CAIE Biology A-level

Topic 6 - Nucleic Acids and Protein Synthesis

Definitions and Concepts

Adenosine triphosphate (ATP) - A nucleotide derivative that acts as the energy currency of cells. It consists of a molecule of ribose, a nitrogenous adenine base and three phosphate groups.

Amino acids - The monomers containing an amino group (NH_2), a carboxyl group (COOH) and a variable R group that make up proteins.

Anticodon - A sequence of three nucleotide bases at one end of a tRNA molecule that is specific to an mRNA codon.

Antiparallel - Describes the complementary strands of a DNA double helix which run parallel but in opposite directions (5' to 3' and 3' to 5').

Complementary base pairing - Describes how hydrogen bonds form between complementary purine and pyrimidine bases. Two bonds form between A and T in DNA or U in RNA. Three bonds form between G and C.

Deletion mutation - A form of gene mutation in which one or more nucleotide bases are removed from a DNA sequence.

Deoxyribonucleic acid (DNA) - An information storing molecule made up of deoxyribonucleotide monomers joined by phosphodiester bonds to form a double helix.

DNA ligase - An enzyme that catalyses the formation of phosphodiester bonds between Okazaki fragments on the lagging strand during DNA replication.

DNA nucleotide - The monomer that makes up DNA and consists of deoxyribose, a nitrogenous base and a phosphate group.

DNA polymerase - An enzyme that catalyses the formation of phosphodiester bonds between nucleotides during the synthesis of a new DNA strand.

Exons - Regions of DNA or RNA that code for amino acid sequences.

Gene - A sequence of nucleotides on a chromosome that codes for the production of one or more polypeptide chains and functional RNA.

Gene mutation - A change to at least one nucleotide base in DNA or the arrangement of bases. Gene mutations can occur spontaneously during DNA replication.

Insertion mutation - A form of gene mutation in which one or more nucleotide bases are added to a DNA sequence.

Interphase - The longest stage of the eukaryotic cell cycle. It consists of G_1 phase, S phase and G_2 phase and occurs before mitosis. DNA replication occurs during S phase.

Introns - Non-coding sequences of DNA found between exons.

Lagging strand - The DNA strand that is synthesised discontinuously in the 3' to 5' direction (away from the replication fork) during semi-conservative replication.

Leading strand - The DNA strand that is synthesised continuously in the 5' to 3' direction (towards the replication fork) during sem-conservating replication.

Messenger RNA (mRNA) - A type of RNA that carries genetic information from the nucleus to the ribosomes for protein synthesis. It is a single helix consisting of thousands of mononucleotides.

Non-transcribed strand - The strand of DNA whose base sequence corresponds to that of the mRNA transcript synthesised during transcription (although it has T instead of U).

Nucleotide - The monomer from which nucleic acids are made that consists of a pentose sugar, nitrogenous base and phosphate group.

Phosphodiester bond - A type of bond that joins nucleotides together to create polynucleotides.

Polypeptide - Molecules formed by the condensation of many amino acids.

Purine - A class of nitrogenous bases which are made up of two rings. Adenine and guanine are members.

Pyrimidine - A class of nitrogenous bases which are made up of a single ring. Cytosine, thymine and uracil are members.

Ribonucleic acid (RNA) - A relatively short molecule made up of ribonucleotide monomers joined by phosphodiester bonds.

Ribosomes - Organelles found either free in the cytoplasm or bound to the ER that are involved in the synthesis of proteins.

RNA nucleotide - The monomer that makes up RNA and consists of ribose, a nitrogenous base and a phosphate group.

RNA polymerase - An enzyme that catalyses the formation of phosphodiester bonds between nucleotides during the synthesis of a new RNA strand.

Semi-conservative replication - The replication of DNA to produce two new DNA molecules which both contain one new strand and one strand from the original DNA molecule.

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.

Substitution mutation - A form of gene mutation in which one nucleotide base is exchanged for another. This may change an amino acid or produce the same amino acid (due to the degeneracy of the genetic code).

Transcribed strand -The DNA strand that acts as a template for RNA polymerase during transcription. Also known as the template strand.

Transcription - The formation of pre-mRNA in eukaryotes and mRNA in prokaryotes from a section of the template strand of DNA. It is the first stage of protein synthesis.

Transfer RNA (tRNA) - A form of RNA that carries specific amino acids to the ribosomes. It is single-stranded and takes a clover-leaf shape. One side is longer than the other enabling the attachment of an amino acid. At the opposite end is an anticodon specific to the amino acid.

Translation - The second phase of protein synthesis that takes place on the ribosomes. mRNA is used as a template for the attachment of tRNA molecules with complementary anticodons. The amino acids carried on adjacent tRNA molecules are joined to form a polypeptide chain.

Triplet code - A specific sequence of three nucleotides on a molecule of DNA or RNA codes for a particular amino acid in protein synthesis.

Universal - A feature of the genetic code; the same codons code for the same amino acids in almost all organisms.