may also be seen at the beginning of DNA replication when one side of a double strand becomes transposed with a short newly synthesized single strand of DNA.

Diversity index A measure of the biological diversity (generally the species diversity) within an environment. There are various types of diversity index, which are calculated in various ways from the number of species present and their relative abundance. Such indices can be used to detect ecological changes due e.g. to stress on an environment. cf. biotic index.

DNA fingerprinting Method of ascertaining individual identity, family relationships, etc., by means of DNA analysis. The DNA fingerprint consists

of a pattern of DNA fragments obtained on analysis of certain highly variable repeated DNA sequences within the genome, whose number and arrangement are virtually unique to each individual. DNA fingerprints can be obtained from a tiny quantity of blood, semen or hair, and are widely used in forensic work and also in ecological studies.

DNA hybridization Technique for determining the similarity of two DNAs (or DNA and RNA) by reassociating single strands from each molecule and determining the extent of double-helix formation; general method involving reassociation of complementary DNA or RNA strands, used to identify and isolate particular DNA or RNA molecules from a mixture.

DNA library Collection of cloned DNAs.

DNA microarrays Attachment of DNA on highly arrayed solids in order to investigate ordinary gene expression.

DNA polymerase Enzyme that catalyzes DNA synthesis from deoxyribonucleotide triphosphate using a single or double strand of DNA as a model.

DNA probe Small fragment of radioactively or fluorescently marked single-stranded DNA with the same nucleotide sequence as an area of interest in human DNA.

DNA replication Series of processes whereby parental DNA is actually replicated and passed down to daughter cells during cell proliferation through the synthesis of complementary nucleotide chains using double-stranded DNA from the parent cells as a model (semiconservative replication).

Docosahexaenoic acid Polyunsaturated fatty acid from the omega-3 family with 22 carbon atoms and six double bonds; found chiefly in blue-backed fish.

Dominance frequency In ecology, proportion of samples in which a particular species is predominant.

Dominance Property possessed by some alleles of determining the phenotype when present in one copy in a cell. As one member of a heterozygous pair they mask the effects of the other allele (the recessive allele) to give a phenotype identical to that when the dominant allele is present as two copies. This phenomenon is known as complete dominance. Incomplete dominance is exhibited when the effects of the other allele are not completely masked; the extent to which a particular species predominates in a community and affects other species.

DOPA 3,4-dihydroxyphenylalanine, formed from tyrosine in the adrenal medulla, brain, and sympathetic nerve terminals by the enzyme tyrosine hydroxylase. It is a biosynthetic precursor of noradrenaline, adrenaline and dopamine. Also oxidized by dopa-oxidase to a melanin precursor, e.g. in the basal layers of skin. l-dopa is used in the treatment of Parkinson's disease.

Duchenne muscular dystrophy Muscular disease characterized by progressive atrophy of skeletal muscle and diminished muscular strength.

Economic trait Livestock genetic trait with productive aspects.

Ecosystem Community of different species interdependent on each other, together with their non-living environment, which is relatively self-contained in terms of energy flow, and is distinct from neighbouring communities. Different types of ecosystem are defined by the collection of organisms found within them, e.g. forest, soil, grassland. Continuous ecosystems covering very large areas, such as the northern coniferous forest or the steppe grassland, are known as biomes.

Ecotope A particular kind of habitat within a region; the total relationship of an organism with its environment, being the interaction of niche, habitat and population factors.

Ecotypes Genetic varieties of a species that may show morphological differences or adaptations to different environments.

Efficiency of plating (EOP) Ratio of the number of the number of plaques made when a bacteriophage or other specific host is used as an instruction bacterium to the number of plaques obtained when a standard bacterium is the instruction bacterium.

Eicosapentaenoic acid (EPA) Known by the systematic name 5,8,11,14,17-eicosapentaenoic acid, this is an unsaturated fatty acid with 20 carbon atoms and five double bonds. It has a molecular formula of $C_{20}H_{30}O_2$ and a molecular weight of 302. It is abundant in fish, especially sardines and mackerels.

Electrophoresis Technique for separating molecules such as proteins or nucleic acid fragments on the basis of their net charge and mass, by their differential migration through paper, or through a polyacrylamide or agarose gel (gel electrophoresis) in an electric field

Electroporation Method of gene introduction in which DNA is inserted in a cell that is suspended in DNA solution when a direct current high-voltage pulse is passed through it. The electricity results in a hole being produced in the cell membrane; the DNA molecule is thought to enter the cell simultaneously through electrophoresis. This method can be applied with a wide variety of cells, including those of animals, plants, and microorganisms. It is widely used, since a relatively high rate of efficiency in gene introduction can be obtained when the appropriate conditions are selected.

Embden-Meyerhof pathway Metabolic pathway in which glucose is broken down into glucose-6-phosphate, fructose-1,6-biphosphate, glyceraldehyde-3-phosphate, phosphoenolpyruvate, and finally pyruvic acid. It consists of 10 stages of enzyme reaction is named after two (or three) of the people who contributed to explicating it: G. Embden, O. Meyerhof, J. K. Parnas,

O. H. Warburg, and C. F. Cori. It accounts for a major portion of the metabolic system during glycolysis and alcohol fermentation and is a chief pathway through which sugars are broken down by respiration. The pathway is also used by some bacteria in butyric acid and homolactic fermentation. Several enzymes in the Embden-Meyerhof pathway are distributed within the cell's membrane.

Embedding Method that involves creating a thin tissue fragment to serve as a sample for microscope study.

Embryo transfer Reproductive technology in which very early embryos produced by *in vitro* fertilization or artificial insemination are transferred into a surrogate mother for further development, used in cattle and sheep breeding to produce many more offspring from a prize female than she could produce naturally.

Embryo Multicellular organism from the first cell division of the initial fertilized egg to the ontogenesis process prior to independent survival.

Embryogenesis Process of the development of a new individual and formation of an embryo from a fertilized egg.

Endangered species Plant or animal species threatened with extinction.

Endobionts Organisms living within the body of other organisms (e.g., the dinoflagellates that live inside corals).

Endoliths Microorganisms such as bacteria, cyanobacteria, eukaryotic algae, and lichens that grow inside the pore spaces between mineral grains within porous translucent rocks.

Endoreduplication The process by which the nuclear DNA undergoes repeated rounds of replication without intervening mitotic separation, yielding DNA levels higher than the haploid or diploid state.

Endosymbiosis The condition in which one or more organisms live within the cells or body of a host without causing disease or other conspicuous harmful consequences.

Enhancer DNA region that enhances gene transcription efficiency by promoting the bonding of RNA synthase to promotor genes through protein interactions.

Envelope Certain viruses, layer of lipid and protein surrounding capsid, the lipid being derived from host cell membrane as the virus is discharged from the cell, the protein being virus-encoded. Such viruses are known as enveloped viruses; bacterial envelope.

Environmental genomics A set of procedures that employ phylogenetic information and molecular methods to explore the species diversity of natural microbial communities without first growing the organisms in culture.

Eosinophil Type of white blood cell classed as a granulocyte. It contains granules that stain with the red acidic dye eosin and which contain substances that can

induce inflammation when the granules are secreted by exocytosis. It is involved in destruction of parasites and in inflammatory reactions.

Epibacteria Bacteria that are attached to surfaces, such as the outsides of microalgal cells or macroalgal bodies.

Epibody A layer of cells that forms the outer surface of a coralline red alga.

Epidermal growth factor Cytokine that stimulates the division of epidermal and other cells, and has been used to promote wound healing.

Epidermis Outer layer or layers of the skin, derived from embryonic ectoderm. In vertebrates a non-vascular stratified tissue, often keratinized,

Epilimnion The upper layer of a stratified water body whose waters are warmer in summer (and are typically more oxygen rich) than bottom waters (hypolimnion).

Epimer Three-dimensional isomer with a different arrangement among multiple chiral centers, as seen with the relationship between D-glucose and D-mannose.

Epipelagic Upper warm ocean waters.

Epipelic Living on the surfaces of mud or sand.

Epiphyte An organism that grows on the surfaces plants or algae.

***Escherichia coli* K-12** Line of colon bacilli developed from germs isolated from a recovering diphtheria patient at Stanford University. Appearing as *Escherichia coli* K-12 (λ) F+, it happens to be a lysogenic strain of the phage λ and was later learned to be a male strain with an F factor. It is the most widely used colon bacillus strain, serving as a study resource in molecular genetics and genetic biochemistry.

***Escherichia coli* plasmid** Chromosomal genetic factor in *E. coli*. The F plasmid, which was the first to be discovered, is around 100 kbp in size and functions to truncate multiple genes known as *tra* and different plasmids and chromosomal DNA in other cells (experimentally, this has included *Saccharomyces* yeast other intestinal bacteria besides *E. coli*). This process is similar to the truncation of T-DNA by *Agrobacterium*. Other examples include R plasmids (with resistance to multiple drugs) and colicin factors.

Etching Use of chemicals to corrode the surfaces of metals, ceramics, semiconductors, and other materials.

Etiology Research or theories concerning the factors responsible for disease and the means by which infection occurs, or the discipline concerned with the causes of disease.

Eubacteria The “true” bacteria, unicellular prokaryotic microorganisms possessing cell walls, with cells in the form of rods, cocci or spirilla, many species motile with cells bearing one or more flagella. They are distinguished

from the archaeobacteria by the possession of peptidoglycan cell walls and ester linked lipids. They include the Gracilicutes, and the Firmicutes.

Euendoliths Microorganisms that live under the surface of rocks and actively bore their way through the rock. Several desert lichens are known to be euendoliths, as are certain cyanobacteria found on coral reefs.

Euglenoids Unicellular protists that primarily occur as flagellates having a distinctive surface composed of proteinaceous pellicular strips and a characteristic storage known as paramylon granules; many but not all conduct photosynthesis.

Euglenozoa A protistsupergroup that includes euglenoids and trypanosomes as well as some other protists.

Eukaryote Organism with a nuclear membrane and clearly defined nucleus, as well as organelles enclosed in a membrane, including endoplasmic reticula, a Golgi body, mitochondria, and chloroplasts. Mitosis occurs during cell division and introns are present in genes; distinct from prokaryotes in gene regulation and expression.

Euphotic zone The (upper) portion of the water column that receives enough light for photosynthesis to occur.

Eutrophic aquatic systems Waters that contain relative high levels of nutrients such as phosphate and/or combined nitrogen; typically exhibit high levels of primary productivity.

Eutrophication Phenomenon in which waters transform from a nutrient-poor to a nutrient-rich state.

Evolution The development of new types of living organisms from pre-existing types by the accumulation of genetic differences over long periods of time. It is studied by reference to the fossil record and to the anatomical, physiological and genetical differences between extant organisms. Present-day views on the process of evolution are based largely on the theory of evolution by natural selection formulated by Charles Darwin and Alfred Russel Wallace in the 19th century. Darwin's theory has undergone certain modifications to incorporate the principles of Mendelian genetics, unknown in his day, and the more recent discoveries of molecular biology, but still remains a basic framework of modern biology.

Evolutionarily stable strategy In evolutionary theory, a behaviour pattern or strategy which, if most of the population adopt it, cannot be bettered by any other strategy and will therefore tend to become established by natural selection. Using games theory the results of various different strategies (e.g. in contests between males) can be worked out and a theoretical ESS determined and compared with actual behaviour.

Exclusive Economic Zone Waters for which all sovereign rights are recognized within 200 nautical miles of coastal countries, including exploration, development, and preservation of marine resources, preservation of the marine environment, and scientific research activities.

Exon Block of DNA sequence encoding part of a polypeptide chain (or of tRNA or rRNA), which forms part of the coding sequence of a eukaryotic gene, and which is separated from the next exon by a noncoding region of DNA.

Exospores In cyanobacteria, spores that are cut off from one end of the parental cell. (compare with baeocytes)

Expressed sequence tag (EST) Data based on a cell-derived mRNA model that is developed only once into a base sequence from the end of cDNA synthesized with reverse transcriptase.

Extinction point Minimum level of illumination below which a plant is unable to survive in natural conditions.

Extracellular matrix (ECM) Materials generated by a cell that are secreted from, or produced on, the external surface; includes mucilage, cell walls, and loricas.

Facultative anaerobic bacteria Microorganism that is capable of metabolism by respiration or fermentation and can alternate between the two according to its environment (e.g., lactic acid bacteria, *Escherichia coli*).

Familial adenomatous polyposis (FAP) Autosomal dominant genetic disease in which hundreds to thousands of polyps form in the colon.

Fibronectin Glycoprotein of extracellular matrix, to which animal cells can bind by means of integrins in their plasma membranes. It is involved in interactions of animal cells with extracellular matrix.

Fidelity the degree of limitation of a species to a particular habitat; of DNA replication, transcription and translation, the probability of an error being made during the copying of DNA into DNA or RNA, or during the translation of RNA into protein.

Filter feeding A mode of food collection by herbivores that involves sieving large volumes of water for particles

Fingerprinting In biochemistry, a technique for detecting small differences in amino acid composition/sequence between different proteins by selective cleavage into small peptides which are then separated by electrophoresis in 1st dimension and chromatography in the 2nd dimension resulting in a pattern of peptide spots characteristic for each protein.

Fixation index In population genetics, a measure of genetic differentiation between subpopulations, being the proportionate reduction in average heterozygosity compared with the theoretical heterozygosity if the different subpopulations were a single randomly mating population.

Flagellar transformation A maturation process by which the younger flagella of a parental cell become the older flagella of a progeny cell.

Flagellates Diverse group of unicellular eukaryotic microorganisms, including photosynthetic and non-photosynthetic species, and classified in various schemes as protozoans, protists or algae. They are motile in the adult stage, swimming by means of flagella. They include both free living marine and freshwater species and some important commensals such as those living in the guts of ruminants, and human parasites such as trypanosomes.

Flagellates Unicellular or colonial protists whose cells bear one or more flagella.

Flagellum Long appendage that allows prokaryotes to move in water, or that allows fluids to move through an animal's various tissue surfaces.

Flavobacterium Saprophytic bacterium, chiefly involved in the decomposition of fish and shellfish.

Florideon starch In red algae, a branched α -1,4-linked glucose polymer with some α -1,6 linkages that occurs as granules within the cytoplasm.

Florideophytes An informal name for the members of the red algal class Florideophyceae; characterized by a triphasic reproductive cycle that includes a carposporophyte generation.

Flow cytometer An instrument that uses a laser and detectors to measure the optical properties of cells, such as pigment fluorescence.

Fluctuation Differences that arise among individuals of the same genotype due to changes in somatic cells stemming from incidental environmental influences during the genesis and growth processes.

Follicle cell Single- or multi-layered bubble-shaped epithelial cell found surrounding the exterior of animal tissues. Typical examples include in thyroid follicles and ovarian follicles. Ovarian follicles form a multiple layer of epithelium in mammalian ovaries and a single layer in insects to encircle oocytes. In sea urchins, the egg shell membrane surface is covered in markedly large follicle cells following egg discharge.

Food chain a sequence of organisms within an ecosystem in which each is the food of the next member in the chain. A chain starts with the primary producers, which are photosynthetic organisms (e.g. algae, plants, bacteria) or chemolithotrophic bacteria. These are eaten by herbivores (primary consumers) which are in turn eaten by carnivores (secondary consumers). Small carnivores may be eaten by larger carnivores.

Food quality The extent to which algae are able to provide essential nutrients when consumed as food.

Formulation Manipulation to ensure suitable shape and form to ensure ease of use and application and consistent efficacy when using pharmaceuticals on the human body.

Founder effect Example of genetic drift through which the frequency of a gene in a population varies according to chance or probability. A change in genetic frequencies between two populations that arises when a very small number of organisms break off from an original population to form a new one.

Founder principle Holds that when a small number of organisms become separated from their original population and become isolated founders in a new region, this serves as a factor in species differentiation.

Fucans Also known as fucoidins or ascophyllans, polymers of L-fucose and additional sugars that are sulfated

Fucosan polysaccharides composed of fucose units, found in vesicles (fucosan vesicles) in cells of brown algae where it may be a storage polysaccharides or a waste metabolic product.

Fucoxanthin A xanthophyll pigment that confers golden brown or brown pigmentation to diatoms, chrysophyceans, brown algae, and some other photosynthetic stramenopiles.

Fucoxanthin Brown xanthophyll carotenoid pigment found in brown algae, diatoms and golden-brown algae.

Fusion cell In red algae, (a) generally, a cell resulting from the coalescence of two or more non-gamete cells; (b) specifically, the cell produced by fusion of an auxiliary cell with one or more neighbors.

Gamete Representative cells with haploid genes, i.e., sperm and egg cells.

Gametic meiosis Meiosis occurring during the production of gametes

Gap site Portion of double-stranded DNA where one strand has come away, leaving only the other strand.

Gauss Electrical unit showing the intensity of magnetic induction (CGS unit showing magnetic flux density).

Gelling agent Substance with colloidal properties that exhibits viscosity when added to food and serves as a dispersion stabilizer, adhesion preservative, and coating material.

Gene bank Organization that systematically gathers and preserves genetic resources, including natural species, lines, varieties, wild-type strains, and genetic lines.

Gene expression Translation in the case of transcription and proteins to produce a final genetic product; genes are expressed when a biological product exists and is active.

Gene flow Propagation of genes. Occurs as genes continue to enter one genetic supply from another.

Gene Section of the chromosome that codes for a functional product (RNA or polypeptide resulting from its translation).

Genetic analysis Determination of the number of genes involved in a particular genetic trait, their location on the chromosomes, and their influences on phenotype, among other factors. In a broad sense, this involves physiological and biological analysis of gene function and structure, but it may also refer to analysis of genetic composition in Mendelian groups in a population genetics sense. Genetic analysis is founded on hybridization experiments, which requires the selection of marker genes with clear phenotypic characteristics.

Genetic character Properties determined by a particular gene or group of genes.

Genetic drift Phenomenon in which a gene becomes fixed or lost within a small population.

Genetic load Population genetics index showing the degree of natural selection at the genotype level; quantitatively expands on the concept of a deleterious gene that arises due to mutation becoming a burden on a population due to death or infertility among organisms. It is typically defined as the ratio $(W_{op}-W)/W_{op}$, where W_{op} is the fitness of the optimal phenotype and W is the average fitness of the population. While the definition of load is abstract, it is an important quantity when analyzing genetic changes in a natural population.

Genetic map Diagram showing the relative arrangement and positions of genes on chromosome molecules.

Genicula The uncalcified, flexible regions occurring as joints between calcified, non-flexible regions of the thalli of jointed coralline red algae and some ulvophycean green algae

Genome Project Collaborative international effort to determine the full base sequence of genes and decipher the totality of genetic information.

Genome Totality of chromosomes or genes contained in a gamete.

Genomics Field of molecular biology concerning the study of genome structure and the genetic base sequences that comprise it.

Girdle lamella A flat sheet composed of three thylakoids that extends just under the plastid envelope in some photosynthetic stramenopile algae.

Gland cell In red algae, a specialized cell that serves in secretion or storage

Glaucophytes An informal name for a group of eukaryotic algae capable of producing flagella, which have plastids whose envelope is composed of two membranes and which contain phycobilin pigments in phycobilisomes.

Globular protein Term for any functional protein with a spherical three-dimensional structure, including enzymes, hormones, and antibodies.

Gonidium In *Volvox* and related colonial green algae, an enlarged, nonmotile cell that can generate new (daughter) colonies

Gonimoblast In red algae, one or all of the filaments that bear carpospores (the filaments known in aggregate as the carposporophyte).

Growth hormone Polypeptide produced and secreted by acidophilic cells in the anterior pituitary gland that promote organismal growth.

Gynandrosporous Species of oedogonialean algae that produce androspores on the same filament that produces egg cells.

Gynogenesis Phenomenon in which fertilization occurs only in the female pronucleus for one reason or another, without fusion between male and female pronuclei.

Hair cells In green algae, cells that produce a long, hair like extension.

Haplo Used as a prefix before a symbol indicating a specific chromosome, this refers to organisms in which only one half of a chromosome pair is present in somatic cells.

Haploid Cell or organism with a chromosome number n equaling half the diploid number as a result of meiosis. This situation is also referred to as haploidy. In reference to nuclear phase, this means that only one-half of a chromosome pair is present. During alternation of nuclear phases, a haploid generation is produced when the number of chromosomes is reduced by half by meiosis. Haploid organisms regain diploid status through fertilization. In haploid individuals, only diploids are zygotes, and alternation of generations does not occur. In the parasexual life cycles of some bacteria, diploid cells transform into haploid cells, a phenomenon referred to as haploidization. Organisms are known as haplonts.

Haploid number Indicated with letter n , this refers to number of chromosomes per cell for the haploid generation. This includes the number of chromosomes for gametes. Haploids are cells with a single chromosome number or organisms made up of said cells; in these haploids, haploid generations are present, as well as instances in which the diploid generation's chromosome number is reduced by half as a result of parthenogenesis.

Haploid plant Plant in which the chromosome number has been halved in the life cycle through diploid meiosis. In the vegetative period in higher plants, diploid chromosomes ($2n$) are present in the diploid generation. The ability to easily acquire haploid (n) plants with half a chromosomal set would be useful in the following ways: (1) the ability to obtain pure lines in a short period of time by multiplying the chromosomes of haploid plants; (2) strong viability is pure lines through selection of fatal genes; (3) expression of dominant traits due to the lack of interaction among alleles in haploid plants, and thus greater ease in

identifying genes; (4) potential applications in chromosome engineering; and (5) potential application of allopolyploids in cell genetics. Haploid plants are small in size and highly infertile.

Haploidization Phenomenon that occurs in the parasexual life cycle of some species of bacteria, in which a diploid cell transforms into a haploid cell through the gradual loss of chromosomes without division.

Haploidy Condition in which the chromosome number is reduced by half. Two forms are used, respectively representing the number of chromosomes in gametes and the number of chromosomes for haploids as a form of polyploid. When indicating chromosome number as a series without respect to basic number, whole numbers and haploids are respectively represented as $2n$ and n ; when basic values are used to represent chromosome numbers, the whole number values are shown as $2x$, $3x$, $4x$, and so on, depending on chromosome number, while haploids are shown as x , $2x$, $3x$, $4x$, and so on. Gametes and the number of chromosomes in their generation are described as haploid.

Haplotype Combination of alleles at a series of gene loci on the same chromosome when several genetic loci exist in dense series on a single chromosome. Can be used to distinguish genetic regions.

Hardy-Weinberg principle Principle of population genetics holding that the relative frequency of a genotype under conditions of random hybridization is a multiple of the frequency of alleles involved.

Heat shock protein Protein in which synthesis is induced when a cell, tissue, or organism is at a temperature 5–10 °C higher than its physiological temperature.

Helicase Enzyme needed to separate the forward double strand in a replication fork, as in prokaryotes.

Hepatocyte growth factor (HGF) Growth factor discovered, isolated, and refined for the earliest cultured liver cells. HGF is produced by various cells in the hepatic lobe system, with targets primarily including epithelial cells, neurons, endothelial cells, and some hepatic system cells. Can participate in promoting cell growth, exhibiting cell movement promotion and epithelium formation inducement activity. In development, it serves as a medium for epithelium/hepatic lobe interactions, participating in the formation of the liver, kidneys, lungs, and other internal organs, as well as placenta and the skeletal system.

Heteromorphic alternation of generations A type of sexual reproductive cycle involving two or more multicellular phases, at least two of which are morphologically distinct.

Heteromorphic Morphologically different; in algae, usually applied to distinctive gametophyte and sporophyte phases in sporic life cycles (alternation of generations).

Heteroploid Organism with one or more fewer chromosomes than a whole number multiple. Occurs as result of chromosomes failing to separate or becoming lost during cell division. Organisms are generally sterile. Used for genetic analysis and breeding for special traits.

Heterosis True heterosis occurs when a heterozygote shows stronger survival capabilities than a homozygote. The theory presumes that dominant genes have stronger survival capabilities than recessive ones, such that the first hybrid generation has superior survival capabilities than its parents because it receives different dominant genes from them.

High-performance liquid chromatography (HPLC) Form of chromatography in which improvements in the column's solid state filler and apparatus have enabled high-speed, high-performance separation, allowing for a separation speed around 100 to 1,000 times higher under high pressure.

Holocarp In certain ulvophyceean green seaweeds, conversion of all of a body's cytoplasm into reproductive cells, whose release results in the death of the parental alga.

Homologous chromosomes Chromosomes that bind in meiosis. In fully homologous chromosomes, the same number of identical genes or alleles array in the same sequence; in partially homologous chromosomes, only a portion is homologous.

Homology Property by which the organs of organisms that are being compared in developmental or evolutionary terms may be recognized as having descended from common ancestry. Examples include the pectoral fins in fish, the front legs in amphibians and mammals, and the wings of birds. Features are not necessarily similar in functional terms. May be used similar when comparing nucleic acid and protein structure in terms of molecular evolution. When two or more substances are deemed to have statistically similar structures regardless of function, they are thought to indicate common ancestry and described as homologous.

Homozygosity The possession of identical alleles when several alleles are present at one genetic locus; generally occurs between genetically similar gametes.

Homozygote Refers to a genetic state in which the same allele from among several for a single gene is passed down to offspring from its father and mother.

Host range Range of organisms using a parasitic organisms as a host, including bacteria, viruses, fungi, and other parasites.

Housekeeping gene Gene that codes for a protein essential to general cell functioning and is always expressed structurally. Includes genes that code for enzymes and compositional proteins in universal metabolic pathways, including the glycolytic system.

Huntington's chorea General psychoneural disease accurately recorded in 1872 by the U.S. physician G. Huntington. Autosomal dominant condition that emerges in adults and is clinically characterized by choreic movements, paralysis, and psychological disorders such as schizophrenia-like psychosis or dementia.

Hybridoma In the broad sense, this is a mixed form of cell with tumorlike properties created by artificial fusion of two kinds of cell. Generally refers to plasmocytomas and B cell hybridomas.

Hydrogen bond Unshared bond mediated by hydrogen that forms when a strongly electronegative atom Y (such as fluorine, chlorine, oxygen, or nitrogen) approaches a hydrogen atom possessing a shared bond with another strongly electronegative atom X (same as above), of the type X-H...Y. While the bond energy for the hydrogen bond is around 2–8 kcal, the combined effect of several hydrogen bonds contributes to stability.

Hypolithic algae Algae that grow underneath translucent rocks on the bottom surface where moisture collects.

Hypothalamus Central component of the autonomic nervous system located in the diencephalon of vertebrates. Accelerates, regulates, and integrates numerous physical functions, including secondary growth and development.

Immune globin Antiserum that includes specific antigens or antibodies for antigens.

Impregnation Transportation of a male sperm into a female's body.

In vitro Refers to experiments conducted in acellular systems. In some instances, this includes tissue culturing of cells from multicellular organisms under cell culturing conditions.

In vivo Refers to experiments performed in undamaged organism systems. These are conducted at the cellular level for microorganisms and at the whole-body level in animals.

Inbreeding Breeding between very closely related organisms, as in self-fertilization among plants or sibling mating among animals.

Inbreeding coefficient Value representing the extent of homozygosity among organisms as a result of inbreeding.

Inbreeding depression Phenomenon in which survival capabilities (including size, resistance, and fecundity) are generally diminished due to continued inbreeding over a long period of time.

Induced mutation Artificial inducement of a mutation. Methods include treatment with UV rays or chemicals.

Infectious pancreatic necrosis Acute viral infection that occurs primarily in juveniles of species such as the steelhead trout. Often occurs in juveniles weighing under 1g at the age of around eight weeks, with recorded two-week death rates in excess of 60%.

Infrared spectrophotometer Device in which a solid, liquid, or gaseous sample is separated with a 2.5–25 μm infrared spectroscope, with absorption calculated for each wavelength; the resulting absorption spectra are used for quantitative and qualitative analysis.

Infusion General term for liquids other than blood that are introduced into the blood vessels or under the skin for various purposes. Depending on purpose, they may use electrolyte, amino acid, or sugar solutions, but they are generally designed to have the same osmotic pressure as the blood.

Initiation codon AUG. Codes for the initial amino acid in a polypeptide chain. This initial amino acid is N-formylmethionine in prokaryotic cells and methionine in eukaryotic cells.

Insulin-like growth factor Growth factor with a similar structure to insulin consisting of polypeptides with a molecular weight of 7,500. Its reactions within serum are similar to those of insulin, but two structures have been identified that are not inhibited by insulin antibodies, with the names IGF-I and IGF-II. Both consist of four types of polypeptide chains (A–D), with the A and B chains roughly 45% identical in structure to insulin. In addition to mediating growth hormone activities in chondrocyte proliferation and protein biosynthesis, they exhibit similar physiological functions to insulin.

Integument Pellicle surrounding the ovule; one of the tissues forming the ovule.

Intercalary meristem In kelp brown algae, a region of cell division located between stipe and blade tissues.

Interferon IFN or IF for short. General term for proteins or glycoproteins with antiviral properties induced in animal cells by viruses, double-stranded RNA, or lectin. While they are known for virus inhibition effects not caused by antibodies, they are called interferons because the same effects are exhibited afterwards.

Interferon- γ Interferon produced in T lymphocytes as a result of immune stimuli.

Intergeneric hybrid Hybrid produced from breeding between organisms of two different genera. While comparison with interspecific hybrids may suggest these hybrids would exhibit characteristic traits, hybrids are extremely difficult to produce and often exhibit growth difficulties and severe sterility.

Interleukin (IL) General term for active protein components produced by lymphocytes that influence their own differentiation, growth, or functioning or those of other lymphocytes. They form a complex network in which many liquid factors derived from immune system cells are involved in expression or

regulation of immune response. These factors are known as lymphokines (derived from lymphocytes) or monokines (derived from monocytes or macrophages) and were previously defined purely in terms of their physiological activity. At the same time, the appearance of several different immune activities by the same molecules when purified, isolated, and refined is a major characteristic of these immune system factors. Researchers at an international workshop thus agreed to use the term IL for those factors clearly purified, isolated, and refined as molecules and to identify them sequentially. Over 10 IL molecules have been identified to date, most of them including gene and amino acid primary structure and specific receptors in addition to physiochemical properties.

Intervening sequence Base sequence portion that is not actually translated into mRNA genetic information; mostly found in the base sequences in eukaryote DNA.

Intraspecific Refers to phenomena that arise among members of a species, including competition and cooperation.

Intron Nucleotide sequence within a gene or its transcription product that is not included in the final RNA product of that gene.

Isomorphic alternation of generations A type of sexual cycle in which there are at least two multicellular stages that are morphologically similar.

Isoschizomer Refers to instances in which restriction enzymes isolated and refined from different bacteria have matching recognition sites. Known examples include *Rhodopseudomonas sphaeroides*-derived RSR I as an isoschizomer for *Escherichia coli* RY13-derived *Eco* RI, and *Gluconobacter industrialis*-derived Gin I as an isoschizomer for *Bacillus amyloliquefaciens* H-derived Bam HI.

Isozyme Refers to a sequence of enzymes within the same organism or cell that have protein molecules of different chemical structures but catalyze the same chemical reactions. In these cases, the enzymes have different genes and amino acid composition. Enzymes therefore have different isoelectric points and can be separated using differences in amount of movement through electrophoresis.

Jejunum Rear portion of the mammalian small intestine that connects the duodenum to the ileum.

Juvenile shell Young shell that has begun surviving benthically after a planktonic post-fertilization period.

Knowledge-based industry Industry that involves the use of knowledge to significantly improve products or services or to provide high value-added knowledge services.

Koilocyte Flattened cell that occasionally exhibits heterokaryosis, with holes appearing around the nucleus.

- Label** Radioactive atom introduced into a molecule to allow for easy observation of changes in the metabolism of substances.
- Laminaran (laminarin)** In brown algae and other photosynthetic stramenopiles, a soluble polysaccharide storage product composed of β -1,3-linked glucose *units* together with some branch-producing β -1,6-linkages.
- Landlock type** Phenomenon in which a fish that previously alternated between sea and river environments survives for generations in an inland location due to topographic or environmental changes. Often occurs among salmon, trout, and other fishes that enter rivers to lay eggs.
- Larva** Form of juvenile organism. Among fishes, larvae can be distinguished into yolk-sac larvae, pre-flexion larvae, flexion larvae, and post-flexion larvae.
- Leukocyte** Formed element in the blood that engages in phagocytic action toward germs or foreign substances, exhibiting amoeba-like wandering movement in eukaryotic cells and hematoceles.
- Life cycle** “Life history” refers to the characteristic process of a species from the organism’s genesis to the appearance of second-generation offspring, while “life cycle” refers to the cycle of life from the organism’s reproductive cells to those of the next generation. Processes indicated in the life cycle include alternation of generations, changes in nuclear phase, fertilization, and maturation division (meiosis).
- Ligase** Enzyme that forms a phosphodiester linkage between the 3’ end of one DNA fragment and the 5’ end of another while the fragments are forming base pairs with a model strand.
- Light-dependent reactions** Photosynthetic processes involve the use of light energy to split water and produce ATP and NADPH.
- Light-harvesting complexes (LHCs)** Aggregates of photosynthetic pigments, photoprotective pigments, and pro-teins that function to harvest light during photosynthesis.
- Light-independent reactions** Photosynthetic processes that use ATP and NADPH to transform carbon dioxide into organic compounds.
- Linkage** Phenomenon in which genes governing two or more different traits (non-alleles) are inherited together because they are present on the same chromosome.
- Lipopolysaccharides (LPS)** In general, polysaccharides having attached lipids; specifically, toxins produced by certain bacteria and bloom-forming cyanobacteria that can cause fever and inflammation in humans.
- Lithic algae** Algae that grow in some way in association with rocks or stony substrates such as concrete.

- Litter size** The number of offspring produced per birth. Animals such as cattle and horses were previously known as “single-birth animals” because they typically bear only one offspring at a time, while swine, dogs, cats, and other animals were known as “multiple-birth animals” because they bear multiple offspring at a time.
- Localization** Determination of the site or location of a synchronizer or lesion. Limits the formation of pairs or chiasmata in one part of the chromosome during the pachytene stage.
- Lymphocyte** Blood cell around 6 μm in diameter that is present in the blood, lymph, and lymphatic tissue. Cells are responsible for immune functions, recognizing specific antigens and initiating an immune response by the body or its fluids.
- Lymphoid leukemia** Form of leukemia that occurs in lymphocyte cells within the blood and marrow.
- Macrogametes** Relatively large reproductive cells consisting of female gametes produced from macrogamonts; believed to be female. Fertilization is completed and a zygote formed following fusion with a male gamete. (megagamete, oocarp ↔ microgamete)
- Macrophage** Large lymphocyte with phagocytic functions.
- Magnetic field** Force field operating between magnets, between electric currents, or between magnets and electric currents.
- Magnetic resonance imaging (MRI)** Computerized method in which a type of atomic nucleus is placed in a static field and electromagnetic wave energy is applied at a certain wavelength to generate resonance; the resulting energy emission signals are used to create a cross-sectional image. Whereas X-ray CT scans generally show morphological information, MRI is distinguished by the ability to detect and image chemical and functional changes in tissue.
- Magnetization** Process by which an object placed in a magnetic field becomes a magnet through magnetic induction.
- Marek’s disease virus** Form of herpes virus that causes lymphoma in chickens.
- Marine farm** Facility for the artificial production, management, and cultivation of juvenile marine plants and animals or seedlings.
- Marine snow** Particulate aggregates of algal cells or their remains, fecal pellets, bacteria, and heterotrophic protists, held together by mucilage, that are important in the transformation and transport of organic carbon to deep-ocean sediments.
- Mass doubling time** When a logarithmic phase is maintained through three to five transplants following overnight culturing of a bacterium, the cells double over defined periods of time. The time needed for them to divide is known as the doubling time or generation time. These obviously vary with culturing

conditions, and can be identified with the formula $G = t \log 2 / (\log b - \log a)$, where G is the time taken for one cell to divide into two, a is the initial number of bacteria, and b is the number of bacteria after t minutes. For example, the B/r strain of colon bacillus has a doubling time of 50 minutes, while the *Bacillus subtilis* W23 strain averages 55 minutes; other values include 9.8 minutes for marine *Vibrio* genera and 10 minutes for lactic acid bacteria present in the stomachs of cattle. Yeast has a doubling time of around 60 minutes; for the tuberculosis bacteria, it is six hours.

Mass spectrometer Mass analysis equipment used to separate the ions produced from specimen ionization through their mass/charge ratio.

Matrotrophy The provision of nutrients by cells of the parental generation to cells of the next generation that have been retained on the maternal body.

Medulla Cells or tissues occurring in the center of a fleshy multicellular algal body.

Meiosis Process by which diploid reproductive cells divide into haploid sex cells.

Melanoma Highly malignant tumor that forms in melanin-producing melanocytes and nevocytes (verrucous melanoma cells). Fast-growing and capable of metastasis throughout the body.

Meristem A cell or group of cells that is capable of repeated division and thus adds to the number of cells in a body.

Meroblastic cleavage Form of cleavage in which the blastomere boundaries are incomplete.

Mesoplankton A class of plankton consisting of organisms that are between 0.2 mm and 2 mm in diameter.

Messenger RNA (mRNA) RNA molecule complementary to a single strand of cellular DNA; functions to transport genetic information from the chromosomes to the ribosomes.

Metabolic antagonist Substance that functions antagonistically toward substances involve in an organism's normal metabolism.

Metabolite Any substance produced as a result of metabolism or metabolic processes within the body.

Metabolomics Discipline concerned with the general analysis of the production and transformation of metabolites as a result of protein functions within the body.

Metalimnion The layer of water lying beneath the upper epilimnion that is marked by a steep decline in temperature and increase in density of the water.

Metamerism Form of similarly sized partitions making up an animal's body.

Metaphyton Floating algae that have become detached from substrates where they were attached as periphyton. Metaphyton may make up a significant part of the species diversity of the phytoplankton.

Microbial food web The complex food web consisting of microorganisms less than 20 μm in longest linear dimension and including archaea, bacteria, cyanobacteria, small eukaryotic algae, and small protozoans.

Microbial loop The original term for the microbial food web that recognized the importance of secondary production by archaea and bacteria and their consumption by heterotrophic nanoflagellates and small ciliates to the larger aquatic food web.

Microinjection Method in which a micromanipulator is used to inject tiny amounts of a substance under a microscope.

Microplankton A class of plankton consisting of organisms that are between 20 μm and 200 μm in diameter.

Micropyle Small hole on an egg membrane through which a sperm can penetrate. While micropyles often serve as a passage for the sperm during fertilization, sperm may also pass through the membrane regardless of the micropyles. Sometimes serve as passageways for nutrients during the egg's growth phase.

Microsatellite DNA sequence typically consisting of two to three base pairs repeating roughly 15 to 40 times (indicated as $(CA)_n$ for C and A repeating n times). Commonly found in eukaryotes; in the case of $(CA)_n$, around 5×10^4 and 5×10^5 repetitions are respectively found in humans and mice per haploid gene with the gene's regulatory region or introns. Recently, this sequence has entered wide use as a polymorph DNA marker for gene mapping. This is because polymorphs exhibit a high degree of variation with DNA strand length, allowing for fast and easy polymorph detection with PCR, and since dozens of replications are theoretically present per cM in the genome, it has become possible to draw the detailed maps (1cM maps) needed to label genes per cM. Microsatellites are also used for PCR selection of the yeast artificial chromosomes (YAC) and bacterial artificial chromosomes (BAC) that serve as materials for the physically mapping needed for positional cloning.

Microzooplankton Zooplankton in the size range from 20 μm to 200 μm . Microzooplankton are the main consumers of the microorganisms in the microbial food web.

Minisatellite DNA Form of repeated sequence present in chromosomes. The term refers to small-scale satellite DNA; satellites have long been known to exist as large repeating units in the centromere regions. Minisatellites are even smaller than microsatellites; as an example, a repeating CA sequence is referred to as microsatellite DNA. Microsatellites repeat in units ranging from roughly 10 to 50 base pairs, with total lengths ranging between 2 and 30 kbp. They are characterized by hypervariability, with several alleles effectively present.

Southern blotting using polymorphic minisatellite probes is known as DNA fingerprinting, which is used in identification of individuals and detection of family relationships.

Mixotrophy A form of nutrition in which both autotrophy and heterotrophy may be utilized, depending on the availability of resources. (*see also* phagotrophy)

Molecular barcodes DNA sequences accumulated in online databases that can be used to identify organisms in natural samples.

Molecular biology Discipline concerned with the systematic explication of the structure of organismal molecules and the biological phenomena resulting from their interactions.

Monochromatic radiation The visible light, ultraviolet rays, and X-rays emitted from typical light sources and X-ray generators contain mixtures of various wavelengths. With electromagnetic radiation energy, shorter wavelengths indicate higher energy, which results in changes in physiochemical reactions. Because clear wavelength dependency is present in some reactions, it is advisable to use only a specific wavelength when conducting experiments with electromagnetic radiation. Electromagnetic radiation from one specific wavelength is called monochromatic; visible light and UV rays may be obtained by using filters, prisms, or diffraction grating. Since X-rays cannot be rendered monochromatic with filters, special X-rays and gamma rays with specific wavelengths are used from the outset.

Monoclonal antibody Antibody that reacts to only one antigen determinant. Monoclonal antibodies have been obtained experimentally in test tubes from hybridomas made by fusing antibody-producing cells and myeloma cells.

Monogenea Class of flatworm in the phylum platyhelminthes. Possesses adhesive organisms at the front and back of its body; while it does not have cilia on its epidermis, it does possess tiny villi. It follows a life cycle with a single host and is an external parasite chiefly of fish, although it is found in rare instances as an internal parasite of amphibians and reptiles.

Monogenic Offspring of only one sex. *Drosophila affinis* possesses a line consisting only of males; even when mated with other lines, it produces only males and no females. The line is believed to possess a gene that kills off sperm possessing X chromosomes. In *D. bifasciata*, females that bear only female offspring have been reported.

Monohybrid Hybrid state between different (homo) parents for one pair of alleles only. The hybrid exhibits dominant or intermediate traits, depending on whether the dominance relationship between alleles is complete or incomplete. For the second hybrid generation, the ratios are 3:1 for complete dominance and 1:2:1 for incomplete dominance. = monogenic hybrid

Monophyletic Used to describe a group of organisms that have descended from a single common ancestor.

Morphogenesis Used when structural characteristic of internal tissue are differentiated or when explaining the origins of a particular form.

Morphological species concept The use of structural differences and similarities to distinguish species and classify them.

Multicellularity Composed of multiple adherent cells that have the capacity to communicate with each other and to specialize.

Mutant Organism possessing at least one mutation in its chromosomal DNA. Because mutations that do occur in the DNA cannot be detected unless expressed through changes in the organism's genetic traits, the term typically refers to organisms in which mutations have occurred or the phenotype has changed. Examples of mutated traits include colony forms, antigen structures, biochemical properties such as nutrient demands, drug resistance, and pathogenicity. Mutants can be obtained through natural mutations, but are also produced artificially through the inducement of mutation by various chemical or physical mutagens. They are used as gene labels in the genetic study of microorganisms: although the emergence of pathogenic strains and drug resistance in pathogenic bacteria have frequently resulted in serious problems for research and application. = variant

Mutation frequency The ratio of mutation for a specific trait within a population of cells or organisms (number of mutations/total population). For a cell population, the mutation frequency is determined by three variables. One is mutation rate, or how often mutations arise. Another is mutation emergence time: because mutations happen randomly, it cannot be predicted when or where they will occur. In the case of cell culturing, mutation frequency will increase when mutation occurs early during growth and decrease when it happens toward the end. The third variable is growth rate: mutation frequency changes depending on whether the mutation's growth rate is faster than that of the parent cells.

Mutation lag Phenomenon in which a mutation in a gene is only detected after several generations of cell division.

Mutation load One of the key factors in genetic load, this represents decreased fitness of a population due to a mutation as a value relative to maximum fitness.

Mutation rate Indicates the average frequency of a specific mutation (e.g., his⁻→his⁺) per cell per division (generation), or the likelihood of mutation occurring over the course of a cell's division into two cells.

Mutation Permanent change in genetic material that is passed down to offspring over generations. Mutations can be distinguished into gene mutations and chromosome mutations or irregularities.

- Myeloma** Malignant tumor occurring in the bone marrow due to a malignant mutation in antibody-producing B lymphocytes. Malignant cells enter the bone marrow and destroy tissues there.
- Nanoplankton** A class of plankton consisting of organisms that are between 2 μm and 20 μm in diameter.
- Natural killer cell** Form of lymphocyte found in humans and other animals that recognizes and kills cancer cells.
- Nauplius** Term for the earliest juvenile form hatched from a crustacean egg (e.g., crab, shrimp, or barnacle).
- Nemathocyst** In certain dinoflagellates, a harpoon like ejectile structure that is morphologically distinct from the more common trichocyst.
- New renewable energy** Term referring to energy sources produced through changes to existing fossil fuels or to renewable energy, including sunlight, water, geothermal heat, and biomass.
- Nitrogen fixation** The process by which many cyanobacteria (and some non-photosynthetic bacteria) transform nitrogen gas into ammonia, fixed nitrogen.
- Nitrogenase** In cyanobacteria (and some other bacteria), the holoenzyme that performs nitrogen fixation conversion of diatomic N_2 gas into ammonium ion.
- Node** A site on an algal body from which branches arise.
- Nomadism** Form of collective lifestyle found in mammals. In contrast with a settlement-based lifestyle, it involves traveling from one place to another for daily survival.
- Nuclear magnetic resonance spectrometer** Spectrometer consisting of a magnetic section, an electromagnetic wave emission section, a sample probe wound in transmission and reception coils, and an amplifying recorder.
- Nuclear-associated organelle (NAO)** In red algae, a ringshaped structure that occurs at the spindle poles during cell division.
- Nuclein** Nucleoprotein degradation product intermediate between natural nucleoproteins and nucleic acid. Nucleic acid and base content varies according to nuclein type.
- Nucleomorph** In some algae having plastids of secondary origin (cryptomonads, chlorarachniophytes), a plastid based, double-membrane enclosed structure containing DNA arranged in small chromosomes and other features suggesting origin from a eukaryotic nucleus.
- Null alleles** Alleles that do not result in PCR products due to mutations in their primer section.

- Okadaic acid** A toxin produced by certain dinoflagellates that inhibits serine- and threonine-specific phosphates (which occur widely in eukaryotes); the cause of diarrhetic shellfish poisoning in humans.
- Oligonucleotide probe** A short piece of DNA that specifically binds the ribosomal RNA of particular species.
- Oligosaccharide** Sugar in which 2 to 10 monosaccharide residues are linked in straight or branching chains by glycoside bonds.
- Oligotrophic aquatic systems** Waters that are low in nutrients such as phosphate and combined nitrogen and consequently low in primary productivity and biomass but typically high in species diversity.
- Oligotrophic** Refers to a state lacking the necessary nutrients for the growth of aerobic photosynthetic organisms.
- One gene-one enzyme hypothesis** Hypothesis that single genes influence phenotype by participating in the formation of a single enzyme and governing its characteristics.
- Oogamous** Involving a larger nonmotile egg cell and a smaller motile sperm cell.
- Oogamous reproduction** Sexual reproduction involving egg and sperm.
- Oogomy** Sexual reproduction involving syngamy of a small flagellate male gamete and a larger, nonflagellate (or only transiently flagellate) female gamete.
- Open reading frame (ORF)** Portion of a DNA chain that is transformed into a codon defining a particular amino acid.
- Organelle** Structural unit within eukaryotic cells that performs various functions; akin to the various organs of the body.
- Organotin compound** Organic metal compound consisting of tin with butyl groups attached. Organotin compounds were previously used as PVC polymer stabilizers, plastic additives, industrial catalysts, pesticides, germicides, and wood preservatives. In the 1960s, they were found to be effective antifouling agents, and they are now widely used in anti-fouling paints for vessels and farm fishing gear.
- Osmotic pressure** Pressure that causes water or another solvent to flow from a solution with a low solute concentration to one with a high solute concentration through osmosis. Similar to the hydrostatic pressure that must be used to apply solvent to the more concentrated solution to stop the flow of water or solvent.
- Osmotrophy** A form of nutrition in which dissolved organic carbon is imported from the environment into cells.
- Osteitis fibrosa cystica** Condition that appears with hyperparathyroidism, in which bones undergo fibrous transformation that produces an inflammation reaction. Parathyroid hormones promote the breakdown of calcium from the

bones and its absorption from the gastrointestinal tract, resulting ultimately in higher calcium concentrations in the blood. Due to calcium loss, bones develop holes and bend; cysts sometimes form as well.

Oxygenic photosynthesis Photosynthesis that generates oxygen by breaking water.

Palindrome Section of DNA in which a base sequence has an identical structure when read from left to right or from right to left.

Pallium A sheetlike extension of cytoplasm, also known as a feeding veil, that is produced by some phagotrophic dinoflagellates for the purpose of capturing and digesting prey.

Palmella A stage produced by algae genetically capable of producing flagella consisting of nonmotile cells embedded in an amorphous mucilaginous matrix.

Paraffin compound General term for paraffin wax or liquid paraffin made up of paraffin hydrocarbons or highly saturated hydrocarbons; characterized chiefly by weak reactivity and resistance to chemical medications. Present in heavy oil fractions and used for candles and electrical insulators.

Parasporangium In red algae, a sporangium that produces many spores; not equivalent to a tetrasporangium.

Paraxonemal rod A column of protein that stiffens the hair-covered flagella of euglenids and kinetoplastids.

Parthenogenesis Emergence of an organism from an egg without fertilization. May occur in the natural state or artificially as the result of experimental measures.

Parthenogenesis Production of a new individual from an unfertilized gamete.

Peduncle In dinoflagellates, a microtubule-containing tubular extension of cytoplasm that can be extended attach to prey cells or tissues and either extract their contents or engulf them.

Pelagic Living in open ocean waters rather than near shore coastal or inland waters.

Pellicle (a) In euglenoids, an often flexible, protein containing surface layer consisting of interlocking, helically oriented strips that occurs just inside the cell membrane; (b) in some dinoflagellates, a cellulosic a sporopollenin-containing layer beneath the theca that remains in place when the theca is shed, (c) the surface layers of some other algae.

Peptidoglycan A carbohydrate substance cross-linked peptides that forms much of the cyanobacterial cell wall

Perialgal vacuoles Membrane-bound vacuoles that protect enclosed endosymbionts from digestion within host cells.

Periaxial cells (pericentral cells) In uniaxial red algae cells that are cut off from the main axis that occur in whorl that surrounds the parental axial cell.

Periphyton Organisms that occur on the surfaces of plants, algae, and inorganic substrates in shallow benthic or nearshore littoral habitats.

Periplast In cryptomonads, the cell covering, consisting of intersecting plates lying beneath the cell membrane.

Peroxisome An organelle bound by a single membrane that occurs in the cytoplasm of embryophyte cells and those of some eukaryotic algae and that contains characteristic enzymes such as glycolate oxidase and catalase; this term is also sometimes used more generally as a synonym for microbodies-small single-membrane-bound structures that occur in some algae and contain catalase but not glycolate oxidase.

Phage Short for bacteriophage. Simplest organisms, consisting mostly of proteins and nucleic acid.

Phagocytosis Consumption by leukocytes and other macrophages to eliminate bacteria or other foreign matter.

Phagopod In dinoflagellates, a tubular structure lacking microtubules that can be formed on cells for the purpose of attaching to and extracting the contents of prey cells.

Phagotrophs Organisms that use the process of endocytosis to engulf prokaryotes and/or small algae into cellular digestion structures known as food vacuoles.

Phagotrophy (phagocytosis) A form of nutrition in which particles such as cells are ingested by protists via invagination of the cell surface.

Phenetic Refers to actual expression of genetic traits, in contrast with genotype.

Phenotypic expression Expression and functionalization of traits (phenotypes) from genetically stored information (genotype) at the organismal level, including morphological and biochemical characteristics.

Phosphor dots Small fluorescent particles observed on a CRT screen used for imaging.

Photoautotroph An organism that obtains its organic nutrients by means of photosynthesis; obligate photoautotrophs are restricted to this form of nutrition.

Photosynthetic bacteria General term for prokaryotes that engage in photosynthetic activity to fix carbon with light energy, but differ from plants in not producing oxygen or using water as an electron donor.

Phototaxis Property of moving toward a light source in response to light stimuli. Examples include Pacific sauries, sardines, anchovies, mackerels, squids, and green laver spores.

Phragmoplast In post-mitotic cells of certain green algae and embryophytes, an array of microtubules arranged perpendicularly to the plane of division that, together with coated vesicles and endoplasmic reticulum, is involved with cytokinesis by centrifugal cell plate formation.

Phylogenetic tree A treelike diagram that represents a hypothesis regarding relationships of a group of organisms.

Physiologically active substance Substances in trace amounts with a large influence on an organism's functioning (physiology).

Phytoplankton Floating or swimming microscopic algae.

Picoplankton A class of plankton consisting of organisms such as bacteria and certain small eukaryotic algae that are between 0.2 μm and 2 μm in diameter.

Pili Threadlike structures located on the surfaces of at least some cyanobacteria (and many other Gram-negative bacteria) that are associated with twitching motility exhibited by certain cyanobacteria.

Placebo Substance with no pharmacological effect or slightly similar effects that is administered as a control when testing the effects of a clinic medication. Used to rule out possible psychological effects from medicinal administration.

Planing Cosmetic surgery technique in which an unsightly section of skin is ground down to minimize scar formation and promote epithelial regeneration.

Plankton General term for organisms that survive by floating in seawater, lakes, wetlands, and rivers. They either lack the ability to swim or have only minimal ability, leaving them unable to maintain their position when traveling against a current.

Plankton Microscopic organisms that are suspended or swim in the water column.

Plaque Round, transparent section that emerges over generations after a virus infects a location where cells have attached together to form a plate, killing or dissolving the immediately neighboring cells.

Plasmid Gene that is not part of the cell nucleus; examples include mitochondrial and chloroplast DNA.

Plurilocular sporangium In brown algae, a reproductive structure that is subdivided by cell walls into numerous small chambers (locules), each of which produces a single flagellate cell.

Polar body Small cell emitted during animal meiosis as an egg cell undergoes maturation division into primary and secondary egg cells.

Pollination Attachment of pollen to a stigma. Includes self-pollination, or the transmission of pollen from the same organism or with the same genes from stamen to stigma, and cross-pollination, or pollination with pollen from an organism with different genes.

Polyadenylic acid Adenylic acid sequence generally present at the 3' end of mRNA in eukaryotes.

Polygene Refers to genes in a polygenic system involved in the expression of traits; while individual actions are very weak, multiple individuals act in concert and can be quantitatively measured.

Polymerase chain reaction (PCR) Method for the artificial amplification of genes. In PCR, DNA synthase is used to produce several clones of a DNA fragment all at once, allowing geometric amplification of genes at a particular site to be achieved in a short time with a very small amount of DNA.

Polynucleotide Linear nucleotide sequence connecting the 3' position on one nucleotide sugar to the 5' position and phosphate group on a neighboring nucleotide.

Polyplloid Organism with two or more pairs of genomes.

Polyplloidization Formation of a polyplloid chromosome number.

Polyplloidy Phenomenon in which the number of chromosomes in an organism is a multiple of the number in normal organisms.

Polysome State in which protein synthesis is performed by multiple ribosomes bonded to a single mRNA molecule.

Population genetics Discipline concerned with statistical analysis of genetic change among populations to examine them in connection with species evolution and methods of improving varieties.

Portable plastid hypothesis The idea that secondary red plastids could have originated more than once because they retain a higher proportion of the original primary endosymbiont's genome than do green plastids.

Positional cloning Method of cloning a gene by using information related to its position on the chromosome. When genes from higher plants and animals are being clones, standard gene markers and DNA polymorphs are first used (RFLP, VNTR, CA repeat), and a map of target genes within the vast genome DNA is drawn on the chromosome. Next, a detailed physical map of the area near that genetic locus is drawn. In cases of multiple mutants with irregularities in the target gene (patients with multiple conditions resulting from the same gene), the DNA structure near the target gene is examined for shared changes. Identification of the target gene is made easier when chromosome irregularities are found in deletions or transpositions within the region including the target gene. When a DNA structural change is detected, the full genetic sequence must be compared individually with a known DNA marker to determine the target gene.

Practical salinity units (psu) The number of grams of salt contained in a liter of water. A liter of seawater with 35 grams of salt has 35 practical salinity units.

- Precession** Movement in which the axis of rotation for a rotating body gradually changes direction. Examples include the symmetrical movement of a top, the earth's revolution, and rotational movement in atomic nuclei and molecules. With phenomena resulting from precession, the term nutation is often used to refer to the regular portion and the term precession only for the irregular portion. In Larmor precession, nutation exclusively occurs.
- Predators** Organisms that attack and feed on other organisms, which are killed and consumed. For example, adult copepods are predators on protozoa and the juvenile stages of other aquatic crustaceans.
- Primary endosymbiosis** Incorporation of a free-living prokaryote into a host eukaryotic cell, with subsequent transformation into an organelle.
- Primer** Large molecule that initiates the synthesis of other large molecules in polymerization. Polynucleotide chain that serves as the starting point for the polynucleotide chain expansion in nucleic acid synthesis reactions. Possesses shared bonds with the reaction product.
- Probe** Marker fragment of nucleic acid with a complementary nucleotide sequence to the gene or gene sequence to be detected in hybrid formation experiments.
- Prokaryote** Organism that possesses no nuclear membrane within cells and lacks mitochondria, chloroplasts, endoplasmic reticulum, and organelles surrounded by a Golgi body membrane. Photosynthesis and oxidative phosphorylation reactions occur in the cell membrane.
- Promoter** DNA region that specifically bonds with RNA synthase to initiate transcription. Basic size is around 60 base pairs in *E. coli* promoters. Different promoter types may include site with a transcription promotion factor, which differs from one promoter to the next.
- Proteomics** Discipline examining the interactions of all proteins within the cell.
- Proteomics** The study of types and relative amounts of proteins produced by a cell or other defined structure under defined conditions.
- Protoplast** Constituent of all cells, not including the cell wall. Refers to protoplasm surrounded by a cell membrane; in animals cells without cell walls, the cell itself is a protoplast.
- Protozoa** Terms for multicellular eukaryote observable only under a microscope.
- Pseudopod** Organelle involved in the locomotion of amoeboid cells; general term for temporarily formed protoplasm protuberances.
- Pure line** Line in which all genes are homo. A pure line has no genetic mutations; any mutations between organisms in a pure line is believed to be the result of environmental influences.

Pyrenoid A proteinaceous region in the plastids of many types of algae; known in some cases to contain rubisco and commonly associated with formation of storage compounds.

Quantitative character Quantitatively expressed characteristic (such as yield) found in organisms exhibiting continuous mutation.

Radial centric diatoms Fossil and modern diatoms having radially symmetrical valves of more or less circular outline.

Radial cleavage Form of cleavage found in animals in which blasts form radiating arrangements with respect to the egg axis. In cleavage, vertical cleavage (the meridional cleavage plane) is divided into 180°, 90°, and 45° types according to the partitioning of the mutual angle with the cleavage plane as it passes through the cleavage axis. In this case, the entire horizontal cleavage plane forms a perpendicular with the cleavage axis. Eggs exhibiting this can be found in sponges, coelenterates (cnidarians), echinoderms, protochordates, and amphibians.

Radioallergosorbent test (RAST) Blood testing method in which the presence of allergy-inducing factors is determined by the value of immunoglobulin E antibodies for a specific allergy antigen. In this approach, the specificity of a patient's IgE antibody is determined from the coefficient when an IgE antibody that generates a reaginic allergy is made to react with an allergen adsorbed to a solid phase, and a 125I-marked anti-IgE antibody is further made to react with the IgE antibody. Serological diagnostic method for determining allergens in a patient.

Rate-limiting factor Limiting factor that controls the rate of reaction for an entire system. Include a series of enzyme reactions; when the rate of the whole is determined by the slowness of a reaction phase due to a specific enzyme, that stage is considered the rate-limiting stage and the enzyme the rate-limiting factor. In organism reaction series, changes in the rate-limiting stage occur according to conditions, forming part of the regulation mechanism.

Recombination of genes Field of genetic engineering. In contrast with previous genetic recombination methods involving crossbreeding, it refers to the generation of activity by using micromanipulation to introduce genes from a different species or genus of organism (or artificially synthesized genes) into an organism.

Red algae The informal term for a lineage of algae lacking flagella and centrioles, whose plastids have an envelope consisting of two membranes and contain phycobilin accessory pigments.

Refractory carbon A form of organic carbon that is resistant to microbial, chemical, and physical degradation.

Repeated sequence Existence of an identical or very similar base sequence two or more times on a chromosome.

Replication origin Specific region of the chromosome where DNA replication is initiated. In eukaryotes and prokaryotes alike, chromosome replication occurs only once at a specific time in the cell cycle, and the time and frequency of replication initiation is strictly regulated by the replication origin and the interactions of the protein complexes operating on it.

Replication Self-copying of genetic material. In biosynthesis of genetic material, a single parent molecule serves as a model to create two offspring molecules with identical structure and function. This occurs as a result of semiconservative replication.

Resin Noncrystalline solid or semisolid made up of organic compounds and their derivatives. Divided into natural resins and synthetic resins (plastics), the latter of which are further subdivided into those produced at the time of petroleum refinement and those resulting from synthesis of pure monomers.

Respiratory syncytial virus (RSV) Member of the *Pneumovirus* genus in the family Paramyxoviridae. Containing a negative single strand of genetic material, it causes respiratory infection in children.

Restriction enzyme Endonuclease that recognizes double-stranded DNA and specific base sequences and truncates double-stranded DNA. Categorized into Types I, II, and III according to the factor demands for enzyme activity and the form of truncation. Found widely among bacteria, restriction enzymes come in a great variety of types, differing from species to species in enzyme types and sequences recognized.

Restriction fragment length polymorphism (RFLP) Each species has its own characteristic base sequence of chromosomal DNA. Close observation shows slight differences between individuals of the same species, which is known as DNA polymorphism. Due to differences in the lengths of fragments produced when these DNA polymorphs appear at restriction fragment recognition sites, they can easily be detected through Southern blotting; this is known as restriction fragment length polymorphism.

Retinoblastoma Malignant tumor that occurs in the retina; chiefly affects retinoblasts.

Reverse transcriptase Enzyme contained in the particles of various retroviruses, which synthesizes a complementary DNA nucleotide sequence using single-stranded RNA as a model.

Rhizaria A eukaryotic supergroup that includes the algae known as chlorarachniophytes as well as many types of non-photosynthetic protists.

- Rotifers** Aquatic animals characterized by a ring of cilia at their anterior ends. Rotifers mainly employ filter feeding to graze on algae and other microorganisms, but some practice raptorial feeding.
- Sarcoma** General term for malignant tumors that occur in non-epithelial tissues (typically not including bone marrow lymph tissues), which serve as supporting tissues for organisms.
- Scytonemin** An indole-alkaloid that may color cyanobacterial sheaths yellow or brown and protects cyanobacterial cells from UV radiation.
- Secondary endosymbiosis** The incorporation of a photosynthetic eukaryote, whose plastid was derived from a prokaryote, into a eukaryotic host cell.
- Segregative cell division** In siphonocladalean green algae, cleavage of the multinucleate protoplast into spherical units that then expand, develop walls, and function as independent regions.
- Selenious acid** Chemical formula H_2SeO_3 . Colorless, moisture-absorbing crystals forming hexagonal columns; toxic alkaloid agent that is more weakly acidic than selenic acid. Used as an oxidizing agent.
- Self-fertilization** Fertilization within sperm and egg that occurs within an animal possessing both male and female characteristics. Property of hermaphroditic plants that survive through self-fertilization and are incapable of producing offspring.
- Semicell** Portion of Desmidiaceae somatic cells, in which two semicells are separated by a constricted section and pupilla and joined by a narrow isthmus with a nucleus. Characteristics in genus and species classification include several protuberances and differentiated shapes on its surface.
- Semiconservative replication** Refers to double strand of DNA formed through replication, consisting of one strand from the synthesis parent cell and one newly synthesized strand.
- Serratia marcescens*** Intestinal bacteria from the genus *Serratia*. Gram-negative, mesophilic aerobic bacterium that produces an insoluble red pigment in artificial medium and foods.
- Sex chromosome** In organisms that differentiate between male and female, these chromosomes exhibit sex-based differences in form and number for the same autosomes in males and females.
- Sexual reproduction** Form of reproduction in which two gametes combine or are fertilized into a zygote. Zygotes grow into new organisms or produce asexual reproduction cells.
- Sheath** A layer of polysaccharide mucilage on the body of an alga, particularly filamentous cyanobacteria.

Shuttle vector Complex plasmid produced to allow for replication in any part of two types of cells, even when their form of DNA replication differs.

Simian virus 40 (Simian vacuolating virus 40) SSV or SiSV for short. RNA virus isolated in 1971 from naturally occurring tumors in the woolly monkey. Fibrosarcomas form in monkeys within around one month of infection, and fibroblasts undergo transformation in culturing systems. Growth-defective virus that requires another virus to achieve growth. The virus genome consists of around 5,300 bases, with the roughly 1,000-base cancer-causing gene *sis* near the 3' end. The only example among primates of an RNA tumor virus with a cancer-causing gene.

Single nucleotide polymorphism (SNP) The human genome consists of some 3 billion base pairs. Individual comparison shows differences in 0.01% of the base sequence, which account for racial and other individual differences, as well as diseases.

Single-cell culture Aseptic culturing method used not only with unicellular organisms such as yeasts and bacteria, but also with single cells extracted from multicellular organisms.

Siphonaceous coenocytes Algal bodies characterized by relatively large, multinucleate cells lacking cross-walls except during the formation of reproductive structures.

smRNA RNA generally consisting of 200 or fewer bases. Term is typically used in connection with eukaryotes, although it is often used to exclude tRNA and rRNA. A portion is known to be involved in RNA editing.

Somatic cell division Biological phenomenon in which a single cell divides into two, increasing the number of cells.

Somatic cells In volvoclean green algae, body cells that are not capable of cell division.

Southern blotting Method in which radioactively labeled DNA or RNA probes are used to detect complementary base sequences in mixtures of DNA restriction enzyme fragments.

Specific growth rate Growth rate of a cell population by cell or unit cell quantity; calculated as $(1/x)(dx/dt)$. T = time, x = cell number or quantity.

Spectrophotometer Device that measures the intensity of light at different wavelengths. Consists of a component for splitting into monochromatic light and a component for quantitatively measuring the intensity of that light; mainly used to calculate reflectivity and transmission.

Spermatia The male gametes of red algae; no flagella are present.

Spindle fiber Thin, threadlike cell organelle that emerges from either end of the cell during division. Attaches to the chromosome's centromere to pull the chromosome toward either side.

Splicing Process occurring in the primary RNA transcription product of genes, which include introns containing no genetic information. The intron sections are removed, leaving only the exons that contain genetic information, which are linked together into mRNA for translation into a single polypeptide chain.

Spore In algae, a reproductive spore that may or may not be produced via meiosis; in land plants, cells generated by meiosis that become coated with sporopollenin.

Stabilizer Substance added when storing food to prevent chemical or physical transformation. Included as a way of maintaining product longevity, appearance, or effectiveness.

Standing crop Total number of surviving organisms in a specific population at a given time.

Sticky end DNA end section in which a few bases from the end of DNA molecules or fragments are linked into a single chain, forming a complementary base sequence to the chain formed by bases at the end of a molecule with a different base sequence. Also referred to as a complementary end or cohesive end.

Stratification Formation of a surface layer of warm water over deeper, cold water as a result of density differences that develop during warm-season heating.

Subaerial algae Algae that grow on the surfaces of substrates, where they are exposed to the atmosphere and sunlight.

Subunit Basic component in which proteins are joined by several basic unshared bonds to express some biological function.

Surfactant Substance that adsorbs to the surface in a watery solution and reduces its surface tension. Typically a substance that is amphiphilic at both ends, including an oleophilic and hydrophilic group on the same molecule.

Synapsis Phenomenon in which homologous chromosomes join during meiosis.

Termination codons Three codons that signal the end of a polypeptide chain in protein synthesis (UAA, UAG, and UGA).

Terpene Organic compound found in several plants, consisting of a multiple of five carbons ($5n$, where $n \geq 2$). In biosynthesis terms, a substance derived from a precursors consisting of n isoprenes or isopentanes.

Tetraploid Polyploid organism with four times the basic number of chromosomes.

Textile printing Method of applying beautiful color images to fabric and other textiles; a form of mass production of pattern dyes.

Thelytoky Form of parthenogenesis in insects in which only females are produced.

- Thermotropic liquid crystal** When a substance of unitary composition that typically exists in crystalline state at low or room temperature is slowly heated, it dissolves into a turbid, viscous liquid; when heated further, it becomes a transparent liquid. These may be classified into different types based on the molecular arrangement exhibited in the liquid crystal state with changes in temperature: nematic (threadlike form in which the major axis of a long molecule extends in a particular direction), smetic (form in which long molecules with their major axis extending in specific directions combine to form sheets, which are overlaid in layers), cholesteric (liquid crystal in which the molecules rotate in a spiral shape), and columns.
- Thylakoid** A flattened, saclike membranous structure in cyanobacterial cells and plastids of eukaryotic algae and plants.
- Tissue culture** Culturing of cells from a multicellular organism in liquid medium.
- Toluidine blue** Aminodimethyl aminotoluphenazthionium chloride; useful as a dye to detect substances that are basophilic and metachromatic.
- Toxins** Chemicals from biological sources that kill or disable cells or organisms.
- Trabecula** In some ulvophyceyan green algae, an extension of the cell wall into the cell lumen, which provides structural support.
- Transcription** Enzymatic reaction in which genetic information included on a single DNA strand determines a complementary mRNA base sequence.
- Transduction** The transfer of genes among prokaryotes via viruses.
- Transferrin** Beta-globulin with a molecular weight of roughly 75,000. Iron-transporting protein that bonds with iron (III) ions from two molecules absorbed in serum, using transferrin receptors to supply the cell with the iron needed for growth and hemoglobin production.
- Transformation** Phenomenon in which DNA taken from a cell or virus is introduced into another cell to alter its genetic properties.
- Transgenic fish** Fish that has acquired new functions or phenotypic characteristics through transplantation of foreign genes into its chromosomes.
- Transit peptides** Amino acid sequences at the ends of proteins that foster protein uptake into cell organelles.
- Transition region (transition zone)** In eukaryotic flagella, the zone between the flagellum and its basal body, at the point where the flagellum exits the cell; the specific structure of this region varies among major algal lineages.
- Translation** Process in which genetic information contained in an mRNA molecule determines the amino acid sequence in protein synthesis.
- Transposon** Transferred factor; carries label genes such as those for drug resistance, which can often be found in the chromosomes or plasmids of

prokaryotes. Transposons are separated genetic units characterized by the ability to move from one cell to another, resulting in rearrangement of DNA in the recipient cell; this allows for insertion into various locations in plasmids and chromosomal DNA.

Trichogyne In red algae and some charophycean green algae, the elongated apical portion of the female gamete (carpogonium or oogonium) that is receptive to male gametes.

Trichothallic growth In some brown algae, active cell division occurring in an intercalary position, in a stack of short cells located at the base of filaments.

Triplet Genetic code consisting of three consecutive bases corresponding to an amino acid.

Triploid Cell or organism with three times the basic number of chromosomes. Containing three homologous chromosomes, it is represented as $3n$ and is a form of polyploid created through crossbreeding of a diploid and tetraploid. Sterility often occurs in triploids due to irregularities in chromosome separation during meiosis.

Trophic cascade A chain of effects that proceeds from one level in a food web to another. An increase in phytoplankton, for example, may cause an increase in grazing zooplankton and a further increase in planktivorous fish.

Type 1 diabetes mellitus (IDDM) Diabetes is a metabolic disease in which insulin is insufficiently secreted or does not perform its normal functions. It is characterized by high blood sugar as concentrations of glucose rise in the blood. This high blood sugar results in various symptoms; glucose is excreted in the urine. Diabetes exists in Types I and II; Type I is also known as juvenile diabetes and results from a failure to produce insulin at all.

Unialgal culture A culture that contains only one algal species, though other types of organisms, such as bacteria, may be present.

Unicell A protist body type consisting of a single cell.

Unilocular sporangium In brown algae, a sporangium in which all the spores are produced within a single compartment, usually by meiosis.

Variable number tandem repeats (VNTR) Form of genetic analysis inspired by the fact that DNA base sequences in the chromosome have defined structures of repetition. Takes advantage of the differences in the lengths of amplified DNA fragments resulting from differences in the number of repeated units in the VNTR and STR components of a particular section of DNA.

Vascularization Vascularization mechanisms are divided into the formation of plexuses through the fusion of hematopoietic cell groups created by angioblasts and the formation of tubes, and the formation of blood vessels as vascular

endothelial cells bud from existing vessels to enter tissue as capillaries; the term is generally used to refer to the latter.

Vector Small DNA molecule with autonomous growth capabilities that is used in DNA recombination experiments to connect and amplify donor DNA fragments truncated by restriction enzymes.

Vegetative cells Non-reproductive cells.

Vegetative propagation Form of reproduction in which part of a parent frond breaks away to form a new body; sometimes used to refer to reproduction where no particular reproductive structure is formed.

Velum Flat wing-shaped organ found in veliger larvae of mollusks, with long, stiff cilia extending to the right and left from the back of the mouth.

Viscosity A measure of the stickiness or adhesive property of a fluid. Viscosity is measured as the mass in kilograms of a substance that will flow 1 meter in 1 second. Water is more viscous at lower temperatures than at higher temperatures.

Warburg-Dickens pathway Metabolic pathway that begins with glucose-6-phosphate molecules and involves complete oxidation into one molecule of glucose-6-phosphate, carbon dioxide, water, and phosphoric acid. This pathway is involved in carbon dioxide fixing in photosynthesis, creating reduction potential with the NADPH type for interconversion of monosaccharides.

Wild strain Normal form of a lineage that is found in the natural state.

Xanthophylls Oxygen-containing, yellow-pigmented carotenoids.

X-ray diffraction Pattern of light and darkness that occurs when X-rays are reflected from the molecules of a crystal; caused by refraction phenomena due to wave nature.

Zoospore A flagellate spore.

Zoospore Form of spore involved in asexual reproduction. Possesses flagella that allow it to achieve locomotion in water; in seaweeds and lower bacteria, zoospores result from asexual reproduction of zoosporangia.

Zygotic meiosis Meiosis occurring during zygote maturation or germination

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