

The following glossary explains technical terms and abbreviations used in the reports compiled for the OECD Bioeconomy project and those found in the source documents cited in the reports. It is based on the following sources:

<http://biotechterms.org/>

<http://www.ncbiotech.org/biotech101/glossary.cfm>

<http://stemcells.nih.gov/info/glossary.asp>

<http://www.agen.ufl.edu/~foodsaf/wi008.html>

<http://members.tripod.com/~bioremediation/>

http://www.europabio.org/bi_glossary.htm

<http://filebox.vt.edu/cals/cses/chagedor/glossary.html>

http://www.fao.org/documents/show_cdr.asp?url_file=/DOCREP/003/X3910E/X3910E00.htm

The magazine *Science* has a guide to online biotech and medical dictionaries and glossaries here (focusing on genetics and genomics):

<http://www.sciencemag.org/feature/plus/sfg/education/glossaries.shtml>

A

Abiotic stress

Outside (nonliving) factors which can cause harmful effects to plants, such as soil conditions, drought, extreme temperatures.

Abzyme

See *Catalytic antibody*.

Acidophilus milk

Milk seeded with living *Lactobacillus acidophilus* bacteria used to improve the balance of beneficial bacteria in the intestines of the person who drinks the milk.

Adaptive radiation

The evolution of new species or subspecies to fill unoccupied ecological niches.

Adult stem cell

An undifferentiated cell found in a differentiated tissue that can renew itself and (with certain limitations) differentiate to yield all the specialized cell types of the tissue from which it originated.

Aerobe.

A microorganism that grows in the presence of oxygen. See *Anaerobe*.

Agarose gel electrophoresis

A matrix composed of a highly purified form of agar that is used to separate larger DNA and RNA molecules ranging 20,000 nucleotides. See *Electrophoresis*.

Agrobacterium tumefaciens

A common soil bacterium that causes crown gall disease by transferring some of its DNA to the plant host. Scientists alter *Agrobacterium* so that it no longer causes the disease but is still able to transfer DNA. They then use this altered *Agrobacterium* to ferry desirable genes into plants.

Agroterrorism

The deliberate act of a person or group against the agricultural industry and/or food supply system, which could include the use of chemical or biological weapons.

Alleles

Alternate forms of a gene or DNA sequence, which occur on either of two homologous chromosomes in a diploid organism. See *DNA polymorphism*.

Alternative mRNA splicing

The inclusion or exclusion of different exons to form different mRNA transcripts. See *RNA*.

Amino acid

The fundamental building blocks of a protein molecule. A protein is composed of a chain of hundreds or thousands of amino acids. Our bodies can synthesize most of the amino acids. However, eight amino acids (called "essential amino acids") must be obtained from food.

Ampicillin (beta-lactamase)

An antibiotic derived from penicillin that prevents bacterial growth by interfering with cell wall synthesis.

Amplify (DNA)

To increase the number of copies of a DNA sequence: in vivo by inserting into a cloning vector that replicates within a host cell; in vitro by polymerase chain reaction (PCR).

Anaerobe

An organism that grows in the absence of oxygen. See *Aerobe*.

Anneal

The pairing of complementary DNA or RNA sequences, via hydrogen bonding, to form a double-stranded polynucleotide. Most often used to describe the binding of a short primer or probe.

Antibiotic resistance

The ability of a microorganism to produce a protein that disables an antibiotic or prevents transport of the antibiotic into the cell.

Antibiotics

A class of natural and synthetic compounds that inhibit the growth of or kill other microorganisms. See *Antibiotic resistance*, *Bacteriocide*, *Bacteriostat*.

Antibody

An immunoglobulin protein produced by B-lymphocytes of the immune system that binds to a specific antigen molecule. See *Monoclonal antibodies*, *Polyclonal antibodies*.

Anticodon

A nucleotide base triplet in a transfer RNA molecule that pairs with a complementary base triplet, or codon, in a messenger RNA molecule. See *Codon*, *Messenger RNA*, *RNA*.

Antigen

Any foreign substance, such as a virus, bacterium, or protein, that elicits an immune response by stimulating the production of antibodies. See *Antigenic determinant*, *Antigenic switching*.

Antigenic determinant

A surface feature of a microorganism or macromolecule, such as a glycoprotein, that elicits an immune response.

Antigenic switching

The altering of a microorganism's surface antigens through genetic rearrangement, to elude detection by the host's immune system.

Antimicrobial agent

Any chemical or biological agent that harms the growth of microorganisms.

Anti-oncogene

See *Recessive oncogene*.

Antisense

Way to turn off a gene by putting a "reverse version" or "mirror image" version of the gene into a cell, thereby blocking protein production. See *Marker gene*.

Antisense RNA

A complementary RNA sequence that binds to a naturally occurring (sense) mRNA molecule, thus blocking its translation. See *RNA*.

Apoptosis

A form of programmed cell death, characterized by maintenance of intact cell membranes during the “cell suicide” process to allow adjacent cells to engulf the dying cell so that it does not release its contents and trigger a local inflammatory reaction. An example of apoptosis is the formation of digits by the death of soft tissue during development, e.g. to form the fingers of the human hand.

Asexual reproduction

Nonsexual means of reproduction which can include grafting and budding.

Asian Flu (H2N2)

Influenzas are identified by the type of haemagglutinin (H1 – H15), which is an antigenic glycoprotein found on the surface of the virus and responsible for binding the virus to the host cell, and neuraminidase (N1 – N9), which is an antigenic glycoprotein enzyme found on the surface of the virus. A virulent type of influenza, H2N2 was first identified in China in late February 1957, the Asian flu spread to the United States by June 1957 where it caused about 70,000 deaths. After 1968, H2 flu disappeared, but was maintained in laboratories for research purposes. Between October 2004 and February 2005, the College of American Pathologists (CAP), a professional body which sends unidentified samples of various germs to laboratories for identification, accidentally released test kits containing H2N2 all over the world and efforts are underway to destroy all the samples.

Asilomar Conference

In 1973 after the successful attempt to recombine DNA from one organism with that of another, a group of scientists called for a self-imposed moratorium on certain types of recombinant DNA experiments due to potential risks. Despite no evidence of harm, many scientists complied with the ban and research in the area stagnated. In 1975, a conference at the Asilomar Conference Center brought together 150 scientists from 13 countries, along with attorneys, government officials and members of the press. It was charged to determine whether or not to lift the moratorium and if so to set up strict guidelines under which research could continue safely. Ultimately, the conference produced a set of voluntary guidelines monitoring recombinant DNA experiments.

Assay

Technique for measuring a biological response; a test; a method for determining the presence or quantity of a component.

Astrocyte

One of the large neuroglia cells of neural tissues.

The Australia Group

The Australia Group is a group of 38 countries that have a common commitment to combating the proliferation of chemical and biological weapons. The participating countries are suppliers and trans-shippers of chemicals, biological agents and technology that could be used in chemical and biological

weapons programs. The group was formed by 15 countries in 1985 to address the spread of chemical weapons and ensure that their industries were not, either deliberately or inadvertently, assisting other states to acquire and use such weapons. Growing evidence of diversion of dual use materials to biological weapons programs led the countries concerned to take steps in 1990 to address the spread of biological weapons. The Australia Group maintains Common Control Lists, including a list of dual use biological equipment, biological agents, plant pathogens and animal pathogens, which serve as standard reference lists internationally.

Autosom

A chromosome that is not involved in sex determination.

Avian Flu (H5N1)

Influenzas are identified by the type of haemagglutinin (H1 – H15), which is an antigenic glycoprotein found on the surface of the virus and are responsible for binding the virus to the host cell, and neuraminidase (N1 – N9), which is an antigenic glycoprotein enzyme found on the surface of the virus. Because it is generally known to infect birds H5N1 is also known as “bird flu”. This type of influenza usually does not affect humans, but in 1997 the first case of transmission from a bird to a human occurred during an outbreak in poultry in Hong Kong . The virus caused severe respiratory illness in 18 people, 6 of whom died. Since this initial outbreak, human H5N1 infections have been seen in Thailand , Vietnam , and Cambodia during outbreaks in the poultry population.

B

B lymphocytes (B cells)

A type of cell that produces antibodies.

Bacillus

Singular for a rod-shaped bacterium (plural, bacilli). Also used as the name of a genus of bacteria, including the species *Bacillus thuringiensis*. See *Bacillus thuringiensis (Bt)*.

Bacillus thuringiensis (Bt)

Bacterium that produces a protein called Bt toxin, a biological insecticide. Bt toxin is used to control insect pests by dusting the crop with Bt bacteria. When ingested, Bt toxin kills certain insect larvae, but is regarded as harmless to humans, pets and most beneficial insects such as bees. Inserting a copy of the Bt gene into plants enables them to produce Bt toxin protein. Such plants can resist some insect pests. See *Biological control, Microbial insecticide*.

Backcross

Crossing an organism with one of its parent organisms.

Bacteria

One of the two prokaryotic (meaning that the cell has no nuclear membrane and hence no separate nucleus) domains of living things.

Bacteriocide

A class of antibiotics that kills bacterial cells.

Bacteriophage (phage or phage particle)

A virus that infects bacteria. Altered forms are used as vectors for cloning DNA.

Bacteriostat

A class of antibiotics that prevents growth of bacterial cells.

Bacterium Class of single-cell organisms without a distinct nucleus (plural, bacteria)

One member, *E. coli*, is commonly used in recombinant DNA technology for producing proteins and other chemicals.

Base

On the DNA molecule, one of the four chemical units that are linked in a series to make a strand of DNA. The four DNA bases are: adenine (A), cytosine (C), guanine (G), and thymine (T). In RNA, uracil (U) substitutes for thymine. See *DNA finger printing*, *Nucleotide*.

Base pair (bp)

A pair of complementary nitrogenous bases in a DNA molecule (adenine-thymine and guanine-cytosine). Also, the unit of measurement for DNA sequences.

beta-DNA

The normal form of DNA found in biological systems, which exists as a right-handed helix.

beta-Lactamase

Ampicillin resistance gene. See *Selectable marker*.

Bioassay

A method of determining the effect of a compound by quantifying its effect on living organisms or their component parts.

Bioaugmentation

Increasing the activity of bacteria that decompose pollutants; a technique used in bioremediation.

Biocatalyst

An enzyme that activates or speeds up a chemical reaction.

Biodiversity

The wide diversity and interrelatedness of earth organisms based on genetic and environmental factors.

Bioenrichment

Adding nutrients or oxygen to increase microbial breakdown of pollutants.

Bioethics

The study of the ethical and moral implications of new biological discoveries, biomedical advances, and their applications as in the fields of genetic engineering and drug research. It considers all living organisms and the environment, from the level of the individual to the biosphere.

Biofilms

See *Microbial mats*.

Biological control (biocontrol)

Managing pest populations by purposefully manipulating beneficial natural enemies - predatory or parasitic insects that kill pest insects, or microbes that cause insect diseases. See *Bacillus thuringiensis* (*Bt*).

Biological Resource Centre (BRC)

Service providers and repositories of the living cells, genomes of organisms, and information relating to heredity and the functions of biological systems. BRCs contain collections of culturable organisms, cells and tissues, as well as databases containing molecular, physiological and structural information relevant to these collections and related bioinformatics. Click [here](#) for more information on the OECD's work on the BRC.

Biological molecules

Large, complex molecules, such as proteins, nucleic acids, lipids and carbohydrates, that are produced only by living organisms. Biological molecules are often referred to as macromolecules or biopolymers.

Biological Warfare

The wartime use of biological weapons.

Biological Weapon

The weaponisation of pathogens, parts of them, or their toxins. This may involve modifying the environmental viability of the organism, its dispersal characteristics, its infectivity etc.

Biological Weapons Convention (BWC)

The Convention on the Prohibition of the Development, Production and Stockpiling of Bacteriological (Biological) and Toxin Weapons and on their Destruction (referred to as the Biological Weapons Convention, BWC) was the first multilateral disarmament treaty banning the production and use of an entire category of weapons. It was the result of prolonged efforts by the international community to establish a new instrument that would supplement the 1925 Geneva Protocol. Opened for signature on April 10, 1972, it entered into force March 26, 1975 when 22 governments had finalized their instruments of ratification. It commits the 153 states that are party to it to prohibit national development, production, and stockpiling of biological and toxin weapons and to act to ensure that citizens of those countries likewise do not engage in these activities. However, the absence of any formal verification regime to monitor compliance has limited the effectiveness of the Convention. A protracted process of negotiation to add these missing elements began in the 1990s. Click [here](#) for the BWC website.

Biologics

Agents, such as vaccines, that give immunity to diseases or harmful biotic stresses.

Biomass

The total dry weight of all organisms in a particular sample, population, or area.

Bioprocessing

A technique in which microorganisms, living cells, or their components are used to produce a desired end product.

Biopulping

Experimental way of using a fungus to pretreat wood chips before making paper pulp. Biopulping reduces both energy use and water-polluting by-products.

Bioreactor

A container used for bioprocessing.

Bioremediation

Using organisms, usually microorganisms, to remove toxins from soil, air or groundwater. See *Bioaugmentation*, *Bioenrichment*.

Biosafety Levels I – IV

The combination of containment practices (i.e. - laboratory practices and techniques, safety equipment, and facility design) required for a certain type of biological research. There are four levels of biosafety, where biosafety level I is the least stringent and biosafety level IV the most stringent.

Biosafety

The safe handling practices, procedures and proper use of containment facilities to prevent accidental harm caused by living organisms either directly or indirectly to individuals within laboratories or to the environment.

Biosecurity

Measures to protect against the malicious use of pathogens, parts of them, or their toxins in direct or indirect acts against humans, livestock or crops.

Biosensor technology

The use of cells or biological molecules in an electronic system to detect specific substances. Consists of a biological sensing agent coupled with a microelectronic circuit.

Biosynthesis

Production of a chemical by a living organism.

Biotechnology

The application of science and technology to living organisms as well as parts, products and models thereof, to alter living or non-living materials for the production of knowledge, goods and services.

Bioterrorism

The malicious use by terrorists of pathogens, parts of them, or their toxins in direct or indirect acts against humans, livestock or crops.

Biotic stress

Living organisms which can harm plants, such as viruses, fungi, and bacteria, and harmful insects. See *Abiotic stress*.

Blastocoel

The cavity in the blastula of the developing embryo.

Blastocyst

A preimplantation embryo of about 150 cells. The blastocyst consists of a sphere made up of an outer layer of cells (the trophoblast), a fluid-filled cavity (the blastocoel), and a cluster of cells on the interior (the inner cell mass).

Bone marrow stromal cells

A stem cell found in bone marrow that generates bone, cartilage, fat, and fibrous connective tissue.

Bovine growth hormone/bovine somatotropin (BGH/BST)

Two names for one protein hormone produced in the pituitary gland of cattle. BGH/BST can also be produced by inserting a copy of the gene for BGH/BST into laboratory bacteria. Such recombinant BGH/BST is also referred to as rBGH/rBST. Purified from pituitary glands or from bacterial cultures,

BGH/BST injected into dairy cows can increase milk production up to 20 percent. Compare to porcine somatotropin (PST).

bP

See *Base pair*.

Bt

See *Bacillus thuringiensis*.

C

Callus

A cluster of undifferentiated plant cells that have the capacity to regenerate a whole plant in some species.

Capsid

See *Coat protein*.

Carcinogen

A substance that induces cancer.

Carcinoma

A malignant tumor derived from epithelial tissue, which forms the skin and outer cell layers of internal organs.

Catalyst

A substance that promotes a chemical reaction by lowering the activation energy of a chemical reaction, but which itself remains unaltered at the end of the reaction. See *Catalytic antibody*, *Catalytic RNA*.

Catalytic antibody (abzyme)

An antibody selected for its ability to catalyze a chemical reaction by binding to and stabilizing the transition state intermediate.

Catalytic RNA (ribozyme)

A natural or synthetic RNA molecule that cuts an RNA substrate.

Cation

A positively charged ion.

cDNA

DNA synthesized from an RNA template using reverse transcriptase.

cDNA library

A library composed of complementary copies of cellular mRNAs. See *Library*.

Cell

Smallest unit of living matter able to grow and reproduce independently. Cells contain DNA for storing information, ribosomes for making proteins, and mechanisms for converting energy.

Cell culture

A technique for growing cells *in vitro* (under laboratory conditions on an artificial medium) for experimental research.

Cell division

Method by which a single cell divides to create two cells. This continuous process allows a population of cells to increase in number or maintain its numbers.

Cell fusion

The formation of a hybrid cell produced by fusing two different cells.

Cell-based therapies

Treatment in which stem cells are induced to differentiate into the specific cell type required to repair damaged or depleted adult cell populations or tissues.

Cellular oncogene (proto-oncogene)

A normal gene that when mutated or improperly expressed contributes to the development of cancer. See *Oncogene*.

Centers of origin

Location where the oldest cultivation of a particular crop has been identified.

Central dogma

Francis Crick's seminal concept that in nature genetic information generally flows from DNA to RNA to protein.

Centrifugation

Separating molecules by size or density using centrifugal forces generated by a spinning rotor. G forces of several hundred thousand times gravity are generated in ultracentrifugation. See *Density gradient centrifugation*.

Centromere

The central portion of the chromosome to which the spindle fibers attach during mitotic and meiotic division.

Characterize

Describe the distinguishing traits.

Chloramphenicol

An antibiotic that interferes with protein synthesis.

Chloroplasts

The light absorbing structures found in plant cells which give them their green colour.

Chromatid

Each of the two daughter strands of a duplicated chromosome joined at the centromere during mitosis and meiosis.

Chromosome

One or more microscopic rod-shaped elements in the nucleus of a cell that contain genetic information for that cell. Chromosomes are composed of a single DNA molecule and protein. Each chromosome contains numerous genes. Chromosomes occur in pairs: one obtained from the mother; the other from the father. Chromosomes of different pairs are often visibly different from each other.

Chromosome walking

Working from a flanking DNA marker, overlapping clones are successively identified that span a chromosomal region of interest. See *Chromosome*.

Chymosin

Enzyme, also called rennet, used in making cheese. Chymosin can be extracted from the stomach of veal calves, or from genetically engineered bacteria that have the gene for chymosin.

Cistron

A DNA sequence that codes for a specific polypeptide; a gene. See *DNA*, *Gene*.

Clinical Trials

A rigorously controlled scientific test to answer specific question about the effectiveness and safety of a therapeutic agent (such as a drug or vaccine) using consenting human subjects. Clinical trials are normally performed before the agent is made available for general clinical use and after achieving promising results from laboratory and animal studies.

Clone

A cell, collection of cells or organism containing identical genetic material. Clones are produced from a single parent cell. A stem cell produces a line of clones.

Cloning

Technique of creating a group of genetically identical cells or DNA molecules from the mitotic division a single ancestor. See *Directional cloning*, *Megabase cloning*, *Molecular cloning*, *Subcloning*.

Coat protein (capsid)

The coating of a protein that enclosed the nucleic acid core of a virus.

Code of Conduct / Code of Ethics / Code of Practice

Non-legislated guidelines which one or more organisations voluntarily agree to abide by, and which sets out the standard of conduct or behavior with respect to a particular activity.

Codon

A group of three nucleotides that specifies addition of one of the 20 amino acids during translation of an mRNA into a polypeptide. Strings of codons form genes and strings of genes form chromosomes. See *Initiation codon*, *Termination codon*.

Coenzyme (cofactor)

An organic molecule, such as a vitamin, that binds to an enzyme and is required for its catalytic activity.

Cofactor

See *Coenzyme*.

Colony

A group of identical cells (clones) derived from a single progenitor cell.

Commensalism

The close association of two or more dissimilar organisms where the association is advantageous to one and doesn't affect the other(s). See *Parasitism*, *Symbiosis*.

Communicable Disease

A disease that is transmitted from person to person through direct contact with an infected individual, the infected individual's discharge, or indirectly through a vector. Many of these diseases can be prevented through the use of protective measures, such as increased sanitation or a high level of vaccine coverage of vulnerable populations.

Competency

An ephemeral state, induced by treatment with cold cations, during which bacterial cells are capable of uptaking foreign DNA.

Complementary DNA or RNA

The matching strand of a DNA or RNA molecule to which its bases pair. See *DNA*, *RNA*.

Complementary nucleotides

Members of the pairs adenine-thymine, adenine-uracil, and guanine-cytosine that have the ability to hydrogen bond to one another. See *nucleotide*.

Concatemer

A DNA segment composed of repeated sequences linked end to end.

Conjugation

The joining of two bacteria cells when genetic material is transferred from one bacterium to another.

Constitutive promoter

An unregulated promoter that allows for continual transcription of its associated gene. See *Promoter*.

Containment

The safe methods for managing infectious materials in a laboratory where they are being handled or maintained. The purpose is to eliminate the risk of adverse exposure to harmful agents by laboratory personnel or the outside environment. There are three elements to containment: laboratory practice and technique, safety equipment, and facility design.

Contiguous (contig) map

The alignment of sequence data from large, adjacent regions of the genome to produce a continuous nucleotide sequence across a chromosomal region. See *Mapping*.

Convention on Biological Diversity (CBD)

One of the key agreements adopted at the 1992 Earth Summit in Rio de Janeiro, where many world leaders agreed upon a comprehensive strategy for sustainable development. The Convention established three main goals: the conservation of biological diversity, the sustainable use of its components, and the fair and equitable sharing of the benefits from the use of genetic resources. Click [here](#) to go to the CBD website.

Copy DNA

See *cDNA*.

Cross hybridization

The hydrogen bonding of a single-stranded DNA sequence that is partially but not entirely complementary to a singlestranded substrate. Often, this involves hybridizing a DNA probe for a specific DNA sequence to the homologous sequences of different species.

Cross pollination

Fertilization of a plant from a plant with a different genetic makeup.

Cross protect

Make a plant resistant to a severe virus by intentionally infecting it with a mild strain of the same virus.

Crossing-over

The exchange of DNA sequences between chromatids of homologous chromosomes during meiosis.

Culture

Cultivate cells or living organisms in a prepared medium under laboratory conditions. "Culture" is both the process and the growing cells.

Culture medium

A nutrient system for artificially growing bacteria or other cells. Growth factors that may be added to direct desired changes in the cells.

Cyclic AMP (cyclic adenosine monophosphate)

A second messenger that regulates many intracellular reactions by transducing signals from extracellular growth factors to cellular metabolic pathways.

Cystic fibrosis

Disease of mucous glands throughout the body that usually develops during childhood, and makes breathing increasingly difficult. If a child receives two copies of the defective gene called the CF gene (one copy from each parent) then the child will develop the disease.

Cytogenetics

Study that relates the appearance and behavior of chromosomes to genetic phenomenon.

D

Dalton

A unit of measurement equal to the mass of a hydrogen atom, 1.67×10^{-24} gram/L (Avogadro's number).

Death phase

The final growth phase, during which nutrients have been depleted and cell number decreases. See *Growth phase*.

Denature

To induce structural alterations that disrupt the biological activity of a molecule. Often refers to breaking hydrogen bonds between base pairs in double-stranded nucleic acid molecules to produce in single-stranded polynucleotides or altering the secondary and tertiary structure of a protein, destroying its activity.

Density gradient centrifugation

High-speed centrifugation in which molecules "float" at a point where their density equals that in a gradient of cesium chloride or sucrose. See *Centrifugation*.

Deoxyribonucleic acid

See *DNA*, *Nuclease*.

Diabetes

A disease associated with the absence or reduced levels of insulin, a hormone essential for the transport of glucose to cells.

Dideoxynucleotide (didN)

A deoxynucleotide that lacks a 3' hydroxyl group, and is thus unable to form a 3'-5' phosphodiester bond necessary for chain elongation. Dideoxynucleotides are used in DNA sequencing and the treatment of viral diseases. See *Nucleotide*.

didN

See *Dideoxynucleotide*.

Differentiation

The process whereby an unspecialized early embryonic cell acquires the features of a specialized cell such as a heart, liver, or muscle cell.

Digest

To cut DNA molecules with one or more restriction endonucleases.

Diploid cell

A cell which contains two copies of each chromosome. See *Haploid cell*.

Directed differentiation

Manipulating stem cell culture conditions to induce differentiation into a particular cell type.

Directional cloning

DNA insert and vector molecules are digested with two different restriction enzymes to create noncomplementary sticky ends at either end of each restriction fragment. This allows the insert to be ligated to the vector in a specific orientation and prevents the vector from recircularizing. See *Cloning*.

DNA (deoxyribonucleic acid)

An organic acid and polymer, DNA is the primary genetic material of which genes are made within chromosomes. Each DNA molecule consists of two connected spiral strands in the shape of a double helix. The biological “information tape” that stores genetic information in organisms and transmits it from generation to generation.

DNA analysis

See polymerase chain reaction (PCR) and RFLP mapping. Both PCR and RFLP analysis can be used in DNA fingerprinting for genealogical studies and forensics. See *DNA diagnosis*.

DNA diagnosis

The use of DNA polymorphisms to detect the presence of a disease gene.

DNA fingerprinting

Detecting patterns in DNA that indicate the presence of a gene for a trait. The pattern resembles a bar code printed on a commercial product so computers can scan the price. Forensics experts can use this distinct pattern to link or clear an individual suspected of being involved in a crime; breeders can use these patterns to find and select breeding stock with traits such as disease resistance. The technique also has applications in paternity testing, anthropology, conservation biology and ecological research.

DNA ligase

An enzyme that rejoins cut pieces of DNA.

DNA polymerase

See *Polymerase*.

DNA polymorphism

One of two or more alternate forms (alleles) of a chromosomal locus that differ in nucleotide sequence or have variable numbers of repeated nucleotide units. See *Allele*.

DNA probe

A molecule that has been labeled with a radioactive isotope, dye or enzyme and is used to locate a particular portion of a DNA molecule.

DNA sequence

The order of nucleotide bases in the DNA molecule.

DNA sequencing

Procedures for determining the nucleotide sequence of a DNA fragment.

DNase (deoxyribonuclease)

See *Nuclease*.

Dominant

An allele is said to be dominant if it expresses its phenotype even in the presence of a recessive allele. See *Allele*, *Phenotype*, *Recessive*.

Dominant(-acting) oncogene

A gene that stimulates cell proliferation and contributes to oncogenesis when present in a single copy. See *Oncogene*.

Dormancy

A period in which a plant does not grow, awaiting necessary environmental conditions such as temperature, moisture, nutrient availability.

Double helix

A term used to describe the configuration of a DNA molecule. The helix consists of two spiraling strands of nucleotides held together with chemical bonds.

Double-stranded complementary DNA (dscDNA)

A duplex DNA molecule copied from a cDNA template.

Downstream

The region extending in a 3' direction from a gene.

dscDNA

See *Double-stranded complementary DNA*.

Dual-Use

Initially used to refer to the aspects of certain material, information, and technology that are useful in both military and civilian spheres. It is increasingly being used to refer not only to military and civilian purposes, but also to criminal and terrorist activities.

Duplex DNA

Double-stranded DNA.

E

E. coli (Escherichia coli)

A bacterium commonly found in the intestinal tracts of most vertebrates. It is used extensively in recombinant DNA research both as a simple model of cell biochemical function and as a host for molecular cloning experiments because it has been genetically well characterized.

Ecology

The study of the interactions of organisms with their environment and with each other.

Ecosystem

The organisms in a plant population and the biotic and abiotic factors which impact on them. See *Abiotic factors*, *Biotic factors*.

Ectoderm

Upper, outermost layer of a group of cells derived from the inner cell mass of the blastocyst; it gives rise to skin nerves and brain.

Electrophoresis

Technique for analyzing and separating molecules based on the movement of charged particles in an electric field. See *Agarose gell electrophoresis*, *Polycrylamide gell electrophoresis*.

Electroporation

A method for transforming DNA, especially useful for plant cells, in which high voltage pulses of electricity are used to open pores in cell membranes, through which foreign DNA can pass.

Embryo

Early stages of an animal's development that results when a sperm fertilizes an egg. In humans, the developing organism from the time of fertilization until the end of the eighth week of gestation, when it becomes known as a fetus.

Embryoid bodies

Clumps of cellular structures that arise when embryonic stem cells are cultured.

Embryonic germ cells

Cells found in a specific part of the embryo/fetus called the gonadal ridge that normally develop into mature gametes.

Embryonic stem cell line

Embryonic stem cells, which have been cultured under *in vitro* conditions that allow proliferation without differentiation for months to years.

Embryonic stem cells

Primitive (undifferentiated) cells from the embryo that have the potential to become a wide variety of specialized cell types.

Encapsidation

Process by which a virus' nucleic acid is enclosed in a capsid. See *Coat protein*.

Endoderm

Lower layer of a group of cells derived from the inner cell mass of the blastocyst; it gives rise to lungs and digestive organs.

Endonuclease

See *Nuclease*.

Endophyte

An organism that lives inside another.

Enzyme

A protein that accelerates the rate of chemical reactions. Enzymes are catalysts that promote reactions repeatedly, without being damaged by the reactions.

Epidemic

A fast spreading disease that affects many individuals in a population. Epidemics may be restricted to one locale, one region, or even the entire globe (pandemic). An epidemic, however, is not a characterization of how many members or what proportion of the population is infected but is defined by how fast it is growing. When each infected individual is infecting more than one other individual, so that the number of infected individuals is growing exponentially, the disease is in an epidemic state.

Ethidium bromide

A fluorescent dye used to stain DNA and RNA. The dye fluoresces when exposed to UV light.

Eukaryote

An organism whose genetic material is located within a nucleus. Yeast, fungi, protozoans, plants and animals are eukaryotes. Viruses, bacteria, and blue-green algae are not.

Exon

A DNA sequence that is ultimately translated into protein. See *DNA*.

Exonuclease

See *Nuclease*.

Express

To translate a gene's message into a molecular product. In genetics, manifestation of a characteristic specified by a gene. In industrial biotechnology, production of a specific protein by inserting a gene into a new host organism.

Expression library

See *Library*.

F**Feeder layer**

Cells used in co-culture to maintain pluripotent stem cells. Cells usually consist of mouse embryonic fibroblasts.

Feedstock

Raw material used for chemical or biological processes, such as polymers to produce plastics.

Fermentation

Chemical reaction induced by a living agent (yeast, bacterium or mold) that splits complex organic compounds to simple ones. For example, yeast converts sugar to alcohol and carbon dioxide. In biotechnology, the process of growing microbes to produce chemical or pharmaceutical compounds.

Flanking region

The DNA sequences extending on either side of a specific locus or gene.

Fungus

A microorganism that lacks chlorophyll.

Fusion

Joining the membrane of two cells of different origin to create a cell that contains the parent cells' nuclear material. Used in monoclonal antibody technology to make hybridomas - fusing an immortal cell (one that divides continuously) and an anti body-producing cell. See *Monoclonal antibody*.

Fusion gene

A hybrid gene created by joining portions of two different genes (to produce a new protein) or by joining a gene to a different promoter (to alter or regulate gene transcription).

G

Gamete

A haploid sex cell, egg or sperm, that contains a single copy of each chromosome.

Gasohol

Fuel, blend of ethanol and unleaded gasoline, usually 10 percent ethanol and 90 percent gasoline. See *Ethanol*.

GEM

A genetically engineered microorganism.

Gene

A section of a DNA molecule at a given locus on a chromosome that encodes a specific protein, enzyme or several related proteins. It is considered the functional unit of heredity. See *Dominant gene*, *Fusion gene*, *Gene amplification*, *Gene expression*, *Gene flow*, *Gene pool*, *Gene splicing*, *Gene translocation*, *Recessive gene*, *Regulatory gene*.

Gene amplification

The increase, within a cell, of the number of copies of a given gene. Amplification is one mechanism through which proto-oncogenes are activated in malignant cells.

Gene cloning

The process of synthesizing multiple copies of a particular DNA sequence using a bacteria cell or another organism as a host. See *DNA*, *Host*.

Gene expression

The process of producing a protein from its DNA- and mRNA-coding sequences.

Gene flow

The exchange of genes between different but (usually) related populations.

Gene frequency

The percentage of a given allele in a population of organisms. See *Allele*.

Gene insertion

The addition of one or more copies of a normal gene into a defective chromosome.

Gene linkage

The hereditary association of genes located on the same chromosome.

Gene mapping

Determining the relative locations of genes on a chromosome.

Gene modification

The chemical repair of a gene's defective DNA sequence. See *DNA*.

Gene pool

The totality of all alleles of all genes of all individuals in a particular population.

Gene splicing

Combining genes from different organisms into one organism by inserting new genetic information into a chromosome using recombinant DNA techniques.

Gene translocation

The movement of a gene fragment from one chromosomal location to another, which often alters or abolishes expression.

Genetics

See *Genetic analysis*.

Genetic analysis

Studying how traits and genes for traits are passed from generation to generation, and how genes and the environment interact to result in traits. See *Genetics*.

Genetic assimilation

Eventual extinction of a natural species as massive pollen flow occurs from another related species and the older crop becomes more like the new crop. See *Gene flow*.

Genetic code

The three-letter code that translates nucleic acid sequence into protein sequence. The relationships between the nucleotide base-pair triplets of a messenger RNA molecule and the 20 amino acids that are the building blocks of proteins. See *Base pair, Nucleic acid, Nucleotide*.

Genetic counselling

Providing current or prospective parents with information on the probabilities of inherited diseases occurring in their children, and on diagnosis and treatment of such diseases.

Genetic disease

A disease that has its origin in changes to the genetic material, DNA. Usually refers to diseases that are inherited in a Mendelian fashion, although noninherited forms of cancer also result from DNA mutation.

Genetic drift

Random variation in gene frequency from one generation to another.

Genetic engineering

Using recombinant DNA techniques and related methods to move one or several genes from one organism to another, to rearrange one or several genes within a cell, or to alter gene-controlled processes. Transferring a DNA segment from one organism and inserting it into the DNA of another organism to modify, amplify, transform and express genetic information. The two organisms can be totally unrelated. Genetic engineering changes the type or amount of proteins an organism is capable of producing. See *Recombinant DNA*.

Genetic linkage map

A linear map of the relative positions of genes along a chromosome. Distances are established by linkage analysis, which determines the frequency at which two gene loci become separated during chromosomal recombination. See *Mapping*.

Genetic marker

A gene or group of genes used to "mark" or track the action of microbes.

Genetically Modified Organisms (GMO)

GMOs are organisms wherein the genetic material (ADN) has been artificially altered, usually by replacing some of the host organism's genes with those of another related or unrelated species. GMOs are often irreproducible in nature. For example, plants can be crossbred with insecticides in order to be more resistant to insect damage.

Genome

The total hereditary material of a cell, contained in the chromosomes of a given organism, usually the haploid chromosome state.

Genomic library

A library composed of fragments of genomic DNA. See *Library*.

Genotype

The structure of DNA that determines the expression of a trait. The specific genetic makeup of an organism, as contrasted with the actual characteristics of an organism. See *Phenotype*.

Genus

Category of organisms including closely related species ranking above a species and below a family. Interbreeding between organisms within the same category can occur.

GEO

Genetically engineered organism.

Germ cell

Reproductive cell. See *Somatic cell*.

Germ cell (germ line) gene therapy

The repair or replacement of a defective gene within the gamete-forming tissues, which produces a heritable change in an organism's genetic constitution.

GMO

Genetically modified organism.

Growth curve

See *Growth phase*.

Growth factor

A serum protein that stimulates cell division when it binds to its cell-surface receptor.

Growth phase (curve)

The characteristic periods in the growth of a bacterial culture, as indicated by the shape of a graph of viable cell number versus time. See *Death phase*, *Lag phase*, *Logarithmic phase*, *Stationary phase*.

Guidelines

A statement or other indication of policy or procedure by which to determine a course of action. Guidelines may be developed by government agencies at any level, institutions, professional societies, governing boards, or by the convening of expert panels. Though not necessarily mandatory, the text is generally a comprehensive guide to problems and approaches in any field of activity.

H

Haploid cell

A cell containing only one set, or half the usual (diploid) number, of chromosomes.

Hematopoietic stem cell

A stem cell from which all red and white blood cells develop.

Heterochromatin

Dark-stained regions of chromosomes thought to be for the most part genetically inactive.

Heteroduplex

A double-stranded DNA molecule or DNA-RNA hybrid, where each strand is of a different origin.

Heterogeneous nuclear RNA (hnRNA)

The name originally given to large RNA molecules found in the nucleus, which are now known to be unedited mRNA transcripts, or pre-mRNAs. See *RNA*.

HGH

See *Human growth hormone*.

hnRNA

See *Heterogeneous nuclear RNA*.

Homologous chromosomes

Chromosomes that have the same linear arrangement of genes, a pair of matching chromosomes in a diploid organism. See *Chromosomes*.

Homologous recombination

The exchange of DNA fragments between two DNA molecules or chromatids of paired chromosomes (during crossing over) at the site of identical nucleotide sequences.

Homozygote

An organism whose genotype is characterized by two identical alleles of a gene. See *Allele*, *Genotype*.

Hormone

Chemical that acts as a messenger relaying instructions to start certain physiological activities. Hormones are synthesized in one type of cell, and released to direct the function of other cell types.

Host

An organism that contains another organism.

Human embryonic stem cell

A type of pluripotent stem cell derived from the inner cell mass of the blastocyst.

Human Genome Project

A project coordinated by the National Institutes of Health (NIH) and the Department of Energy (DOE) to determine the entire nucleotide sequence of the human chromosomes. See *NIH*.

Human growth hormone

Human somatotropin, a protein hormone made in the pituitary gland that stimulates the liver to produce somatomedins, which stimulate growth of bone and muscle. Lab-grown (HGH) bacteria given a copy of the gene for human growth hormone can then produce large amounts of HGH, which can be purified and used to treat certain kinds of human dwarfism, a pathological condition of growth arrested by various causes.

Hybrid

The offspring of two parents differing in at least one genetic characteristic (trait). Also, a heteroduplex DNA or DNA-RNA molecule.

Hybridization (breeding)

Production of offspring, or hybrids, from genetically dissimilar parents. In selective breeding, it usually refers to the offspring of two different species.

Hybridization

The hydrogen bonding of complementary DNA and/or RNA sequences to form a duplex molecule. See *Northern hybridization*, *Southern hybridization*.

Hybridoma

A type of hybrid cell produced by fusing a normal cell (B lymphocyte) with a tumor cell. When lymphocytes (antibody-producing cells) are fused to the tumor cells, the resulting hybridomas produce antibodies and maintain rapid, sustained growth, producing large amounts of an antibody. Hybridomas are the source of monoclonal antibodies.

Hydrolysis

A reaction in which a molecule of water is added at the site of cleavage of a molecule to two products.

I

Immortalizing oncogene

A gene that upon transfection enables a primary cell to grow indefinitely in culture. See *Oncogene*.

Immunoassay

A technique for identifying substances, based on the use of antibodies.

Immunotoxin

The coupling of an antibody and a molecule that is toxic to the cell.

Influenza

Known commonly as “the flu”, influenza is an acute contagious viral infection characterized by inflammation of the respiratory tract. It rapidly spreads around the world in seasonal epidemics. Influenza can mutate quickly and major genetic changes in the virus have caused three influenza pandemics in the 20th century, killing many millions of people. Asian flu (H2N2) and Avian Flu (H5N1) are types of influenzas. There are three types of influenzas:

- Influenza A viruses infect mammals and birds
- Influenza B viruses infect only humans
- Influenza C viruses infect only humans

In situ

Refers to performing assays or manipulations with intact tissues.

In vitro

Performed in a test tube or other laboratory apparatus.

In vitro fertilization

An assisted reproduction technique in which fertilization is accomplished outside the body.

In vitro selection

Selection at the cellular or callus stage of individuals possessing certain traits, such as herbicide resistance.

In vivo

In the living organism or cell.

Incomplete dominance

A condition where a heterozygous offspring has a phenotype that is distinctly different from, and intermediate to, the parental phenotypes. See *Heterozygote*, *Phenotype*.

Initiation codon

The mRNA sequence AUG, coding for methionine, which initiates translation of mRNA.

Inner cell mass

The cluster of cells inside the blastocyst. These cells give rise to the embryonic disk of the later embryo and, ultimately, the fetus.

Inositol lipid

A membrane-anchored phospholipid that transduces hormonal signals by stimulating the release of any of several chemical messengers. See *Phospholipid*.

Insertion mutations

Changes in the base sequence of a DNA molecule resulting from the random integration of DNA from another source. See *DNA*, *Mutation*.

Insulin

Protein hormone that regulates blood sugar, made in cells of the pancreas. In the laboratory, microbes given a copy of the gene for human insulin can make insulin to treat diabetes mellitus, a shortage of insulin.

Interferon

A family of small proteins produced naturally cells. Interferons increase the resistance of surrounding cells to attacks by viruses. One type of interferon, alpha interferon, is effective against certain types of cancer. Others may prove effective in treating **autoimmune** diseases.

Intergenic regions

DNA sequences located between genes that comprise a large percentage of the human genome with no known function.

Interleukin

A protein produced naturally by the body to stimulate the immune system. There are at least 18 known kinds of interleukins.

Introgression

Backcrossing of hybrids of two plant populations to introduce new genes into a wild population.

Intron

A noncoding DNA sequence within a gene that is initially transcribed into messenger RNA but is later snipped out. See *Coding, DNA, Messenger RNA, Transcription*.

Invasiveness

Ability of a plant to spread beyond its introduction site and become established in new locations where it may provide a deleterious effect on organisms already existing there.

Ion

A charged particle.

Isotope

One of two or more forms of an element that have the same number of protons (atomic number) but differing numbers of neutrons (mass numbers). Radioactive isotopes are commonly used to make DNA probes and metabolic tracers.

J

Joining (J) segment

A small DNA segment that links genes to yield a functional gene encoding an immunoglobulin.

K

Kanamycin

An antibiotic of the aminoglycoside family that poisons translation by binding to the ribosomes.

Kanr. Kanamycin resistance gene

See *Selectable marker*.

Karyotype

All of the chromosomes in a cell or an individual organism, visible through a microscope during cell division.

L

Lactase

Enzyme in certain yeasts and mammalian intestinal tracts that catalyzes converting lactose to glucose and galactose. See *Lactose*.

Lactose

Milk sugar; also white crystal sugar made from whey used in baby food, baked goods, candies and pharmaceuticals.

Lag phase

The initial growth phase, during which cell number remains relatively constant prior to rapid growth. See *Growth phase*.

Lawn

A uniform and uninterrupted layer of bacterial growth, in which individual colonies cannot be observed.

Leukocyte

A white blood cell, an important component of the body's immune system.

Library

A collection of cells, usually bacteria or yeast, that have been transformed with recombinant vectors carrying DNA inserts from a single species. See *cDNA library*, *Expression library*, *Genomic library*.

Ligate

The process of joining two or more DNA fragments.

Lineage

A chart that traces the flow of genetic information from generation to generation.

Linkage map

See *Genetic linkage map*.

Linkage

The frequency of coinheritance of a pair of genes and/or genetic markers, which provides a measure of their physical proximity to one another on a chromosome.

Linked genes/markers

Genes and/or markers that are so closely associated on the chromosome that they are coinherited in 80% or more of cases.

Linker

A short, double-stranded oligonucleotide containing a restriction endonuclease recognition site, which is ligated to the ends of a DNA fragment.

Liposomes

Membrane-bound vesicles constructed in the laboratory to transport biological molecules.

Locus (plural = loci)

A specific location or site on a chromosome.

Log phase

See *Logarithmic phase*.

Logarithmic phase (log or exponential growth phase)

The steepest slope of the growth curve, the phase of vigorous growth during which cell number doubles every 20-30 minutes. See *Growth phase*.

Long-term self-renewal

The ability of stem cells to renew themselves by dividing into the same non-specialized cell type over long periods (many months to years) depending on the specific type of stem cell.

Lymphocyte

A type of leukocyte found in the blood, lymph nodes and certain organs. Lymphocytes are continuously made in the bone marrow. See *B lymphocytes*, *T lymphocytes*.

Lysis

The destruction of the cell membrane.

Lysogen

A bacterial cell whose chromosome contains integrated viral DNA.

Lysogenic

A type or phase of the virus life cycle during which the virus integrates into the host chromosome of the infected cell, often remaining essentially dormant for some period of time. See *Lysogen*.

Lytic

A phase of the virus life cycle during which the virus replicates within the host cell, releasing a new generation of viruses when the infected cell lyses.

M

Macrophage

A type of white blood cell that ingests dead tissue and cells and is involved in producing Interleukin.

Mapping

Determining the physical location of a gene or genetic marker on a chromosome. See *Continuous map*, *Genetic map*, *Physical map*.

Marker gene

Gene that is easy to find or observe, used to identify which plants have been successfully transformed.

Megabase cloning

The cloning of very large DNA fragments. See *Cloning*.

Meiosis

The reduction division process by which haploid gametes and spores are formed, consisting of a single duplication of the genetic material followed by two mitotic divisions.

Mesenchymal stem cells

Cells from the immature embryonic connective tissue. A number of celltypes come from mesenchymal stem cells, including chondrocytes, which produce cartilage.

Mesoderm

Middle layer of a group of cells derived from the inner cell mass of the blastocyst; it gives rise to bone, muscle, and connective tissue.

Messenger RNA (mRNA)

The class of RNA molecules that copies the genetic information from DNA, in the nucleus, and carries it to ribosomes, in the cytoplasm, where it is translated into protein. See *RNA*.

Metabolism

The biochemical processes that sustain a living cell or organism.

Metallothionein

A protective protein that binds heavy metals, such as cadmium and lead.

Microbe

Microorganism; any organism that can be seen only with the aid of a microscope.

Microbial insecticide

Preparation of living microbes (such as bacteria or fungi) pathogenic to specific groups of insects. See *Bacillus thuringiensis (Bt)*, *Biological control*.

Microbial mats (biofilms)

Layered groups or communities of microbial populations.

Microenvironment

The molecules and compounds such as nutrients and growth factors in the fluid surrounding a cell in an organism or in the laboratory, which are important in determining the characteristics of the cell.

Microinjection

A means to introduce a solution of DNA, protein, or other soluble material into a cell using a fine microcapillary pipet.

Mitosis

The replication of a cell to form two daughter cells with identical sets of chromosomes.

Molecular biology

The study of the biochemical and molecular interactions within living cells.

Molecular cloning

The biological amplification of a specific DNA sequence through mitotic division of a host cell into which it has been transformed or transfected. See *Cloning*.

Molecular genetics

The study of the molecular structure and function of genes. The study of the flow and regulation of genetic information between DNA, RNA, and protein molecules.

Monoclonal antibodies

Immunoglobulin molecules of single-epitope specificity that are secreted by a clone of B cells.

Monoclonal antibody

A highly specific, purified protein antibody that is derived from only one clone of cells and recognizes only one specific foreign substance invading the body (antigen). A monoclonal antibody may be used for early disease diagnosis and therapy.

Monogenic

Controlled by or associated with a single gene.

Movable genetic element

See *Transposon*.

mRNA

See *Messenger RNA*.

Multigenic

Many genes are involved in the expression of a trait.

Multi-locus probe

A probe that hybridizes to a number of different sites in the genome of an organism. See *Probe*.

Mutagen

Agent that causes biological mutation. Examples include chemicals, radioactive elements and ultraviolet light. See *Pentachlorophenol*.

Mutagen

Any agent or process that can cause mutations. See *Mutation*.

Mutant

A cell microorganism that manifests new characteristics due to a change in its genetic material.

Mutation

An alteration in DNA structure or sequence of a gene that may cause that cell and all cells derived from it to look or behave differently.

N

Neural stem cell

A stem cell found in adult neural tissue that can give rise to neurons, astrocytes, and oligodendrocytes.

Neurons

Nerve cells, the structural and functional unit of the nervous system. A neuron consists of a cell body and its processes, an axon, and one or more dendrites. Neurons function by the initiation and conduction of impulses and transmit impulses to other neurons or cells by releasing neurotransmitters at synapses.

Nick translation

A procedure for making a DNA probe in which a DNA fragment is treated with DNase to produce single-stranded nicks, followed by incorporation of radioactive nucleotides from the nicked sites by DNA polymerase.

Nicked circle (relaxed circle)

During extraction of plasmid DNA from the bacterial cell, one strand of the DNA becomes nicked. This relaxes the torsional strain needed to maintain supercoiling, producing the familiar form of plasmid. See *Plasmid*.

Nitrocellulose

A membrane used to immobilize DNA, RNA, or protein, which can then be probed with a labeled sequence or antibody.

Nitrogen fixation

The conversion of atmospheric nitrogen to biologically usable nitrates.

Nitrogenous bases

The purines (adenine and guanine) and pyrimidines (thymine, cytosine, and uracil) that comprise DNA and RNA molecules.

Nodule

The enlargement or swelling on roots of nitrogen-fixing plants. The nodules contain symbiotic nitrogen-fixing bacteria. See *Nitrogen fixation*.

Nontarget organism

An organism which is affected by an interaction for which it was not the intended recipient.

Northern blotting

See *Northern hybridization*.

Northern hybridization (Northern blotting)

A procedure in which RNA fragments are transferred from an agarose gel to a nitrocellulose filter, where the RNA is then hybridized to a radioactive probe. See *Hybridization*.

Nuclease

A class of enzymes that degrades DNA and/or RNA molecules by cleaving the phosphodiester bonds that link adjacent nucleotides. In deoxyribonuclease (DNase), the substrate is DNA. In endonuclease, it cleaves at internal sites in the substrate molecule. Exonuclease progressively cleaves from the end of the substrate molecule. In ribonuclease (RNase), the substrate is RNA. In the S1 nuclease, the substrate is single-stranded DNA or RNA.

Nucleic acids

The two nucleic acids, deoxyribonucleic acid (DNA) and ribonucleic acid (RNA), are made up of long chains of molecules called nucleotides. DNA is made of thousands of sets of four different nucleotides repeated randomly. See *DNA, RNA, Nucleotides*.

Nuclein

The term used by Friedrich Miescher to describe the nuclear material he discovered in 1869, which today is known as DNA.

Nucleoside analog

A synthetic molecule that resembles a naturally occurring nucleoside, but that lacks a bond site needed to link it to an adjacent nucleotide. See *Nucleoside*.

Nucleoside

A building block of DNA and RNA, consisting of a nitrogenous base linked to a five carbon sugar. See *Nucleoside analog*.

Nucleotide

A building block of DNA and RNA, consisting of a nitrogenous base, a five-carbon sugar, and a phosphate group. Together, the nucleotides form codons, which when strung together form genes, which in turn link to form chromosomes. Can be found as individual molecules (e.g., ATP, the "energy molecule"). See *Chromosome, Codon, Complementary nucleotides, Dideoxynucleotide, DNA, Gene, Oligonucleotide, RNA*.

Nucleus

The membrane-bound region of a eukaryotic cell that contains the chromosomes.

O

Oligodendrocyte

A cell that provides insulation to nerve cells by forming a myelin sheath around axons.

Oligonucleotide

A DNA polymer composed of only a few nucleotides. See *Nucleotide*.

Oncogene

A gene that contributes to cancer formation when mutated or inappropriately expressed. See *Cellular oncogene*, *Dominant oncogene*, *Immortalizing oncogene*, *Recessive oncogene*.

Oncogenesis

The progression of cytological, genetic, and cellular changes that culminate in a malignant tumor.

Oncology

The study of tumors.

Open pollination

Pollination by wind, insects, or other natural mechanisms.

Open reading frame

A long DNA sequence that is uninterrupted by a stop codon and encodes part or all of a protein. See *Reading frame*.

Operator

A prokaryotic regulatory element that interacts with a repressor to control the transcription of adjacent structural genes.

Organelle

A cell structure that carries out a specialized function in the life of a cell.

Origin of replication

The nucleotide sequence at which DNA synthesis is initiated.

Overlapping reading frames

Start codons in different reading frames generate different polypeptides from the same DNA sequence. See *Reading frame*.

Ovum

A female gamete.

P

Palindrome

See *Palindromic sequence*.

Palindromic sequence

A DNA locus whose 5'-to-3' sequence is identical on each DNA strand. The sequence is the same when one strand is read left to right and the other strand is read right to left. Recognition sites of many restriction enzymes are palindromic. See *DNA*.

Pandemic

The outbreak of an infectious disease over a large geographical region and affecting a large percentage of the human and/or animal population.

Parasitism

The close association of two or more dissimilar organisms where the association is harmful to at least one. See *Commensalism*, *Symbiosis*.

Passage

A round of cell growth and proliferation in cell culture.

Pathogen

Living organism which can cause disease in another organism.

Pathogen Security

See *biosecurity*.

pBR322

A derivation of ColE1, one of the first plasmid vectors widely used. See *Plasmid*.

PCR

See *Polymerase chain reaction*.

Pedigree

A diagram mapping the genetic history of a particular family.

Pentachlorophenol

Chemical formerly widely used to preserve wood from decay and insect damage, now a restricted-use pesticide. According to the U.S. Environmental Protection Agency, it can be an acute toxin causing such problems as burns and breathing difficulty. It may cause developmental effects such as birth defects and affect male and female reproductive capacity. It can also harm wildlife. See *Bioremediation*.

Persistence

Ability of an organism to remain in a particular setting for a period of time after it is introduced.

Phage (particle)

See *Bacteriophage*.

Phenotype

The observable characteristics of an organism as opposed to the set of genes it possesses (its genotype). The phenotype that an organism manifests is a result of both genetic and environmental factors. Therefore, organisms with the same genotype may display different phenotypes due to environmental factors. Conversely, organisms with the same phenotypes may have different genotypes.

Pheromone

A hormone-like substance that is secreted into the environment.

Phosphatase

An enzyme that hydrolyzes esters of phosphoric acid, removing a phosphate group.

Phosphodiester bond

A bond in which a phosphate group joins adjacent carbons through ester linkages. A condensation reaction between adjacent nucleotides results in a phosphodiester bond between 3' and 5' carbons in DNA and RNA.

Phospholipid

A class of lipid molecules in which a phosphate group is linked to glycerol and two fatty acyl groups. A chief component of biological membranes. See *Inositol phospholipid*.

Phosphorylation

The addition of a phosphate group to a compound.

Physical map

A map showing physical locations on a DNA molecule, such as restriction sites, and sequence-tagged sites. See *Mapping*.

Plaque

A clear spot on a lawn of bacteria or cultured cells where cells have been lysed by viral infection.

Plasmid (p)

A circular DNA molecule, found outside the chromosome in bacteria, capable of autonomous replication, which typically carries one or more genes encoding antibiotic resistance proteins. Plasmids can transfer genes between bacteria and are the principal tools for inserting new genetic information into microorganisms or plants. See *Nicked circle*, *Relaxed plasmid*, *Stringent plasmid*, *Supercoiled plasmid*.

Plasticity

The ability of stem cells from one adult tissue to generate the differentiated cell types of another tissue.

Pleiotropy

The effect of a particular gene on several different traits.

Pluripotent

Ability of a single stem cell to develop into many different cell types of the body.

Point mutation

A change in a single base pair of a DNA sequence in a gene. See *Mutation*.

Polyacrylamide gel electrophoresis

Electrophoresis through a matrix composed of a synthetic polymer, used to separate proteins, small DNA, or RNA molecules of up to 1000 nucleotides. Used in DNA sequencing. See *Electrophoresis*.

Polyclonal antibodies

A mixture of immunoglobulin molecules secreted against a specific antigen, each recognizing a different epitope.

Polygalacturonase (PG)

Enzyme that digests part of the pectin that forms plant cell walls. Polygalacturonase causes ripening fruit to become soft.

Polygenic

Controlled by or associated with more than one gene.

Polylinker

A short DNA sequence containing several restriction enzyme recognition sites that is contained in cloning vectors.

Polymer

A molecule composed of repeated subunits.

Polymerase (DNA)

Synthesizes a double-stranded DNA molecule using a primer and DNA as a template. See *Polymerase chain reaction*, *RNA polymerase*, *Taq polymerase*.

Polymerase chain reaction (PCR)

Multiplying a particular DNA segment in repeated cycles. The "copies" made in a previous cycle are used as "originals" or templates in the next cycle. For example, PCR enables forensics experts to do DNA testing on very small blood samples.

Polymorphisms

Variant forms of a particular gene that occur simultaneously in a population.

Polynucleotide

A DNA polymer composed of multiple nucleotides. See *Nucleotide*.

Polypeptide (protein)

A polymer composed of multiple amino acid units linked by peptide bonds.

Polyploid

A multiple of the haploid chromosome number that results from chromosome replication without nuclear division.

Polysaccharide

A polymer composed of multiple units of monosaccharide (simple sugar).

Polyvalent vaccine

A recombinant organism into which has been cloned antigenic determinants from a number of different disease-causing organisms. See *Vaccine*.

Population

A local group of organisms belonging to the same species and capable of interbreeding.

Porcine somatotropin (PST)

Pig growth hormone; a protein hormone produced in the pituitary gland of pigs. Like BGH/BST, PST can also be produced by inserting a copy of the gene for PST into laboratory bacteria. When purified from pituitary glands or from bacterial cultures, PST injected into hogs can increase the leanness of pork and improve pork quality.

Primary cell

A cell or cell line taken directly from a living organism, which is not immortalized.

Primer

A short DNA or RNA fragment annealed to single-stranded DNA, from which DNA polymerase extends a new DNA strand to produce a duplex molecule.

Principles

An elementary proposition, fundamental truth, law or doctrine from which others are derived or on which others are founded. A settled rule of action or a governing law of conduct.

Prion

See *Proteinaceous infectious particle*.

Probe

A sequence of DNA or RNA, labeled or marked with a radioactive isotope, used to identify complementary sequences in genes or DNA fragments of interest by detecting the presence of complementary nucleotide sequences. See *Nucleotide*.

Prokaryotes

Organisms whose genetic material is not enclosed by a nucleus; its DNA is usually in one long strand.. The most common examples are bacteria. See *Eukaryote*

Proliferation

Expansion of a population of cells by the continuous division of single cells into two identical daughter cells.

Promoter

A region of DNA extending 150-300 bp upstream from the transcription start site that contains binding sites for RNA polymerase and a number of proteins that regulate the rate of transcription of the adjacent gene. See *Constitutive promoter*.

Pronucleus

Either of the two haploid gamete nuclei just prior to their fusion in the fertilized ovum.

Protease

An enzyme that cleaves peptide bonds that link amino acids in protein molecules.

Protein

A complex biological molecule composed of a chain of amino acids. Proteins have many different functions: structure (collagen); movement (actin and myosin); catalysis (enzymes); transport (hemoglobin); regulation of cellular processes (insulin); and response to stimuli (receptor proteins on surface of all cells). The information for making proteins is stored in the sequence of nucleotides in the DNA molecule. See *Polypeptide*.

Protein engineering

A technique used in the production of proteins with new or artificial amino acid sequences.

Protein kinase

An enzyme that adds phosphate groups to a protein molecule at serine, threonine, or tyrosine residues.

Proteinaceous infectious particle (prion)

A proposed pathogen composed only of protein with no detectable nucleic acid and which is responsible for Creutzfeldt-Jakob disease and kuru in humans and scrapie in sheep.

Proteolytic

The ability to break down protein molecules.

Proto-oncogene

See *Oncogene*.

Protoplast.

A plant or bacterial cell that has had its cell wall removed

Provirus

See *Virus*.

pUC

A widely used expression plasmid containing a -galactosidase gene. See *Plasmid*.

R**Reading frame**

A series of triplet codons beginning from a specific nucleotide. Depending on where one begins, each DNA strand contains three different reading frames. See *Open reading frame*, *Overlapping reading frames*.

Recessive gene

Characterized as having a phenotype expressed only when both copies of the gene are mutated or missing.

Recessive(-acting) oncogene, (anti-oncogene)

A single copy of this gene is sufficient to suppress cell proliferation; the loss of both copies of the gene contributes to cancer formation. See *Oncogene*.

Recognition sequence (site)

A nucleotide sequence composed typically of 4, 6, or 8 nucleotides that is recognized by a restriction endonuclease. Type II enzymes cut (and their corresponding modification enzymes methylate) within or very near the recognition sequence.

Recombinant DNA (rDNA)

The laboratory manipulation of DNA in which DNA, or fragments of DNA from different sources, are cut and recombined using enzymes as a means to isolate genes or to alter their structure and function.. This recombinant DNA is then inserted into the DNA of a cell. This technique includes taking copies of genes from one organism and inserting them in another organism. The two organisms can be totally unrelated. Recombinant DNA has a variety of uses, such as studying how genes work, and producing medicines such as human insulin and other commercial products. See *Genetic engineering*.

Recombinant

A cell that results from recombination of genes.

Recombination frequency

The frequency at which crossing over occurs between two chromosomal loci - the probability that two loci will become unlinked during meiosis.

Recombination

The formation of new combinations of genes. Recombination occurs naturally in plants and animals during the production of sex cells (sperm, eggs, pollen) and their subsequent joining in fertilization. In microbes, genetic material is recombined naturally during conjugation.

Regeneration

The process of growing an entire plant from a single cell or group of cells.

Regenerative or reparative medicine

A treatment in which stem cells are induced to differentiate into the specific cell type required to repair damaged or depleted adult cell populations or tissues.

Regulatory gene

A gene whose protein controls the activity of other genes or metabolic pathways.

Regulatory Oversight

The management or supervision of a group by an outside body in order to control or direct according to rule, principle, or law.

Relaxed circle plasmid

See *Plasmid*.

Relaxed plasmid

A plasmid that replicates independently of the main bacterial chromosome and is present in 10-500 copies per cell. See *Plasmid*.

Renature

The reannealing (hydrogen bonding) of single-stranded DNA and/or RNA to form a duplex molecule.

Replicon

A chromosomal region containing the DNA sequences necessary to initiate DNA replication processes.

Repressor

A DNA-binding protein in prokaryotes that blocks gene transcription by binding to the operator.

Restriction endonuclease (enzyme)

A class of endonucleases that cleaves DNA at very specific locations after recognizing a specific sequence.

Restriction enzymes

Bacterial enzymes that cleave DNA.

Restriction map

A diagram that shows restriction sites (i.e., where a restriction enzyme cleaves DNA) in relation to one another.

Restriction map

See *Mapping*.

Retrovirus

A member of a class of RNA viruses that utilizes the enzyme reverse transcriptase to reverse copy its genome into a DNA intermediate, which integrates into the hostcell chromosome. Many naturally occurring cancers of vertebrate animals are caused by retroviruses.

Reverse genetics

Using linkage analysis and polymorphic markers to isolate a disease gene in the absence of a known metabolic defect, then using the DNA sequence of the cloned gene to predict the amino acid sequence of its encoded protein.

Reverse transcriptase (RNA-dependent DNA polymerase)

An enzyme isolated from retrovirus-infected cells that synthesizes a complementary (c)DNA strand from an RNA template.

RFLP (restriction fragment length polymorphism)

RFLP mapping detects patterns in DNA that can indicate the presence of a gene for a trait. Both RFLP and polymerase chain reaction (PCR) analysis can be used in DNA fingerprinting for genealogical studies and forensics.

Rhizobia

Bacteria in a symbiotic relationship with leguminous plants that results in nitrogen fixation. See *Nitrogen fixation*.

Rhizosphere

The soils region on and around plant roots.

Ribosomal RNA (rRNA)

The RNA component of the ribosome. See *RNA*.

Ribosome

Cellular organelle that is the site of protein synthesis in the cytoplasm. See *Organelle*, *Translation*.

Ribosome-binding site

The region of an mRNA molecule that binds the ribosome to initiate translation.

Ribozyme

See *Catalytic RNA*.

RNA (ribonucleic acid)

Molecule similar to DNA that functions primarily to decode the instructions that genes carry for protein synthesis. There are three major types: messenger RNA, transfer RNA, and ribosomal RNA.

RNA polymerase

Transcribes RNA from a DNA template. See *Polymerase, RNA*.

rRNA

See *Ribosomal RNA*.

S

Satellite RNA (viroids)

A small, self-splicing RNA molecule that accompanies several plant viruses, including tobacco ringspot virus.

Select Agent

All of the viruses, bacteria, fungi, and toxins that, according to the US Center for Disease Control (CDC), the US Department of Health and Human Services, and the US Department of Agriculture, have the potential to cause substantial harm to humans, animals, or plants. Originally a list of 31 infectious agents and 12 biological toxins with additional provisions for recombinant organisms and drug resistant organisms and exemptions for research quantities and vaccine strains of organisms, the list is updated as necessary. The most current list can be obtained from the CDC's website in PDF format [here](#).

Selectable marker

A gene whose expression allows one to identify cells that have been transformed or transfected with a vector containing the marker gene. See *B-Lactamase, Kanr*.

Self-pollination

Pollen of one plant is transferred to the female part of the same plant or another plant with the same genetic makeup.

Semiconservative replication

During DNA duplication, each strand of a parent DNA molecule is a template for the synthesis of its new complementary strand. Thus, one half of a preexisting DNA molecule is conserved during each round of replication.

Sequence hypothesis

Francis Crick's seminal concept that genetic information exists as a linear DNA code; DNA and protein sequence are colinear.

Sequence-tagged site (STS)

A unique (single-copy) DNA sequence used as a mapping landmark on a chromosome.

Sexual reproduction

The process where two cells (gametes) fuse to form one hybrid, fertilized cell. See *Asexual reproduction, Gamete, Hybrid*.

Signal transduction

The biochemical events that conduct the signal of a hormone or growth factor from the cell exterior, through the cell membrane, and into the cytoplasm. This involves a number of molecules, including receptors, proteins, and messengers.

Signals

Internal and external factors that control changes in cell structure and function.

Site-directed mutagenesis

The process of introducing specific base-pair mutations into a gene.

Small nuclear RNA (snRNA)

Short RNA transcripts of 100-300 bp that associate with proteins to form small nuclear ribonucleoprotein particles (snRNPs), which participate in RNA processing. See *RNA*.

snRNA

See *Small nuclear RNA*.

Somatic cell

Cells other than sex or germ cells that compose the body of an organism and which possesses a set of multiploid chromosomes (diploid in most organisms). See *Gamete, Somatic cell gene therapy*.

Somatic cell gene therapy

The repair or replacement of a defective gene within somatic tissue. See *Somatic cell*.

Somatic stem cells

Another name for adult stem cells.

Somatotrophin

See *Human growth hormone*.

Southern blotting

See *Southern hybridization*.

Southern hybridization (Southern blotting)

A procedure in which DNA restriction fragments are transferred from an agarose gel to a nitrocellulose filter, where the denatured DNA is then hybridized to a radioactive probe (blotting). See *Hybridization*.

Species

Group of organisms with common or similar characteristics and capable of interbreeding.

Spore

A form taken by certain microbes that enables them to exist in a dormant stage. It is an asexual reproductive cell. See *Asexual reproduction*, *Dormant*.

Stationary phase

The plateau of the growth curve after log growth, during which cell number remains constant. New cells are produced at the same rate as older cells die. See *Growth phase*.

Stem cells

Cells with the ability to divide for indefinite periods in culture and to give rise to specialized cells.

Sticky end

A protruding, single-stranded nucleotide sequence produced when a restriction endonuclease cleaves off center in its recognition sequence.

Stop codon

See *Termination codon*.

Stringency

Reaction conditions, notably temperature, salt, and pH, that dictate the annealing of single-stranded DNA/DNA, DNA/RNA, and RNA/RNA hybrids. At high stringency, duplexes form only between strands with perfect one-to-one complementarity; lower stringency allows annealing between strands with some degree of mismatch between bases.

Stringent plasmid

A plasmid that only replicates along with the main bacterial chromosome and is present as a single copy, or at most several copies, per cell. See *Plasmid*.

Stromal cells

Non-blood cells derived from blood organs, such as bone marrow or fetal liver, which are capable of supporting growth of blood cells *in vitro*. Stromal cells that make this matrix within the bone marrow are also derived from mesenchymal stem cells.

STS

See *Sequence-tagged site*.

Subcloning

The process of transferring a cloned DNA fragment from one vector to another. See *Cloning*.

Subculturing

The process of growing and replating cells in tissue culture for many months.

Subunit vaccine

A vaccine composed of a purified antigenic determinant that is separated from the virulent organism. See *Vaccine, Enzyme*.

Supercoiled plasmid

The predominant *in vivo* form of plasmid, in which the plasmid is coiled around histone-like proteins. Supporting proteins are stripped away during extraction from the bacterial cell, causing the plasmid molecule to supercoil around itself *in vitro*. See *Plasmid*.

Supergene

A group of neighboring genes on a chromosome that tend to be inherited together and sometimes are functionally related.

Supernatant

The soluble liquid fraction of a sample after centrifugation or precipitation of insoluble solids.

Surface markers

Surface proteins that are unique to certain cell types, which are visualized using antibodies or other detection methods.

Symbiosis

The close association of two or more dissimilar organisms where both receive an advantage from the association. See *Commensalism, Parasitism*.

Synapsis

The pairing of homologous chromosome pairs during prophase of the first meiotic division, when crossing over occurs.

Synthesis

The process whereby separate elements are combined to form a new complex product, synthetic chemical compound or material.

T

T lymphocytes (T cells)

White blood cells, produced in the bone marrow, that aid B cells in making antibodies to fight bacterial infections. They also are instrumental in rejection of foreign tissue, and may be important in the body's defense against cancer.

Taq polymerase

A heat-stable DNA polymerase isolated from the bacterium *Thermus aquaticus*, used in PCR. See *Polymerase*.

TATA box

An adenine- and thymine-rich promoter sequence located 25-30 bp upstream of a gene, which is the binding site of RNA polymerase.

T-DNA (transfer DNA, tumor-DNA)

The transforming region of DNA in the Ti plasmid of *Agrobacterium tumefaciens*.

Telomere

The end of a chromosome.

Template

An RNA or single-stranded DNA molecule upon which a complementary nucleotide strand is synthesized.

Teratoma

A tumor composed of tissues from the three embryonic germ layers. Usually found in ovary and testis. Produced experimentally in animals by injecting pluripotent stem cells, in order to determine the stem cells' abilities to differentiate into various types of tissues.

Termination codon

Any of three mRNA sequences (UGA, UAG, UAA) that do not code for an amino acid and thus signal the end of protein synthesis. Also known as stop codon. See *Codon*.

Terminator region

A DNA sequence that signals the end of transcription.

Tetracycline

An antibiotic that interferes with protein synthesis in prokaryotes.

Thymidine kinase (tk)

An enzyme that allows a cell to utilize an alternate metabolic pathway for incorporating thymidine into DNA. Used as a selectable marker to identify transfected eukaryotic cells.

Ti (tumor-inducing) plasmid

A giant plasmid of *Agrobacterium tumefaciens* that is responsible for tumor formation in infected plants. Ti plasmids are used as vectors to introduce foreign DNA into plant cells.

Tissue culture

Growing or cloning plant or animal tissues or cells in test tubes or other laboratory glassware, without other contaminating organisms, for propagation, chemical production and medical research.

Toxicity

A measure of the degree to which something is toxic or poisonous, or a substance's potential to exert a harmful effect on humans, animals, or plants and a description of the effect and the conditions or concentration under which the effect takes place.

Toxin

A complex and poisonous organic substance, especially a protein, that is produced by living cells or organisms and is capable of causing disease when introduced into the body tissues but is often also capable of inducing neutralizing antibodies or antitoxins.

Trait

See *Phenotype*.

Treaty

A treaty is a binding agreement under international law concluded by two or more sovereign nations. Treaties can be called by many names: treaties, international agreements, protocols, covenants, conventions, exchanges of letters, exchanges of notes, etc.; however all of these are equally treaties.

Transcapsidation

The partial or full coating of the nucleic acid of one virus with a coat protein of a differing virus. See *Coat protein*.

Transcription

The process of creating a complementary RNA copy of DNA.

Transdifferentiation

The observation that stem cells from one tissue may be able to differentiate into cells of another tissue.

Transducing phage

See *Transduction*.

Transduction

The transfer of DNA sequences from one bacterium to another via lysogenic infection by a bacteriophage (transducing phage).

Transfection

The uptake and expression of a foreign DNA sequence by cultured eukaryotic cells.

Transfer DNA. See *T-DNA*.

Transfer RNA (tRNA)

See *tRNA*.

Transformant

In prokaryotes, a cell that has been genetically altered through the uptake of foreign DNA. In higher eukaryotes, a cultured cell that has acquired a malignant phenotype. See *Transformation*.

Transformation

A change in the genetic structure of an organism as a result of the uptake and incorporation of foreign DNA. In higher eukaryotes, the conversion of cultured cells to a malignant phenotype - typically through infection by a tumor virus or transfection with an oncogene. See *Transformant*, *Transformation efficiency*.

Transformation efficiency

The number of bacterial cells that uptake and express plasmid DNA divided by the mass of plasmid used (in transformants/microgram). See *Transformation*.

Transforming oncogene

A gene that upon transfection converts a previously immortalized cell to the malignant phenotype. See *Oncogene*.

Transgene

See *Transgenic*.

Transgenic

An organism in which a foreign DNA gene (a transgene) is incorporated into its genome early in development. The transgene is present in both somatic and germ cells, is expressed in one or more tissues, and is inherited by offspring in a Mendelian fashion. See *Transgenic animal*, *Transgenic plant*.

Transgenic animal

Genetically engineered animal or offspring of genetically engineered animals. The transgenic animal usually contains material from at least one unrelated organism, such as from a virus, plant, or other animal. See *Transgenic*.

Transgenic plant

Genetically engineered plant or offspring of genetically engineered plants. The transgenic plant usually contains material from at least one unrelated organisms, such as from a virus, animal, or other plant. See *Transgenic*.

Transition-state intermediate

In a chemical reaction, an unstable and high-energy configuration assumed by reactants on the way to making products. Enzymes are thought to bind and stabilize the transition state, thus lowering the energy of activation needed to drive the reaction to completion.

Translation

The process of converting the genetic information of an mRNA on ribosomes into a polypeptide. Transfer RNA molecules carry the appropriate amino acids to the ribosome, where they are joined by peptide bonds.

Translocation

The movement or reciprocal exchange of large-chromosomal segments, typically between two different chromosomes.

Transposable genetic element

See *Transposon*.

Transposition

The movement of a DNA segment within the genome of an organism.

Transposon (transposable, or movable genetic element)

A relatively small DNA segment that has the ability to move from one chromosomal position to another.

Transposon

A mobile genetic element that can move from one location in the genome and reinsert at another site.

tRNA (transfer RNA)

The class of small RNA molecules that transfer amino acids to the ribosome during protein synthesis. See *Transfer RNA*.

Trophoblast

The extraembryonic tissue responsible for implantation, developing into the placenta, and controlling the exchange of oxygen and metabolites between mother and embryo.

Tumor DNA

See *T-DNA*.

Tumor virus

A virus capable of transforming a cell to a malignant phenotype. See *Virus*.

Tumor-inducing plasmid

See *Ti plasmid*.

U**Undifferentiated**

Not having changed to become a specialized cell type.

United Nations Resolution 1540

United Nations resolution 1540 (2004) was adopted by the Security Council in April 2004, calling on all states to develop and implement effective laws that establish domestic controls to prevent the proliferation of nuclear, chemical, or biological weapons and their means of delivery, including by establishing appropriate controls over related materials.

Upstream

The region extending in a 5' direction from a gene.

V

Vaccine

A preparation of dead or weakened pathogen, or of derived antigenic determinants, that is used to induce formation of antibodies or immunity against the pathogen. See *Polyvalent vaccine*, *Subunit vaccine*.

Vaccinia

The cowpox virus used to vaccinate against smallpox and, experimentally, as a carrier of genes for antigenic determinants cloned from other disease organisms.

Variable surface glycoprotein (VSG)

One of a battery of antigenic determinants expressed by a microorganism to elude immune detection.

Variation

Differences in the frequency of genes and traits among individual organisms within a population.

Vector

The agent used to carry new DNA into a cell. Viruses or plasmids are often used as vectors. Also living carriers of genetic material such as insects that carry pollen from plant to plant,.

Viral oncogene

A viral gene that contributes to malignancies in vertebrate hosts. See *Oncogene*.

Viroid

A plant pathogen that consists of a naked RNA molecule of approximately 250-350 nucleotides, whose extensive base pairing results in a nearly correct double helix. See *Satellite RNA*.

Virulence

The degree of ability of an organism to cause disease.

Virus

An infectious particle composed of a protein capsule and a nucleic acid core, but which must invade a cell to reproduce. A double-stranded DNA copy of an RNA virus genome that is integrated into the host chromosome during lysogenic infection. See *Coat protein*, *DNA*, *Genome*, *Host*, *Nucleic acid*, *RNA*, *Tumor virus*.

VSG

See *Variable surface glycoprotein*.

W

Wild type

An organism as found in nature; the organism before it is genetically engineered.

X

X-linked disease

A genetic disease caused by a mutation on the X chromosome. In X-linked recessive conditions, a normal female "carrier" passes on the mutated X chromosome to an affected son.

X-ray crystallography

The diffraction pattern of X-rays passing through a pure crystal of a substance.

Xenotransplantation

Z

Z-DNA

A region of DNA that is "flipped" into a lefthanded helix, characterized by alternating purines and pyrimidines, and which may be the target of a DNA-binding protein.

Zoonotic Agent

A pathogen that is, under normal conditions, communicable from animals to humans

Zygote