Molecular Basis of Inheritance

CHAPTER 6

TRY YOURSELF

ANSWERS

1. The three dimensional structure of DNA was proposed by Watson and Crick in 1953. According to this model each strand of DNA has a specific polarity. One end is considered as 5′ end whereas the other end is considered as 3′ end. One of the strands runs in 5′-3′ direction while the other runs in 3′-5′ direction. This arrangement of two strands of DNA is considered antiparallel.

The nitrogen bases present on one strand, pair with the nitrogen bases present on the other strand by means of hydrogen bonds. Purine base A always pairs with the pyrimidine base T by two hydrogen bonds and the purine base G always pairs with the pyrimidine base C with three hydrogen bonds. This pairing is termed as complementary base pairing. As the base sequence present on one strand of DNA decides the base sequence of the other strand, the strands are regarded as complementary strands.

2. In prokaryotes, such as, *E. coli*, though they do not have a defined nucleus, the DNA is not scattered throughout the cell. DNA being negatively charged is held with some nucleoid associated proteins that have positive charges in a region termed as 'nucleoid'. The DNA in nucleoid is organised in large loops held by proteins.

3. Watson and Crick suggested that the two strands of DNA molecule uncoil and separate and each strand serves as a template for the synthesis of a new (complementary) strand. The template and its complement, then form a new DNA double strand. Thus, two daughter DNA molecules identical to the parent molecule are formed and each daughter DNA molecule consists of one old (parent) strand and one new strand. Since only one parental strand is conserved in each daughter molecule, this mode of replication is said to be semiconservative.

4. DNA is the hereditary material.

5. Primase is an enzyme that synthesises short RNA sequences called primers. They serve as a starting point for DNA synthesis.

6. *t*RNA is the smallest RNA among all three types of RNA. It takes part in the transfer of activated amino acids from cellular pool to ribosome, so that they can take part in protein formation. *t*RNAs have a clover leaf structure which is stabilised by strong hydrogen bonds between the nucleotides.

7. Transcription is the process of formation of *m*RNA from DNA. In prokaryotes, transcription requires:

- A template DNA strand
- Four types of ribonucleotide triphosphates : ATP, GTP, CTP and UTP
- RNA polymerases
- Some transcription factors like sigma (σ) factor, rho (ρ) factor.

8. In most organisms, AUG codon is the start or initiation codon. When AUG occurs in between the two ends of a cistron, it codes for amino acids methionine (eukaryotes) or N-formyl methionine (prokaryotes). But when, AUG occurs immediately after a termination codon it acts as start codon. In rare cases, GUG, also serves as the initiation codon. The three triplets, UAA, UAG, UGA do not code for any amino acid. They cause the release of polypeptide chain from the ribosome and are also called as stop codons.

9. Singlet and doublet codes are not adequate to code for 20 amino acids, therefore, it was pointed out that triplet code is the minimum required. Out of all 64 possible triplet codons, 61 codons code for different amino acids and 3 codons do not code for any amino acid.

10. The two protein synthesis inhibitors that inhibit the initiation of translation are :

(a) Neomycin : Inhibits the interaction between *t*RNA and *m*RNA.

(b) Tetracycline : Inhibits binding of amino acyl-*t*RNA to ribosome.

11. The termination of translation occurs when a nonsense codon (UAA, UAG or UGA) is encountered for which there is no complementary *t*RNA. Therefore, no more aminoacyl *t*RNA reaches the A site. The P site *t*RNA is hydrolysed and the completed polypeptide is released in the presence of GTP – dependent release factor. It is single (eRF1) in eukaryotes and two (RF1 and RF2) in prokaryotes.

12. The lac operon constitute of three elements:

(a) An operator site : It is a DNA sequence that regulates transcription of the structural gene.

(b) A regulatory gene : It encodes for the repressor that recognises the operator sequence.

(c) Structural genes : The three genes (z, y and a) encoding the enzymes β-galactosidase, permease and transacetylase respectively are required for the metabolism of lactose.

13. Repressors are the negative regulators. They control the functions of structural genes by decreasing or eliminating the transcription of genes.
Activators are the positive regulators, that increase the transcription of regulated genes. In *lac* operon, repressor acts as a lactose sensor while activator acts as a glucose sensor.

14. DNA fingerprinting is a technique of determining nucleotide sequences of certain areas (VNTRs) of DNA which are unique to each individual. A DNA fingerprint is same for every cell, tissue and organ of a person. Therefore, it can be used to identify real genetic mother, father and the offspring.

15. DNA polymorphism is the variation at genetic level, arises due to mutations. Such variations are unique at particular site of DNA. They occur approximately once in every 500 nucleotides or about 10^7 times per genome. These mutations occurs in non-coding DNA sequence and does not show any phenotypic effect but are heritable. Thus, the polymorphism in DNA forms the basis of genetic mapping of human genome.

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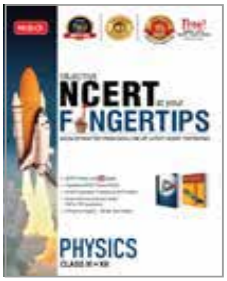

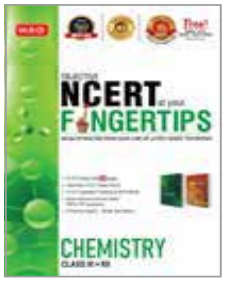

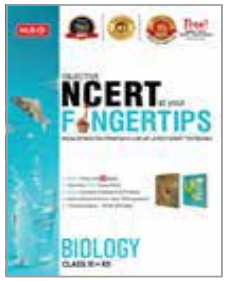

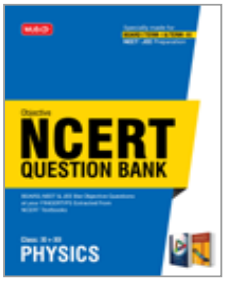

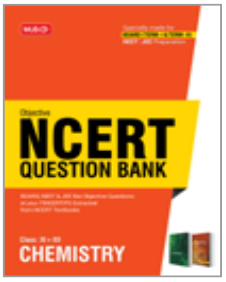

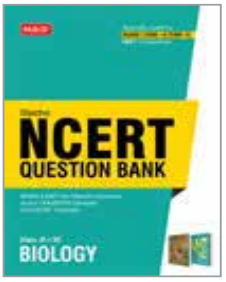

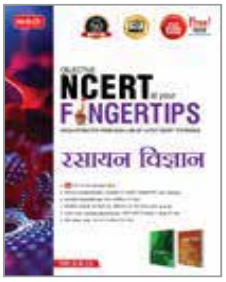

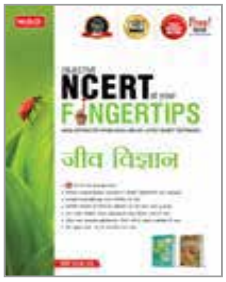

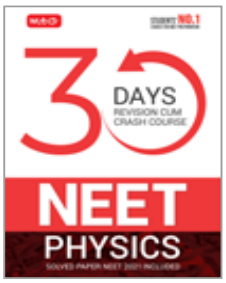

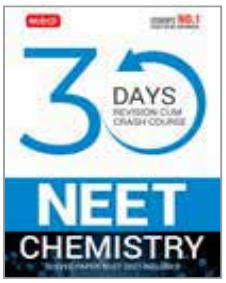

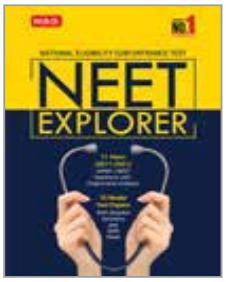

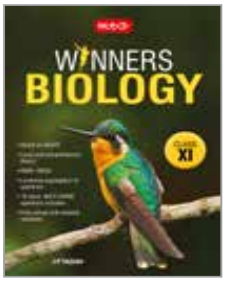

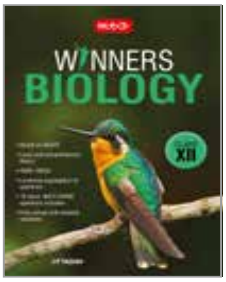

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