

Contents

Chapter 1: Introduction to Molecular Biology	1	5.6	Modifications of the Regulatory Bases	76
1.1 Introduction	1	5.7	Physical and Chemical Properties of Nucleic Acids	77
1.2 History of Molecular Biology	1	5.8	Optical and thermal Properties of Nucleic Acids	79
1.3 Some Model Organisms used in Molecular Biology	2	5.9	Special Features of DNA	81
1.4 Tools of Molecular Biology	5	5.10	Structure and Functions of RNA	81
1.5 Recombinant DNA Technology	14	5.11	Evidence of DNA as the Carrier of Genetic information	82
1.6 Proteomics	19	5.12	The Central Dogma	84
Chapter 2: The Cell: Structure and Functions	24	Chapter 6: Structure and Organisation of Genome	88	
2.1 Introduction	24	6.1	Introduction	88
2.2 General Properties of Cells	24	6.2	Nature of the Gene	88
2.3 Viruses	25	6.3	Organisation of Genes On Chromosomes	90
2.4 Prokaryotes	26	6.4	Evolution of Genes	92
2.5 Eukaryotes	29	6.5	Repeating DNA	94
Chapter 3: Chemistry of Cells	39	6.6	Classification of Eukaryotic DNA	95
3.1 Introduction	39	6.7	Organisation of Genomes	96
3.2 Elements of Atomic Structure	39	6.8	Types of Genomes	99
3.3 Types of Chemical Forces	40	6.9	Molecular Nature of Chromosome Structure	105
3.4 Functional Groups	42	6.10	Structure of Chromatin	107
3.5 Energy Changes and Chemical Reactions	43	6.11	Special Chromosome Structures	111
3.6 Types of Biomolecules Found in Cells	44	Chapter 7: The Cell Cycle	115	
3.7 Combinations of Biomolecules	52	7.1	Introduction	115
Chapter 4: Basic Rules of inheritance	54	7.2	Cell Cycle in Eukaryotes	116
4.1 Introduction	54	7.3	Regulation of Cell Division.	121
4.2 Mendelian inheritance	54	7.4	Regulation of Cell Cycle Progression	121
4.3 Deviations from the Mendelian Laws	57	7.5	Control in Multicellular Organisms	128
4.4 Chromosomal Basis of inheritance	63	7.6	Control of Cell Cycle in Mammalian Cells	134
4.5 Quantitative inheritance	64	7.7	Checkpoints in Cell Cycle	136
Chapter 5: Nucleic Acids	67	7.8	Cell Division Cycle and Cancer	136
5.1 Introduction	67	7.9	Special Cell Cycle Systems in Animals	138
5.2 Molecular Composition of Nucleic Acids	67	7.10	Regulation of Meiotic Cell Cycle	139
5.3 The Primary Structure of Polynucleotides	71	7.11	Regulation of Bacterial Cell Cycle	139
5.4 The Secondary Structure of DNA	73	Chapter 8: DNA Replication	143	
5.5 The Tertiary Structure of Nucleic Acids	75	8.1	Introduction	143

8.2	General Features of DNA Replication	143	Chapter 12: Translation: Decoding the	
8.3	Nearest Neighbour's Frequency	150	Genetic information	251
8.4	Enzymology of DNA Replication	151	12.1	Introduction 251
8.5	Mechanism of Bacterial DNA Replication	160	12.2	Protein Synthesis: A High-Energy Process 251
8.6	Mechanism of Eukaryotic DNA Replication	167	12.3	Major Components of Protein Synthesis 252
8.7	Chromatin Remodelling	171	12.4	Translation on Prokaryotic Ribosome 259
8.8	Other DNA Replication Strategies	172	12.5	Translation in Eukaryotes 265
8.9	Chromatin Replication	174	12.6	Global Regulation of Protein Synthesis 271
8.10	Initiation of Replication by Covalent Extension	174	12.7	Other Functions of the Protein Synthesis Apparatus 273
8.11	RNA-Dependent DNA Synthesis	176	12.8	Monocistronic and Polycistronic Mrna 273
8.12	Fidelity of DNA Replication	177	12.9	Inhibitors of Protein Synthesis 274
8.13	Regulation of Replication	178		
Chapter 9: Transcription	181	Chapter 13: Protein Processing and Transportation	281	
9.1	Introduction	181	13.1	Introduction 281
9.2	General Features of Transcription	181	13.2	Intracellular Compartments 282
9.3	Transcription Factors	184	13.3	Protein Targeting 284
9.4	Mechanism of Transcription	185	13.4	Mechanism of Co-Translational Transport of Proteins 286
9.5	Types of RNA	187	13.5	Post-Translational Transport of Proteins into Organelles 291
9.6	RNA Polymerases	188	13.6	Post-Entry Sorting of Membrane Proteins 298
9.7	Transcription in Prokaryotes	190	13.7	Post-Translational Modification of Proteins 301
9.8	Transcription in Eukaryotes	195	13.8	Selenoproteins 307
Chapter 10: RNA Processing	206	13.9	Protein Degradation	307
10.1	Introduction	206	Chapter 14: Regulation of Gene Expression in Prokaryotes	313
10.2	Nature of Gene Transcripts	207	14.1	Introduction 313
10.3	Processing of Ribosomal RNA	209	14.2	General Mechanisms of Regulation 313
10.4	Processing of TrNA	211	14.3	Types of Regulation of Transcription 315
10.5	Messenger RNA Processing	212	14.4	Regulation of initiation 318
10.6	Splicing	215	14.5	Termination of Transcription 326
10.7	Alternative or Differential Splicing	221	14.6	Modification of RNA Polymerase 327
10.8	Self-Cleaving RNA Sequences	224	14.7	Regulation of Protein Synthesis 328
10.9	RNA Processing By Editing	225	14.8	Post-Translational Control 328
10.10	Degradation of RNA	227	14.9	Regulation of Gene Expression in Bacteriophages 329
Chapter 11: Genetic Code	232	Chapter 15: Regulation of Gene Expression in Eukaryotes	332	
11.1	Introduction	232	15.1	Introduction 332
11.2	Collinearity between Genes and Proteins	232	15.2	Regulatory Strategies in Gene Expression 333
11.3	Nature of the Genetic Code	233	15.3	Genomic Control 333
11.4	Genetic Code from <i>in Vitro</i> Protein Synthesis	235	15.4	Changes in DNA Methylation States 337
11.5	General Nature of the Genetic Code	237	15.5	Modification of Histones 338
11.6	Degeneracy of the Code	241	15.6	Regulation and Gene Organisation 339
11.7	Differential Codon Usage	243		
11.8	Ambiguity in the Genetic Code	243		
11.9	Second Genetic Code	245		

15.7	Regulatory Mechanisms	340	18.12	Mobile Introns and Inteins	420
15.8	Activation of Transcription	341	18.13	Bacterial integrons	421
15.9	Models for Regulation	342	18.14	Retroelements	421
15.10	Negatively Acting Sequence Elements	344	18.15	Lines and Sines	422
15.11	Regulation of Eukaryotic Transcription Factors	346	18.16	Use of Transposons as Molecular Tools	424
15.12	Gene Silencing by Modification of Histones and DNA	348	Chapter 19: Mutagenesis and DNA Repair	429	
15.13	Regulation of Elongation	349	19.1	Introduction	429
15.14	Post-Transcriptional Regulation	349	19.2	Basic Types of Mutations	429
15.15	Regulation of Cytoplasmic Transport of Nuclear RNA	353	19.3	Origin of Spontaneous Mutations	432
15.16	Regulation of Translation	355	19.4	Rates of Mutation	433
15.17	Post-Translational Regulation	358	19.5	Molecular Basis of Mutations	434
15.18	Gene Expression Mechanisms and Specialised Cells	358	19.6	Gross Variations of Chromosomes	436
15.19	Regulation of Gene Expression by RNA Interference	359	19.7	Induced Mutations	439
Chapter 16: Epigenetic Regulation	367	19.8	Mutations from DNA Replication and Repair	444	
16.1	Introduction	367	19.9	Types of DNA Damage	446
16.2	Epigenetics	367	19.10	Directed Mutagenesis	447
16.3	Epigenetic Phenomena	370	19.11	Detection of Mutations and Carcinogenesis	451
16.4	Apogenetics	378	19.12	DNA Repair	452
Chapter 17: Genetic Recombination	384	19.13	Recombinational Repair	455	
17.1	Introduction	384	19.14	Global Response To DNA Damage	459
17.2	Types of Recombination	385	19.15	Reverse Mutations and Suppressor Mutations	460
17.3	Genetic Recombination in Bacteria	386	19.16	RNA Damage and Repair	461
17.4	Recombination in Eukaryotes	387	19.17	Pathological Effects of Defective DNA Repair	461
17.5	Site-Specific Recombination	395	Chapter 20: Molecular Biology of Cancer	465	
Chapter 18: Mobile Elements: Drivers of Genome Evolution	402	20.1	Introduction	465	
18.1	Introduction	402	20.2	Types of Cancer	466
18.2	Classification of Mobile Elements	403	20.3	Tumour Clonality: Derivatives of a Single Abnormal Cell	466
18.3	General Mechanisms of Transposition	404	20.4	Molecular Basis of Carcinogenesis	467
18.4	Types of Transposition Reactions	405	20.5	Tumour Cells	468
18.5	Regulation of Transposition	409	20.6	Cytomorphological Properties of Cancer Cells	468
18.6	Consequences of Transposition	410	20.7	Oncogenes	472
18.7	Bacterial Transposons	411	20.8	Tumour Suppressor Genes	480
18.8	IS-Mediated DNA Rearrangements	412	20.9	Cancer: A Multi-Causal Process	483
18.9	Eukaryotic Transposable Elements	415	20.10	Chemical Carcinogens	483
18.10	Controlling Elements in Corn	418	20.11	Human Cancers	485
18.11	Transposons in Drosophila	419	20.12	Prevention and Treatment of Cancer	485
			20.13	Treatment of Cancer	486
			Index	492	