Glossary

Common terms in molecular biology – part 1 (a–f)

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Presently, cardiovascular surgeons cannot practise good surgery without understanding the structure and function of the heart; similarly a modern physician will not be able to practise good medicine without understanding the structure and function of genes. – Professor Paul Berg, Nobel Laureate (paraphrased)

Molecular biology is increasingly taking centre stage in all aspects of medicine, especially oncology, and may soon have therapeutic applications. Here, I present some of the commonly used terms in molecular biology which may be useful for oncologists in their practice as well as in understanding the pathophysiology of the diseases. The list is not all-inclusive, but covers most important terms.

Acute transforming retroviruses – Viruses that have acquired sequences from the host genome, giving them the property of causing tumours or transformation of cells in culture. They are also known as viral oncogenes.

Allele – One of several alternate forms of a gene occupying a locus on a chromosome.

Allosteric control – Ability of an interaction at one site of a protein to influence the activity at another site.

Amplification – Induction of additional copies of a chromosomal sequence seen as intrachromosomal or extrachromosomal DNA.

Anchorage dependent – Need of normal eukaryotic cells for a surface to which to attach in order to grow in culture.

Anneal – To form hydrogen-bonded base pairs between complementary strands of nucleic acids.

Antiparallel – Strands of the double helix are organised in opposite directions, so that the 5' end of one strand is aligned with the 3' end of the other strand.

Antisense – This is a noncoding strand, and serves as a template for mRNA synthesis. It is complementary to the sense strand. Antisense oligonucleotides have been synthesized to block information flow at mRNA.

Apoptosis – Also known as programmed cell death. It is conceptualised as a preprogrammed pathway of sequential biochemical events that leads to cleavage of nuclear chromatin and eventual cell death with characteristic morphological changes. Apoptosis is an active process as compared to passive cell necrosis.

Bacteriophage – Bacterial viruses which have been extensively modified for use as molecular cloning vehicles.

Base pair (bp) – Pairing of A with T or C with G in a double helix. Other pairs can be formed in RNA under certain conditions. The distance along a piece of DNA is measured in bps.

C-value – Total amount of DNA in a haploid genome.

CCAAT box – Part of a conserved sequence, located upstream of the starting point of the eukaryotic transcription site. It may be involved in binding RNA polymerase. It is only one of the many protein-binding motifs involved in transcriptional regulation.

Cap – Addition of a modified 7-methylguanosine nucleotide to the 5' end of the growing mRNA chain.

CDC – Cell division cycle protein, involved directly in the control of the cell cycle, eg, CDC2(p34) is a kinase enzyme.

CdK (cyclin-dependent kinase) – Enzymes with activities that are tightly regulated by protein phosphorylation and associated with cyclins. Sequential activation of the cyclin/CdK complexes probably governs the orderly transitions of the cell cycle.

cdNA – Single-stranded DNA complementary to RNA and synthesized from it by reverse transcription, *in vitro*.

cdNA clone – Duplex DNA sequence representing RNA.

cdNA libraries – A collection of clones representative of the mRNA of a given cell type that is formed using reverse transcriptase.

Cell line – A cell culture composed of a single immortalised stem cell population.

Cellular oncogene – Altered proto-oncogene, eg, by mutation, which leads it to acquire an altered cellular function that contributes to carcinogenesis.

CentiMorgan – Unit representing a recombination frequency of 1% or approximately 1 million base pairs in humans.

Chromosomal walking and jumping – Techniques of mapping segments of DNA (up to several hundred kb) through the identification of overlapping DNA fragments in a genomic DNA library. They are performed to reach a particular point of interest.

Cis-acting locus – A regulatory sequence that effects activity of DNA sequences on its own molecule of DNA.

Cis-configuration – Two sites on the same molecule of DNA.

Clone – Large number of identical cells or molecules with a single ancestral cell or molecule.

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sity Medical School,
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Cloning vector—Plasmid or phage that is used as a vector for an inserted foreign gene for the purpose of producing more DNA product or characterisation of DNA.

Closed reading frame—Contains termination codons that prevent its translation into proteins.

Coding sequence—That part of the genome or mRNA that is translated into protein.

Codon—A triplet of nucleotides coding for one amino acid or termination signal.

Complementary bases—Bases which are hydrogen bonded specifically in a DNA duplex or in DNA/RNA heteroduplex.

Conditional expression—Gene expression that occurs only in response to certain stimuli or specific conditions.

Consensus sequence—An idealised nucleotide or amino acid sequence in which each position represents the base most often found when many actual sequences are compared.

Constitutional deletion—Deletion inherited in the germline from one or other parent and present in every cell of the body (usually examined in lymphocytes), *cf* somatic.

Constitutive expression—A gene that is present and expressed at the same level for most of the cell cycle.

Copy number—The number of copies of a gene present in genomic DNA.

Cosmid—A lambda-derived cloning vector which can carry large fragments of DNA. The vector contains a selectable marker, a plasmid origin of replication, a polylinker, or restriction site into which DNA can be inserted. (The yeast artificial chromosome system, known as the YAC system, which allows large human DNA fragments to be cloned in the yeast, is not a cosmid).

CpG islands—Sequences relatively rich in the dinucleotide CpG; often associated with genes and possibly involved in transcriptional regulation.

Cytokines—Proteins which act as signals to coordinate the cellular response.

Cytoskeleton—Network of fibres in the cytoplasm of the eukaryotic cells.

Deletion—Loss of a single base pair or a large sequence of DNA on chromosomes.

Denaturation—(a) of DNA; melting (separation) of the complementary strands caused by high temperature or chemical conditions, usually reversible. (b) of protein; loss of higher order structures caused by high temperature or chemical conditions, usually irreversible.

Determination—A commitment to follow a given developmental lineage (pathway).

Differentiation—An increase in specialisation towards a specific function as related to embryological development.

DNAase—An enzyme that breaks bonds in the DNA.

DNA chromatin—Structural packing of DNA double helix into nucleus. The helix is coiled

around histones (to form a nucleosome) which are twisted into a 30-nm wide fibre; this fibre is coiled into loops attached to the nuclear matrix and the loops/matrix are themselves coiled into chromosome bands.

DNA cloning—A technique involving the integration of a specific DNA sequence into a self-replicating element (plasmid or virus) that reproduces itself in bacteria to generate huge numbers of identical copies.

DNA library—Collection of different cDNAs or fragments of genomic DNA propagated in a cloning vector (phage or plasmid) from which specific sequences can be isolated (cloned). Another term used is genomic library.

DNA transfection—The transfer of DNA into cells in culture.

Domain—Large polypeptide chains are folded into units and each folded unit is known as a domain. Frequently used to indicate a region of a protein that has a specific function, eg, ligand-binding domain.

Double minutes—Extra pairs of chromosomal fragments visualised on metaphase spreads, associated with amplification, eg, multidrug resistance, myc oncogene.

Down-regulation—Process by which a cell loses its sensitivity to growth factor or hormone stimulation (often by endocytosis of growth factor receptors).

Downstream—Sequences proceeding further in the direction of expression.

Drug adducts—DNA modified by a covalently bound drug or the reactive side-group of a drug.

End-labelling—Addition of a radioactively labelled group to one end (5' or 3') of a DNA strand.

Endonucleases—Enzymes which cleave bonds within a nucleic acid chain.

Enhancer element—Cis-acting sequence that increases the utilisation of eukaryotic promoters (see Cis-acting locus).

Epigenetic phenomenon—Passed from a cell to its progeny without any alteration in the coding sequence of DNA.

Episome—Plasmid able to integrate into bacterial DNA.

Epitope—Antigenic determinant (there may be several per molecule).

Euchromatin—The decondensed form of chromatin typical of the interphase nucleus.

Excision repair—System that removes a single-stranded DNA sequence containing damaged or misplaced bases and replaces them in duplex with a complementary strand.

Exonucleases—Enzymes which cleave nucleotides at the end of a polynucleotide chain, eg, 5' or 3' end of DNA or RNA.

Exons—Transcribed sequence not spliced out of mature RNAs.

Footprinting—Technique for identifying the site of DNA/protein binding.