

Contents

Preface

v

Forward

vii

1. Introduction

1.1

From Molecular Biology to Biotechnology – a brief history

Mendel's Law of Inheritance

1.2

Evidence of DNA as Genetic Material

1.4

Summary

1.7

Questions

1.7

2. Nucleic Acids

2.1

Physical and Chemical Structure of DNA

2.1

Summary

2.21

Questions

2.21

3. Chromosome Organisation

3.1

Summary

3.11

Questions

3.12

4. DNA Replication, Repair and Recombination

4.1

DNA Replication

4.1

DNA Recombination

4.2

Summary

4.14

DNA Repair

4.14

Types of DNA Damage

4.15

Types of DNA Repair

4.20

Summary

4.25

DNA Recombination

4.25

Summary

4.28

Questions

4.30

5. Transcription in Bacteria

5.1

Introduction

5.1

Overview of Transcription

5.4

RNA Polymerases

5.5

Promoters

5.7

Mechanism of Transcription in Bacteria

5.8

Summary

5.11

Transcriptional Regulation in Bacteria	5.12
Summary	5.22
Questions	5.22
6. Transcription in Eukaryotes	6.1
Introduction	6.1
RNA Polymerases	6.2
Promoters	6.3
Mechanism of Transcription in Eukaryotes	6.5
Chromatin Modification	6.8
RNA Processing	6.11
Self-Splicing	6.16
RNA Editing	6.17
Summary	6.18
Transcriptional Regulation in Eukaryotes	6.18
Repressors	6.19
Activators	6.19
Summary	6.25
Questions	6.25
7. Translation/Protein Synthesis	7.1
Genetic Code	7.2
Protein Synthesis in Prokaryotes	7.9
Protein Synthesis in Eukaryotes	7.12
Summary	7.14
Questions	7.15
8. Transposable Elements or Mobile DNA	8.1
Prokaryotic Mobile Elements	8.2
Eukaryotic Transposons	8.8
Summary	8.26
Questions	8.27
9. Recombinant DNA Technology	9.1
Steps in Gene Cloning	9.11
DNA Libraries	9.11
Polymerase Chain Reaction	9.16
Electrophoresis	9.19
Applications	9.21
Summary	9.25
Questions	9.26
10. Genomes and Proteomes	10.1
Human Genome Project	10.1
Functional Genomics	10.2
Next Generation Sequencing	10.5

Genome Editing	10.8
Structural Genomics	10.9
Proteomics	10.10
Structural Proteomics	10.10
Quantitative Proteomics	10.15
Summary	10.19
Questions	10.19

Index *Molecular Biology to Biotechnology – a brief history* **I.1**

Let us go back in time and retrace the advent of molecular biology. The term 'molecular biology' first appeared in a report for the Rockefeller Foundation in 1938 by Warren Weaver who advocated that financial support should be given to this new area in science – Molecular biology. However, this science was truly initiated on April 25, 1953, in the British journal *Nature* when a paper entitled "Molecular Structure of Nucleic Acids: a structure for Deoxyribose Nucleic acid" was published by an American James D. Watson and an Englishman Francis Crick. This paper was the culmination of work that stretched back 85 years to Friedrich Miescher, a Swiss scientist who had reported his discovery of a nucleic acid. He named it nuclein as it was isolated from the nuclei of pus cells and salmon sperm. Miescher reported his findings in 1871. A few years earlier, in 1866, Gregor Mendel had published his work done with the garden pea plant and this led to the principles of independent segregation and assortment of genes. Mendel's work would lay down the foundation of classical genetics and Miescher's experiments had started molecular genetics.

Molecular biology is a science which grew out of the disciplines of genetics and biochemistry and as of late is now an integral part of biotechnology. Biotechnology is a term which was coined in 1919 by a Hungarian engineer Karl Ereky. He used it as an umbrella term to broadly define it as "the development and utilization of biological processes, forms and systems for obtaining maximum benefits to man and other forms of life". Humankind has been using biotechnological methods for thousands of years like the age-old practices of using yeast or bacteria for the production of wine, beer, vinegar, bread, cheese and yoghurt.

Biotechnology has now emerged as one of the key technologies of the twenty-first century and with the breath-taking progress made in the last 60 years, the use of molecular biology will revolutionise our