GURU GOBIND SINGH PUBLIC SCHOOL, CHAS

BIOLOGY ASSIGNMENT Week 5

Class XII

DNA

(1) DNA is a long polymer of deoxyribonucleotides.

(2) The length of the DNA depends on the number of nucleotide pairs present in it.

(3) Bacteriophage lambda has 48,502 base pairs.

Central dogma of molecular biology

(1) Crick proposed the Central dogma in molecular biology

(2) It states that the genetic information flows from DNA à RNA à Protein.

(3) In some viruses like retroviruses, the flow of information is in reverse direction, which is from RNA à DNA à mRNA à Protein.

Structure of polynucleotide chain:

(1) A nucleotide has three components-

(a) A nitrogen base

(b) A pentose sugar (ribose in RNA and deoxyribose in DNA)

(c) A phosphoric acid.

(2) There are two types of nitrogen bases:

(a) Purines (Adenine and Guanine)

(b) Pyrimidines (Cytosine, Uracil and Thymine)

(3) Adenine, Guanine and Cytosine are common in RNA and DNA.

(4) Uracil is present in RNA and in DNA in place of Uracil, Thymine is present.

(5) In RNA, Pentose sugar is ribose and in DNA, it is Deoxyribose.

(6) Based on the nature of pentose sugar, two types of nucleosides are formed - ribonucleoside and deoxyribonucleotides.

(7) Two nucleotides are joined by 3'-5' Phosphodiester linkage to form dinucleotide.

(8) More than two nucleotides join to form polynucleotide chain.

(9) The two strands of DNA (called DNA duplex) are antiparallel and complementary, i.i., one in 5'->3' direction and the other in 3"->5" direction.

History of DNA

(1) DNA is an acidic substance in the nucleus.

(2) It was first identified by Friedrich Meischer in 1869. He named it as 'Nuclein"

(3) In 1953 double helix structure of DNA was given by James Watson and Francis Crick, based on X-ray diffraction data produced Maurice Wilkins and Rosalind Franklin.

Packaging of DNA Helix

(1) The basic unit into which DNA is packed in the chromatin of eukaryotes.

(2) Nucleosome is the basic repeating structural (and functional) unit of chromatin, which contains nine histone proteins.

(3) Distance between two conjugative base pairs is 0.34nm

(4) The length of the DNA in a typical mammalian cell will be 6.6 X109 bp X 0.34 X10-9 /bp, it comes about 2.2 meters.

(5) The length of DNA is more than the dimension of a typical nucleus (10-6m)

DNA Replication

(1) DNA is the only molecule capable of self duplication so it is termed as a living molecule.

(2) All living beings have the capacity to reproduce because of DNA.

(3) DNA replication takes place in S-phase of the cell cycle. At the time of cell division, it divides in equal parts in the daughter cells.

(4) Delbruck suggested three methods of DNA replication i.e.

(i) Dispersive

(ii) Conservative

(iii) Semi-conservative

(5) The process of DNA replication takes a few minutes in prokaryotes and a few hours in eukaryotes.

RNA

(1) RNA is the first genetic material.

(2) RNA is a non hereditary nucleic acid except in some viruses (retroviruses).

(3) RNA used to act as a genetic material as well as catalyst.

(4) It is a polymer of ribonucleotide and is made up of pentose ribose sugar, phosphoric acid and nitrogenous base (A,U,G,C).

(5) RNA may be of two types – genetic and non-genetic.

Genetic Code

(1) Term genetic code was given by George Gamow (1954). He was the first to propose the triplet code (one codon consists of three nitrogen bases).

(2) The relationship between the sequence of amino acids in a polypeptide chain and nucleotide sequence of DNA or mRNA is called genetic code.

(3) There occur 20 types of amino acids which participate in protein synthesis. DNA contains information for the synthesis of any types of polypeptide chain. In the process of transcription, information transfers from DNA to m-RNA in the form of complementary N2-base sequence.

(4) A codon is the nucleotide sequence in m-RNA which codes for particular amino acid; whereas the genetic code is the sequence of nucleotides in m-RNA molecule, which contains information for the synthesis of polypeptide chain.

(5) 61 out of 64 codons code for only 20 amino acids.

(6) The main problem of genetic code was to determine the exact number of nucleotide in a codon which codes for one amino acid.

Characteristics of genetic code

(1) Triplet in nature

(a) A codon is composed of three adjacent nitrogen bases which specify one amino acid in polypeptide chain.

(b) For example- In m-RNA if there are total 90 N2 – bases. Then this m-RNA determines 30 amino acids in polypeptide chain.

(2) Univerality

(a) The genetic code is applicable universally.

(b) The same genetic code is present in all kinds of living organism including viruses, bacteria, unicellular and multicellular organisms. In all these organisms, triplet code for specific amino acid.

(3) Non-ambiguous

(a) Genetic code is non ambiguous i.e. one codon specifies only one amino acid and not any other.

(b) In this case one codon never code two different amino acids. Exception GUG codon which code both valine and methionine amino acid.

(4) Non-overlapping

(a) A nitrogen base is a constituent of only one codon.

(5) Comma less

(a) There is no punctuation (comma) between the adjacent codon i.e. each codon is immediately followed by the next codon.

(b) If a nucleotide is deleted or added, the whole genetic code read differently.

(c) A polynucleotide chain having 50 amino acids shall be specialized by a linear sequence of 150 nucleotides. If a nucleotide is added in the middle of this sequence, the first 25 amino acids of polypeptide will be same but next 25 amino acids will be different.

(6) Degeneracy of genetic code

(a) Only two amino acids – tryptophan and methionine are specified by single codon.

UGG for tryptophan

AUG for methionine

(b) All the other amino acids are specified or coded by 2 to 6 codons.

(c) Leucine, serine and arginine are coded or specified by 6-codons.

(d) Degeneracy of genetic code is related to third position (3'-end of triplet codon) of codon. The third base is described as 'Wobble base'.

ANSWER THE FOLLOWING QUESTIONS:

1. Describe the double helical model of DNA.

2. Describe the structure of DNA.

3. Explain the different types of Nitrogen Bases.

4. Explain Central Dogma.

5. What is transformation of DNA? Explain with the help of F. Griffith experiment.