Subject Code : RN2P8

Molecular Biology

Unit I – DNA: Properties, enzymes, replication

Nucleic acids as genetic information carriers: experimental evidence. DNA structure: historical aspects and current concepts, melting of DNA. DNA replication: general principles, various modes of replication, isolation and properties of DNA polymerases, proof reading, continuous and discontinuous synthesis. Asymmetric and dimeric nature of DNA polymerase III and simultaneous synthesis of leading and lagging strands, DNA polymerase, exonuclease activity in eukaryotic DNA polymerases. Superhelicity in DNA, linking number, topological properties, mechanism of action of topoisomerases.

Unit II – DNA: Repair mechanisms

Initiation of replication of single stranded DNA. Construction of replication fork in test tube. Reteroviruses and their unique mode of DNA synthesis. Relationship between replication and cell cycle. Inhibitors of DNA replication (blocking precursor synthesis, nucleotide polymerization, altering DNA structure). DNA damage and repair: types of DNA damage (deamination, oxidative damage, alkylation, pyrimidine dimmers). Repair pathways – methyl-directed mismatch repair, very short patch repair, nucleotide excision repair, base excision repair, recombination, repair, SOS system.

Unit III – RNA types, processing and their regulation

Structural features of RNA (rRNA, tRNA and mRNA) in relation to function. Initiator and elongator class of tRNA, ribosome binding site in mRNA and corresponding site on rRNA, peptidyl transferase activity of 23S rRNA - Transcription: general principles - basic apparatus - types of RNA polymerases, Processing steps. initiation, elongation and termination, inhibitors of RNA synthesis. Polycistronic and monocistronic RNAs. Control of transcription by interaction between RNA polymerases and promoter regions, use of alternate sigma factors, controlled termination: attenuation and antitermination.

Unit IV – Transcription and regulation

DNA binding proteins, enhancer sequences and control of transcription. Identification of protein – binding proteins, enhancer sequences and control of transcription. Identification of protein-binding sites on DNA. Global regulatory responses - heat shock response - stringent response and regulation by small molecules such as ppGpp and cAMP, regulation of rRNA and tRNA synthesis.

Maturation and processing of RNA: methylation, cutting and trimming of rRNA; capping, polyadenylation and splicing of mRNA ; cutting and modification of tRNA degradation system. Catalytic RNA, group I and group II intron splicing, RNase P.

Unit V – Genetic code – Protein synthesis – Translation process

Basic features of the genetic code. Protein synthesis: details of initiation, elongation and termination, role of various factors in the above steps,

inhibitors of protein synthesis. Synthesis of exported proteins on membrane-bound ribosomes, signal hypothesis. In vitro transcription and translation systems.

Reference:

1. Antony, J.F., Griffiths, Gilbert, W.M., Lewontin, R.C. and Miller, J.H. (2002). Modern genetic analysis, Integrating Genes and Genomes, 2nd edition, WH Freeman and Company, New York.
2. Blackburn, G.M. and Gait, M.J. (1996). Nucleic acids in chemistry and biology. Oxford University Press.
3. Bruce Alberts, Dennis Brag, Julian Lewis, Martin Raff, Keith Roberts, James D. Watson. (1994). Molecular Biology of cell. Garland Publishing Inc.
4. George M. Malacinski, David Freifelder. (1998). Essentials of Molecular Biology. Jones and Bartlett Publsihers.
5. Lewin, B, (2000). Genes VII. Oxford University Press.
6. Maloy, S.R., Cronan, J.R. Freifelder, D. (1994). Microbial Genetics, Jones and Bartlett Publishers.
7. Neidhart, F.C. (1996). Cellular and Molecular Biology(Vol. I & II), *Escherichia coli* and *Salmonella typhirium*.
8. Maacinski, G.M. and Freifelder, D. (1998). Essentials of Molecular Biology, 3rd Edition, John and Bartlett Publishers.
9. Sir John Kendrew (1994). The encyclopedia of Molecular Biology. Blackwell Science Ltd.