Definitions and Concepts for AQA Biology A-level

Topic 4 - Genetic Information, Variation and Relationships between Organisms

Adaptation: A feature of an organism that increases its chance of survival in its environment. An adaptation may be anatomical, physiological or behavioural.

Allele: A version of a gene.

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

Arithmetic mean: The average of a set of numbers calculated by dividing the sum of the values by the number of values.

Artificial classification: A type of classification that divides organisms into groups based on analogous characteristics such as leaf shape, number of legs and type of wing.

Binomial system: A universal system of naming organisms that consists of two parts: the generic name and the specific name, e.g. *Homo sapiens*.

Biodiversity: The variety of genes, species and habitats within a particular area.

Cellular proteome: The proteins expressed in a given type of cell.

Chromatid: One strand of a replicated chromosome.

Chromosome: A structure consisting of a long, coiled molecule of DNA and its associated proteins, by which genetic information is passed from generation to generation.

Chromosome mutation: A change to the number or structure of chromosomes that can occur spontaneously.

Classification: The organisation of organisms into groups. There are two types of classification: artificial and phylogenetic.

Codon: A sequence of three bases on mRNA that codes for a specific amino acid.

Conservation: The maintenance of ecosystems and biodiversity by humans in order to preserve the Earth's resources.

Courtship: The behaviour by which members of a species select reproductive partners. It enables organisms to recognise their own species, identify a mate with a capacity to breed, form a pair bond, synchronise mating and become able to breed themselves.

Crossing over: The process in meiosis 1 in which homologous chromosomes pair up, their chromatids wrap around one another and their alleles are exchanged at equivalent portions of chromatids. This creates genetic variation.

Degenerate: A feature of the genetic code; more than one triplet can code for a particular amino acid.

Deletion: A form of gene mutation in which one or more nucleotide bases are removed from a DNA sequence. This may change all amino acids in a sequence, rendering the protein non-functional.

Directional selection: A type of selection that favours individuals that differ in one direction (fall to the left or the right) from the population mean. This changes the traits of the population.

Ecosystem diversity: A measure of the range of different habitats in a particular area.

Eukaryotic DNA: Linear molecules of DNA which, together with histones, form chromosomes. DNA in the mitochondria and chloroplasts of eukaryotic cells is circular and does not have associated proteins.

Exon: A sequence of DNA that codes for an amino acid sequence.

Fertilisation: The random fusion of haploid gametes during fertilisation to produce a diploid zygote. Genetic information is mixed, creating genetic variation.

Gene: A length of DNA 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.

Generic name: Denotes the organism's genus. The first letter is written in upper case, e.g. *Homo*.

Genetic code: The rules by which triplets in a DNA base sequence code for the sequence of amino acids in a polypeptide chain. The genetic code is degenerate, universal and non-overlapping.

Genetic diversity: The number of different alleles in a population. Genetic diversity between organisms can be investigated by comparing observable characteristics, DNA and mRNA base sequences and amino acid sequences.

Genome: The entire set of genes in a cell.

Histones: Proteins that, together with DNA, form chromosomes in the nuclei of eukaryotic cells.

Homologous chromosomes: A chromosome pair, one paternal and one maternal, with the same gene loci.

Independent segregation: The random separation of homologous chromosomes in meiosis 1 that produces genetic variation.

Index of diversity (*d*): Describes the relationship between the number of different species and the abundance of individuals in each of these species within a community. It is calculated using the formula:

$$d = \frac{N(N-1)}{\sum n(n-1)}$$

where *d* is the index of diversity, *N* is the total number of organisms of all species and n is the total number of organisms of each species.

Intron: A non-coding sequence of DNA.

Locus: The position of a gene on a chromosome.

Mean (normal distribution curve): A measure of the maximum height of a normal distribution curve.

Meiosis: A type of cell division that produces four genetically different daughter cells (gametes) with a haploid number of chromosomes. It involves two divisions.

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.

Mitosis: A form of cell division that produces two genetically identical diploid daughter cells.

Mutagenic agent: An agent that increases the rate of gene mutations above normal level.

Natural selection: The process by which the frequency of 'advantageous' alleles gradually increases in a population's gene pool over time.

Non-coding sequence: A sequence of DNA that does not code for an amino acid sequence e.g. repeating base sequences and introns. Non-coding sequences make up significant portions of eukaryotic nuclear DNA.

Non-disjunction: A change in the number of chromosomes due to the failure of homologous chromosomes to separate during meiosis. This may result in a gamete with one more or one less chromosome.

Non-overlapping: A feature of the genetic code; each base in a sequence is read once and is only part of one triplet.

Phylogenetic classification: A type of classification that divides organisms into groups based on evolutionary relationships and homologous characteristics. It uses a hierarchy in which smaller groups are contained within larger groups, with no group overlap.

Phylogeny: The evolutionary relationships between individuals or groups of organisms.

Prokaryotic DNA: Circular pieces of DNA that do not have associated proteins.

Random sampling: A sampling technique used to avoid bias e.g. creating a square grid and generating random coordinates.

Recombination: When broken-off pieces of chromatid combine with another chromatid on a different chromosome during crossing over.

Ribosomes: Sub-cellular structures where protein synthesis takes place. Ribosomes consist of a small subunit and a large subunit.

RNA polymerase: An enzyme that moves along the DNA template strand and joins adjacent nucleotides to form pre-mRNA.

Species: A group of similar organisms that are able to breed with one another to produce living, fertile offspring.

Species diversity: A measure of the number of different species and the abundance of individuals in each of these species within a community.

Species richness: A measure of the number of different species in a community at a given time. It is a measure of species diversity.

Specific name: Denotes the organism's species. It is written in lower case letters, e.g. *sapiens*.

Splicing: The process following transcription in eukaryotic cells in which introns are removed from pre-mRNA and exons are joined together to form mRNA.

Stabilising selection: A type of selection that favours individuals close to the mean, maintaining the traits of the population.

Standard deviation (normal distribution curve): A measure of the width of a normal distribution curve and an indication of the range of values.

Substitution: 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).

Taxon: Each group within a phylogenetic classification system.

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 in 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: A sequence of three bases that codes for an amino acid.

Universal: A feature of the genetic code; the code is the same in almost all organisms. This is evidence for evolution.

Variation: The differences between individuals due to genes, the environment or a combination of both.