

Gene Organization, Replication and Repair

THEORY

- 1. Structure of DNA (4 lectures)**
DNA structure, features of the double helix, various forms of DNA, denaturation and reassociation of DNA.
[Molecular Biology of the Gene (2008) Watson et al., p101-117]
- 2. Genes and genomic organization (8 lectures)**
Genome sequence and chromosome diversity, definition of a gene, organization of genes in viruses, bacteria, animals and plants. Nucleosome structure and packaging of DNA into higher order structures.
[Lehninger: Principles of Biochemistry (2013) Nelson and Cox, p979-985, p994-1003; Molecular Biology of the Gene (2008) Watson et al., p135-152, p157-160, p187-191]
- 3. Replication of DNA (18 lectures)**
The chemistry of DNA synthesis, DNA polymerase, the replication fork, origin of replication, enzymes and proteins in DNA replication, various modes of replication, stages of replication of *E. coli* chromosome, relationship between replication and cell division, replication in eukaryotes. Comparison of replication in prokaryotes and eukaryotes. Inhibitors of DNA replication and applications in medicine. Supercoiling of DNA and its importance, topoisomerases, critical role of topoisomerases in cell, topoisomerase inhibitors and their application in medicine.
[Molecular Biology of the Gene (2008) Watson et al., p195-254; Lehninger: Principles of Biochemistry (2013) Nelson and Cox, p985-993]
- 4. Recombination and transposition of DNA (10 lectures)**
Homologous recombination, proteins and enzymes in recombination, site-specific recombination, serine and tyrosine recombinases, biological roles of site-specific recombination, transposition, three classes of transposable elements, importance of transposable elements in horizontal transfer of genes and evolution.
[Molecular Biology of the Gene (2008) Watson et al., p283-310, p319-354]
- 5. Molecular basis of mutations (2 lectures)**
Importance of mutations in evolution of species. Types of mutations - transition, transversions, frame shift mutations, mutations induced by chemicals, radiation, transposable elements, Ames test.
[Principles of Genetics (2010) Snustad and Simmons, p354-364]
- 6. Various modes of DNA repair (6 lectures)**
Replication errors and mismatch repair system, repair of DNA damage, direct repair, base excision repair, nucleotide excision repair, recombination repair, translesion DNA synthesis.
[Molecular Biology of the Gene (2008) Watson et al., p257-281]

Essential Readings

1. Molecular Biology of the Gene (2008) 6th ed., Watson, J.D., Baker, T.A., Bell, S.P., Gann, A., Levine, M. and Losick, R., Cold Spring Harbor Laboratory Press, Cold spring Harbor (New York), ISBN:0-321-50781 / ISBN:978-0-321-50781-5.
2. Lehninger: Principles of Biochemistry (2013) 6th ed., Nelson, D.L. and Cox, M.M., W. H. Freeman & Company (New York), ISBN:13: 978-1-4292-3414-6 / ISBN:10-14641-0962-1.
3. Principles of Genetics (2010) 5th ed., Snustad, D.P. and Simmons, M.J., John Wiley & Sons Asia, ISBN:978-0-470-39842-5.

PRACTICALS

1. Verification of Chargaff's rule by paper chromatography.
2. Ultraviolet absorption spectrum of DNA and RNA.
3. Determination of DNA and RNA concentration by $A_{260\text{nm}}$.
4. Determination of the melting temperature and GC content of DNA.
5. To study the viscosity of DNA solutions.
6. Isolation of chromosomal DNA from *E. coli* cells.