

CAIE Biology A-level

Topic 19 - Genetic Technology

Definitions and Concepts

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Bioinformatics - The development of the computer tools and software required to organise and analyse unprocessed biological data.

Bt maize - A variant of maize genetically engineered to produce its own insecticide, the Bt toxin, making it resistant to corn borers.

Cystic fibrosis - An autosomal recessive condition characterised by the production of thick, sticky mucus that causes lung infections and scarring.

DNA ligase - An enzyme that joins the sugar-phosphate backbone of two DNA segments.

DNA polymerase - An enzyme that synthesises a double-stranded molecule of DNA from a single template strand using complementary nucleotides.

Embryo biopsy - A few cells from an embryo can be extracted and screened for genetic diseases.

Gel electrophoresis - A type of chromatography that separates nucleic acid fragments or proteins by size using electric current.

Gene editing - A type of genetic engineering that involves the deletion, insertion or replacement of DNA at particular sites in the genome.

Gene therapy - A therapeutic technique in which a faulty allele is replaced with a functional allele in order to treat or prevent disease.

Genetically modified organism (GMO) - An organism that has had its genome altered.

Genetic engineering - The modification of the genome of an organism by the insertion of a desired gene from another organism. This enables the formation of organisms with beneficial characteristics.

Genetic screening - Testing individuals for specific genes or faulty alleles. This can be used to detect disorders (e.g. haemophilia, sickle cell disease, cystic fibrosis, Huntington's disease) or to identify an increased risk of some cancers (e.g. breast cancer).

Genome sequencing - Determining the entire DNA nucleotide base sequence of an organism.

GM salmon - Genetically modified salmon. A gene that is inserted into fertilised eggs results in an increased appetite, enabling the fish to reach the desired market size rapidly.

Golden rice - A variety of rice genetically engineered to produce beta-carotene, a precursor of vitamin A.

Haemophilia - A sex-linked genetic condition caused by a mutation of the factor VIII (*F8*) gene on the X chromosome. This disrupts the body's ability to form clots.

Huntington's disease - A genetic disorder characterised by the progressive degeneration of nerve cells in the brain, reducing the affected individual's ability to think, talk and move.



Ligases - Enzymes which catalyse the joining of two molecules, usually via a hydrolysis reaction.

Liposome - A vesicle with a lipid bilayer that can be used to administer medication.

Marker gene - An additional gene inserted into a plasmid that is used to aid in the identification of host cells that have taken up the desired gene. Marker genes are easily recognisable, e.g. fluoresce, provide antibiotic resistance.

Microarrays - A method of DNA sequencing. The DNA sample hybridises with fragments of single-stranded DNA bound to a chip.

Plasmids - Loops of DNA found in the cytoplasm of prokaryotic cells. They can be used as vectors in genetic engineering.

Polymerase chain reaction (PCR) - An *in vitro* technique used to rapidly amplify fragments of DNA.

Promoter sequence - A region upstream of a gene where the transcription initiation complex is formed.

Recombinant DNA - A combination of DNA from two different organisms.

Recombinant protein - A protein produced as a result of the expression of recombinant DNA in a cell.

Restriction endonucleases - Enzymes that cut DNA molecules at recognition sequences, creating sticky ends.

Reverse transcriptase - A viral enzyme which produces cDNA from an RNA template.

Severe combined immunodeficiency (SCID) - A group of polygenic diseases which disrupt the development of B and T lymphocytes, resulting in persistent infection.

Sickle cell anaemia - A disease characterised by hook-shaped red blood cells. A missense point mutation of GAG to GTG in the HbA (normal) allele for the β -globin polypeptide results in the HbS (sickle cell) allele of the gene.

Taq polymerase - A DNA polymerase from a bacterial species which is adapted to live in extreme heat. It is used in PCR technology to produce fragments.

Vector - A carrier used to transfer a gene from one organism to another, e.g. plasmid, virus, liposome.

