

GLOSSARY OF BIOTECHNOLOGY TERMS

Alpha helix: A common protein structure, found especially in hair, wool, fingernails, and animal horns, characterized by a single, spiral chain of amino acids stabilized by hydrogen bonds.

Amino acids: The most basic building blocks of all life. Amino acids are molecules that contain both amino and carboxylic acid functional groups.

Antigen: Usually a protein found on the surface of the virus that stimulates the immune response, especially the production of antibodies.

Biobased products: Fuels, chemicals, building materials, electric power, or heat produced from biological materials. The term may include any energy, commercial, or industrial products, other than food or feed, that utilize biological material or renewable domestic agricultural (plant, animal, and marine) or forestry materials.

Bioinformatics: The use of applied mathematics, informatics, statistics, and computer science to study biological systems. Major research areas include sequence alignment, gene finding, genome assembly, protein structure alignment, protein structure prediction, prediction of gene expression, and protein-protein interactions.

Biopesticides: Certain types of pesticides derived from such natural materials as animals, plants, bacteria, and certain minerals. For example, canola oil and baking soda are considered biopesticides.

Biotechnology: A set of biological techniques developed through basic research and applied to research and product development. Biotechnology refers to the use of recombinant DNA, cell fusion, and new bioprocessing techniques.

Biotechnology-derived: The use of molecular biology and/or recombinant DNA technology, or in vitro gene transfer, to develop products or to impart specific capabilities in plants or other living organisms.

Bt corn: A maize plant that has been developed through biotechnology so that the plant tissues express a protein that is toxic to some insects but nontoxic to humans and other mammals.

Cell: The basic structural and functional unit of all organisms. Cells contain DNA and many other elements to enable the cell to function.

Cellulase: An enzyme complex that breaks down cellulose to beta-glucose. It is produced mainly by symbiotic bacteria in the ruminating chambers of herbivores. Aside from ruminants, most animals (including humans) do not produce cellulase and are therefore unable to use most of the energy contained in plant material.

Chromosomes: The self-replicating genetic structure of cells containing the cellular DNA. Humans have 23 pairs of chromosomes.

Collagen: The main protein of connective tissue and the most abundant protein in mammals. It is the main component of ligaments and tendons.

Cry1A: A protein derived from the bacterium *Bacillus thuringiensis* that is toxic to some insects when ingested. This bacterium occurs widely in nature and has been used for decades as an insecticide, although it constitutes less than two percent of the overall insecticides used.

Cultivar: In botany, a plant that has been created or selected intentionally and maintained through cultivation.

Double helix: The twisted-ladder shape that two linear strands of DNA assume when complementary nucleotides on opposing strands bond together.

DNA (deoxyribonucleic acid): The genetic material of all cells and many viruses; the molecule that encodes genetic information. DNA is a double-stranded molecule held together by weak bonds between base pairs of nucleotides. The four nucleotides in DNA contain the bases adenine (A), guanine (G), cytosine (C), and thymine (T). In

nature, base pairs form only between A and T and between G and C; thus the base sequence of each single strand can be deduced from that of its partner.

Gene: The fundamental physical and functional unit of heredity. A gene is an ordered sequence of nucleotides located in a particular position on a particular chromosome that encodes a specific functional product such as a protein or an RNA molecule.

Gene expression: The process by which a gene's information is converted into the structures and functions of a cell.

Gene expression profiling: A method of monitoring expression of thousands of genes simultaneously on a glass slide called a microarray.

Gene flow: The transfer of genes from one population to another of the same species, as by migration or the dispersal of seeds and pollen.

Gene mapping: The process of determining where genes are located on individual chromosomes.

Gene splicing: The isolation of a gene from one organism, and then the introduction of that gene into another organism using techniques of biotechnology.

Gene therapy: An experimental medical technique that relies on the insertion of genes into an individual's cells and tissues to treat a disease. Typically, a defective gene is replaced by a normally functioning one. The normal gene is delivered to target tissues in most cases by an adenovirus that has been genetically altered to render it harmless.

Gene transfer: A common technique in molecular biology that refers to a genetic change brought about by taking up and recombining DNA.

Genetic engineering: The technique of removing, modifying, or adding genes to a DNA molecule in order to change the information it contains. By changing this information, genetic engineering changes the type or amount of proteins an organism is capable of producing, thus enabling it to make new substances or perform new functions.

Genetically modified organism (GMO): Often, the label GMO and the term "transgenic" are used to refer to organisms that have acquired novel genes from other organisms by laboratory gene transfer methods.

Genetics: The study of the patterns of inheritance of specific traits.

Genome: All the genetic material in the chromosomes of a particular organism.

Germline: The line (sequence) of germ cells that have genetic material that may be passed to a child.

Herbicide-tolerant crop: Crop plants that have been developed to survive application(s) of one or more commercially available herbicides by the incorporation of certain gene(s) via biotechnology methods such as genetic engineering, or via traditional breeding methods such as natural, chemical, or radiation mutation.

Hybrid: Seed or plant produced as the result of controlled cross-pollination as opposed to seed produced as the result of natural pollination. Hybrid seeds are selected to have higher quality traits (for example, yield or pest tolerance).

Membrane protein: A protein molecule that is attached to or associated with the membrane of a cell.

Microbial pesticides: Pesticides that consist of a microorganism, for example, a bacterium, fungus, virus, or protozoan, as the active ingredient. Microbial pesticides can control many different kinds of pests, although each separate active ingredient is relatively specific to its target pest or pests. For example, some fungi control certain weeds, and other fungi kill specific insects. The most widely used microbial pesticides are subspecies and strains of *Bacillus thuringiensis*, or Bt.

Molecular machine: An assemblage of a discrete number of molecular components designed to achieve a specific function. Each molecular component performs a single act, while the entire supramolecular structure performs a more complex function that results from the cooperation of the various molecular components.

Molecular self-assembly: The assembly of molecules without guidance or management from an outside source. Self-assembly can occur spontaneously in nature,

for example in cells (such as the self-assembly of the lipid bilayer membrane) and other biological systems, as well as in human engineered systems. Many biological systems use self-assembly to assemble various molecules and structures. Imitating these strategies and creating novel molecules with the ability to self-assemble into supramolecular assemblies is an important technique in nanotechnology.

Monoclonal antibody: An antibody that is mass produced in the laboratory from a single clone and that recognizes only one antigen. Monoclonal antibodies are typically made by fusing a normally short-lived, antibody-producing B cell to a fast-growing cell, such as a cancer cell. The resulting hybrid cell, or hybridoma, multiplies rapidly, creating a clone that produces large quantities of the antibody.

Mutation: Any inheritable change in DNA sequence.

Nanomedicine: A rapidly moving scientific field in which scientists are developing a wide variety of nanoparticles and nanodevices, scarcely a millionth of an inch in diameter, to improve detection of cancer, boost immune responses, repair damaged tissue, and thwart atherosclerosis. Earlier in 2005, the U.S. Food and Drug Administration approved a nanoparticle bound to the cancer drug Taxol for treatment of advanced breast cancer. Another nanoparticle is being tested in heart patients in the United States as a way to keep their heart arteries open following angioplasty.

Nanometer: One billionth of a meter.

Nanotechnology: Systems for transforming matter, energy, and information that are based on nanometer-scale components with precisely defined molecular features. Also, techniques that produce or measure features less than 100 nanometers in size.

Natural selection: The concept developed by Charles Darwin that genes that produce characteristics that are more favorable in a particular environment will be more abundant in the next generation.

Nucleotide: A cellular constituent that is one of the building blocks of ribonucleic acids (RNA) and deoxyribonucleic acid (DNA). In biological systems, nucleotides are linked by enzymes in order to make long, chainlike polynucleotides of defined sequence.

Pathogen: An agent that causes disease, especially a living microorganism such as a bacterium or fungus.

Peptide: Fragments of a protein, from two or more amino acids in a chain, much like beaded chain bracelets. When animal meat proteins are digested, they break down first into peptides and then into their amino acid constituents.

Pesticide resistance: A genetic change in response to selection by a pesticide resulting in the development of strains capable of surviving a dose lethal to a majority of individuals in a normal population. Resistance may develop in insects, weeds, and pathogens.

Plant-incorporated protectants (PIPs): Formerly referred to as plant pesticides, substances that act like pesticides that are produced and used by a plant to protect it from pests such as insects, viruses, and fungi.

Pollen: The cells that carry the male DNA of a seed plant.

Polymerase chain reaction (PCR): A technique for copying and amplifying the complementary strands of a target DNA molecule. It is an in vitro method that greatly amplifies, or makes millions of copies of, DNA sequences that otherwise could not be detected or studied.

Protein: A large molecule composed of one or more chains of amino acids in a specific order. The order is determined by the base sequence of nucleotides in the gene that codes for the protein. Proteins are required for the structure, function, and regulation of the body's cells, tissues, and organs, and each protein has unique functions. Examples are hormones, enzymes, and antibodies.

Proteomics: The use of technologies such as mass spectrometry to detect protein biomarkers in the blood that may indicate early signs of disease, even before symptoms appear. One such marker is C-reactive protein, an indicator of inflammatory changes in blood vessel walls that presage atherosclerosis.

Recombinant DNA molecules (rDNA): A combination of DNA molecules of different origin that are joined using recombinant DNA technologies.

Recombinant DNA technology: A procedure used to join together DNA segments in a cell-free system (an environment outside a cell or organism). Under appropriate conditions, a recombinant DNA molecule can enter a cell and replicate there, either autonomously or after it has become integrated into a cellular chromosome.

Recombination: The process by which progeny derive a combination of genes different from that of either parent.

Resistance management: Strategies that can be employed to delay the onset of resistance. For insect resistance management, this includes the use of a “refuge” in which the insect will not be challenged by the pesticide used in the rest of the field.

Selective breeding: Making deliberate crosses or matings of organisms so that the offspring will have a desired characteristic derived from one of the parents.

Single nucleotide polymorphisms (SNPs): Relationships between genes and probing populations for variations in the genetic code that may increase one’s risk for a particular disease or determine one’s response to a given medication.

Splicing: See Gene splicing.

Stem cell: A “generic” cell that can make exact copies of itself indefinitely. In addition, a stem cell has the ability to produce specialized cells for various tissues in the body, such as heart muscle, brain tissue, and liver tissue. Scientists are able to maintain stem cells forever, developing them into specialized cells as needed. There are two basic types of stem cells. The first type is the embryonic stem cell, which is obtained from either aborted fetuses or fertilized eggs that are left over from in vitro fertilization. Embryonic stem cells are useful for medical and research purposes because they can produce cells for almost every tissue in the body. The second type is the adult stem cell, which is not as versatile for research purposes because it is specific to certain cell types, such as blood, intestines, skin, and muscle.

Tissue culture: A process of growing a plant in the laboratory from cells rather than seeds. This technique is used in traditional plant breeding, as well as when using techniques of agricultural biotechnology.

Traditional breeding: The modification of plants and animals through selective breeding. Practices used in traditional plant breeding may include aspects of biotechnology such as tissue culture and mutation breeding.

Transgenic: Containing genes altered by insertion of DNA from an unrelated organism; taking genes from one species and inserting them into another species in order to get a certain trait expressed in the offspring.

Variety: Subdivision of a species for taxonomic classification. Used interchangeably with the term “cultivar” to denote a group of individuals that is distinct genetically from other groups of individuals in the species. An agricultural variety is a group of similar plants that, by structural features and performance, can be identified from other varieties within the same species.

Virus: A noncellular biological entity that can reproduce only within a host cell. Viruses consist of nucleic acid covered by protein; some animal viruses are also surrounded by a membrane. Inside the infected cell, the virus uses the synthetic capability of the host to produce a progeny virus. ■

Sources: *Agricultural Biotechnology: Informing the Dialogue*. Cornell University College of Agriculture and Life Sciences: Ithaca, NY. 2003; *McGraw-Hill Dictionary of Scientific and Technical Terms*. 6th ed. New York and Chicago: McGraw-Hill, 2002; Nill, Kimball R. *Glossary of Biotechnology Terms*. 3rd ed. Boca Raton, FL: CRC Press, 2002; *Wikipedia* at <http://en.wikipedia.org/>; *The McGraw-Hill Encyclopedia of Science & Technology Online* at <http://www.accessscience.com/> Encyclopedia.