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Mutations at Molecular level

At molecular level, mutations results in permanent alteration in sequence of nucleotides (bases) of genetic material. These alterations (mutations) in base sequence may be of two types, viz.,
(1) alteration in whole nucleotide and (2) alteration in a portion of nucleotide as described below:

Alteration in Whole nucleotide

Such alterations or mutations are the result of breaking the backbone of genetic nucleic acid (DNA or RNA as the case may be) at two or more places. Such alterations include addition, deletion inversion or transposition of one or more nucleotides. All these mutations except inversion are possible for single stranded nucleic acids. Inversion requires double stranded nucleic acid

Alteration in a portion of Nucleotide

Some mutations affect only a part of a nucleotide, resulting in replacement of base pair. The replacement of base pair may take place during replication of DNA without any breakage of DNA. These base pair replacement can be of two types, viz.

Transition - Substitution or replacement of one purine by another purine or one pyrimidine by another pyrimidine is known

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as transition (A ↔ G or C ↔ T). It means that both way change between purines (A and G) and pyrimidines (C & T) can occur. Such type of change yield a normal base.

Transversion

Substitution of a purine by pyrimidine and vice versa (A or G ↔ C or T or U) is called transversion. In transversion, either a base is converted into an abnormal base or is substituted by such base. These changes occur either due to misincorporation or misreplication. Moreover, transitions are generally more frequent than transversions.

Frameshift Mutations

The mutations which arise due to additions or deletion of nucleotides in mRNA are known as frameshift mutations, because the normal reading frame of base triplets (Codons) is altered as a consequence of such mutations. The addition or deletion of nucleotides occur in numbers other than three or multiple of three. The reading frame in such case is shifted from the point of addition or deletion onwards. The addition or deletion of base pairs takes

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place in intervalary position. Sometimes, addition and deletion take place at the same position, they are known as double frameshifts. Such changes may restore the normal reading frame in mRNA. Frameshift mutations arise in two ways, viz. (1) by error during DNA repair or replication, and (2) by acridine dyes.

Nonsense and Missense Mutations

After frameshift mutations, three types of codons are produced, viz. (1) Sense codons, (2) missense codons and (3) non-sense codons. The sense codons are normal codons which are read in the same way as before frameshift mutations. Missense mutations have missense codons which code for different amino acids. Nonsense mutations are those having nonsense codons which do not code for any amino acid. Nonsense mutations result in premature termination of polypeptide chains and hence are also called chain termination mutations. Missense mutations usually result in replacement of single amino acids in the polypeptide chain. missense mutations are more frequent than nonsense mutations.

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