

# Contents

## The cellular basis of biochemistry

Types of living cells	1
The structure of prokaryotic and eukaryotic cells	2
Endocytosis and exocytosis through the plasma membrane	2
The nucleus	2
Mitochondria	3
Lysosomes	3
Peroxisomes	3
The endoplasmic reticulum	3
The cytoskeleton	3
Subcellular fractionation	4
The microsome fraction	5
Marker enzymes	5
Metabolic functions of organelles	6



## An introduction to proteins and peptides

The role of amino acids in the cell	7
Structure of amino acids	8
Asymmetry in biochemistry	8
Ionic properties of amino acids	9
Peptide structure and the peptide bond	9
Ionic properties of peptides	11
Purification of proteins and determination of relative molecular mass	11
The determination of the amino acid sequence of proteins	12
Protein structural hierarchies	14
Protein denaturation and renaturation	14
Peptides, structure and biological activity	14
	15



## Nucleic acids and protein synthesis

	17	<b>3</b>
Introduction: Replication, transcription and translation	18	
Nucleic acid structure and synthesis	18	
Other enzymes with DNA synthetic activity	24	
Biosynthesis of proteins: translation	31	
Molecular cell biology	44	
Recombinant DNA (genetic engineering)	49	

## Protein structure and function with hemoglobin as an example

	55	<b>4</b>
The properties of proteins	56	
The folding of globular proteins	56	
General principles of protein folding	57	
Structure and properties of myoglobin and hemoglobin	61	

## Proteins: specialized functions

	67	<b>5</b>
Plasma proteins	68	
The immune system and the immunoglobulins	73	
Proteins of molecular motors	78	

## The structure and function of enzymes

	83	<b>6</b>
The properties of enzymes	84	
Enzyme kinetics	85	
Metabolic regulation and control	89	
Enzyme phosphorylation and dephosphorylation	91	
Second messengers	93	
Allosteric properties of enzymes	94	
Metabolic control analysis	96	
Genetic diversity of enzymes	96	
Coenzymes and water-soluble vitamins	100	

## Carbohydrates: structures and interconversions 109

Monosaccharides and disaccharides	110
Polysaccharides	111
Interconversions of monosaccharides	112
Detoxification mechanisms	114

7

## Nitrogen metabolism 117

Protein breakdown and excretion of nitrogen	118
The supply of amino acids	120
Catabolism of essential amino acids and the formation of adrenaline, histamine, thyroxine and serotonin	122
The biosynthesis and metabolism of heme	126

8

## Oxidative catabolism of glucose and fatty acids 131

$\beta$ -Oxidation and glycolysis	132
The citric acid cycle	136
The electron transport chain	137
Oxidative phosphorylation	139
Other mitochondrial topics	141

9

## Carbohydrate and lipid metabolism in the fasting state 145

Metabolism in the fasting state	146
Glycogen and its degradation	146
Gluconeogenesis	148
Ketone body formation and utilization	149
Control of the blood glucose in health and disease	150

10

## Carbohydrate and lipid metabolism in the absorptive state 153

The process of absorption	154
Glycogenesis	156
Lipogenesis	157

11

## Plasma lipoproteins, cholesterol metabolism and atherosclerosis

163

Plasma lipoproteins and cholesterol metabolism

164

12

## The action of hormones and other effectors in regulating glycogen and glucose metabolism, ketogenesis and lipogenesis

175

Whole-body interactions

176

The regulation of glycogen metabolism

176

Regulation of glycolysis and gluconeogenesis

178

Regulation of lipid metabolism

181

13

## Phospholipids, other lipid substances and complex carbohydrates

185

Phospholipids

186

Lipid-soluble vitamins

188

Other lipid compounds

191

Complex carbohydrates

194

14

## Biomembranes, receptors and signal transduction

199

The basis of membrane structure

200

Structure of the phospholipid bilayer

200

Membrane receptors

201

G proteins

204

Cell signalling systems

206

Receptor traffic

209

The cytoskeleton

211

Membrane transport

212

Cell adhesion

212

15

# The post-genomic era and its impact on the future of biochemistry and molecular biology

217

Introduction

218

Bioinformatics

218

Apoptosis

219

Telomeres and telomerases

220

Growth control and cancer

221

Further Reading

225

Index

227

**16**