

Contents

Foreword

vii

Preface

ix

1. Gene Structure and Colinearity

1.1

Gene Structure

1.1

Types of Genes

1.8

What is a Gene?

1.20

Introns

1.21

Why are the Eukaryotic Genes Split?

1.28

Overlapping and Nested Genes

1.36

The Smallest Known Gene

1.39

Pseudogenes

1.39

Colinearity

1.40

References

1.44

2. Gene Organization and Genome Evolution

2.1

Gene Organization

2.1

Fold-Back Elements of *Drosophila*

2.10

Evolution of Genome Size

2.11

Evolutionary Changes in DNA Sequences

2.14

Nucleotide Polymorphism

2.17

Ancient DNA

2.19

References

2.20

3. Defense Genes and Vaccines

3.1

Immunoglobulins

3.1

Immunoglobulin Genes

3.3

Recognition System for Recombination

3.5

New Codon Generation

3.11

Allelic Exclusion

3.11

T-cell Receptor Genes

3.12

MicroRNAs in the Homeostasis and Function of the Immune System

3.14

Theories of Antibody Diversity

3.15

Hybridomas and Monoclonal Antibodies

3.16

Human Leukocyte Antigens

3.21

Human Leukocyte Antigen Complex	3.21
Escaping the Immune Detection	3.25
Vaccines	3.25
References	3.30
4. Oncogenes and Antioncogenes	4.1
Retroviruses contain Oncogenes	4.2
Normal Cells contain Proto-oncogenes	4.2
<i>Src</i> Oncogene	4.3
Origin of Oncogenes	4.5
Identification of an Oncogene	4.6
Fine structure of an Oncogene	4.8
Activation of Proto-oncogenes	4.8
Genetic Abnormalities and Aberrant Features of Cancer Cells	4.9
p53 is the Most Frequently Mutated Gene in Human Cancers	4.11
Evolution of Tumor Suppressor Mechanisms	4.13
RNA Polymerases and Cancer	4.15
Genes Associated with Cancers	4.16
Pall's Model of Carcinogenesis	4.18
More About Carcinogenesis	4.21
MicroRNAs and Development of Cancer	4.27
Tumor Development	4.33
Epigenetic Alterations and Neoplasia	4.35
How Immune System Counteracts Oncogenes?	4.36
Anti-oncogenes	4.37
Antisense Molecules as Anticancer Drugs	4.38
Signal Transduction by Oncoproteins	4.39
References	4.41
5. Gene Function	5.1
Relationship Between Gene and Enzyme	5.1
Genetic Control of Biochemical Reactions	5.1
One gene-one Reaction Hypothesis	5.3
Relationship Between Genotype and Phenotype	5.3
One Gene-One Enzyme Hypothesis	5.5
One Gene-One Polypeptide Hypothesis	5.8
One Gene-One Chromomere Hypothesis	5.9
One Gene-One Antigen Hypothesis	5.10
One Cistron-One Polypeptide Hypothesis	5.10
One Gene-One Ribosome-One Protein Hypothesis	5.10
One Gene-One Ribosome-One Protein Hypothesis	5.10
One Gene-One Primary Cellular Function Hypothesis	5.11
Gene Discoveries	5.11
Two Genes-One Polypeptide Hypothesis	5.12
Studying Gene Function by Knocking Off Genes	5.13

One Gene-Many Polypeptides Hypothesis	5.13
One Enzyme-Two Functions Concept	5.14
Recent Thoughts on Gene Function	5.14
<i>References</i>	5.16
6. Transcription in Bacteria and Viruses	6.1
Central Dogma and its Modification	6.1
Transcription in Bacteria	6.4
RNA-Directed RNA Synthesis	6.25
Transcriptional Apparatus in Archaea	6.26
Transcription in Viruses	6.26
Reverse Transcription in Viruses	6.29
Reverse Transcription in Bacteria	6.31
<i>References</i>	6.33
7. Transcription in Eukaryotes	7.1
Promoter Sequences for Eukaryotic RNA Polymerases	7.1
Eukaryotic RNA Polymerases	7.3
Gene Classification based on RNA Polymerase Used	7.25
Process of Eukaryotic Transcription	7.27
Transcriptional Complexity	7.33
Some Features of Eukaryotic Transcription	7.33
Transcription of LINE-1 Elements	7.37
Transcription of Centromeric Repeats	7.39
<i>References</i>	7.40
8. Intricacies of Eukaryotic Transcription	8.1
Mapping Transcribed Regions	8.1
Transcription Coexpression of Interacting Genes	8.1
Transcriptional Forests	8.2
Transcriptional Processivity	8.2
Transcriptional Elements	8.3
Synergistic Transcription	8.5
Smart Transcription Factors	8.10
Chloroplast DNA Transcription	8.13
Mitochondrial DNA Transcription	8.13
Transcription In Relation to Other Biological Processes	8.14
Hormones and Transcription	8.15
Tissue-Specific Gene Expression	8.15
Exploiting Gene Expression	8.19
<i>References</i>	8.22
9. RNA Processing in General	9.1
Pre-Messenger RNA Processing	9.1

Pre-Transfer (Soluble) RNA Processing	9.16
Pre-Ribosomal RNA Processing	9.31
Self-Splicing of rRNA In <i>Tetrahymena</i> port	9.36
RNA Transport	9.37
<i>References</i>	9.38
10. Alternative RNA Splicing and RNA Editing	10.1
Alternative RNA Splicing	10.1
RNA Editing	10.12
RNA Unwinding	10.25
<i>References</i>	10.26
11. Updated Genetic Code	11.1
Genetic Code	11.1
Glossary of Terms on Genetic Code	11.2
Properties of Genetic Code	11.2
Deciphering the Genetic Code	11.8
Genetic Code at Work	11.10
Extended Anticodon Hypothesis	11.10
Genetic Code Specificity	11.10
Expansion of Genetic Alphabet	11.11
Recoding	11.11
The Second Code	11.18
<i>References</i>	11.19
12. Protein Biosynthesis	12.1
Translation in Prokaryotes	12.1
Translation in Eukaryotes	12.32
Role of MicroRNAs in Protein Synthesis	12.45
Hybrid Arrested Translation	12.46
Hybrid Released Translation	12.46
Protein Engineering	12.46
<i>References</i>	12.48
13. Fate of Nascent Proteins, Ribosomes, and Messenger RNAs	13.1
Protein Modification	13.1
Protein Secretion in Prokaryotes	13.2
Protein Translocation in Prokaryotes	13.9
Co-Translational Targeting (Secretory Pathways) in Eukaryotes	13.10
Post-Translational Targeting in Eukaryotes	13.14
Protein Folding	13.16
Molecular Chaperone	13.20
Protein Turnover	13.20
Protein Degradation	13.21
Fate of Ribosomes After Translation	13.23

Messenger RNA Decay	13.24
Exosome	13.25
References	13.30
14. Gene Expression – An Overview	14.1
Gene Structure	14.1
Gene Function	14.1
Gene Expression	14.1
Gene Regulation	14.5
Expression System	14.5
Gene Expression Networks	14.6
Analysis of Gene Expression	14.6
Systems Biology Approach	14.11
Metabolomics	14.11
Ionome and Ionomics	14.13
References	14.14
Glossary	G.1
Subject Index	S.1