

## Contents

Introduction . . . . .	1	Structural proteins . . . . .	70
<b>Basics</b>		Globular proteins . . . . .	72
<b>Chemistry</b>		Protein folding . . . . .	74
Periodic table . . . . .	2	Molecular models: insulin . . . . .	76
Bonds . . . . .	4	Isolation and analysis of proteins . . . . .	78
Molecular structure . . . . .	6	<b>Nucleotides and Nucleic Acids</b>	
Isomerism . . . . .	8	Bases and nucleotides . . . . .	80
Biomolecules I . . . . .	10	RNA . . . . .	82
Biomolecules II . . . . .	12	DNA . . . . .	84
Chemical reactions . . . . .	14	Molecular models: DNA and RNA . . . . .	86
<b>Physical Chemistry</b>		<b>Metabolism</b>	
Energetics . . . . .	16	<b>Enzymes</b>	
Equilibriums . . . . .	18	Basics . . . . .	88
Enthalpy and entropy . . . . .	20	Enzyme catalysis . . . . .	90
Reaction kinetics . . . . .	22	Enzyme kinetics I . . . . .	92
Catalysis . . . . .	24	Enzyme kinetics II . . . . .	94
Water as a solvent . . . . .	26	Inhibitors . . . . .	96
Hydrophobic interactions . . . . .	28	Lactate dehydrogenase: structure . . . . .	98
Acids and bases . . . . .	30	Lactate dehydrogenase: mechanism . . . . .	100
Redox processes . . . . .	32	Enzymatic analysis . . . . .	102
<b>Biomolecules</b>		Coenzymes 1 . . . . .	104
<b>Carbohydrates</b>		Coenzymes 2 . . . . .	106
Overview . . . . .	34	Coenzymes 3 . . . . .	108
Chemistry of sugars . . . . .	36	Activated metabolites . . . . .	110
Monosaccharides and disaccharides . . . . .	38	<b>Metabolic Regulation</b>	
Polysaccharides: overview . . . . .	40	Intermediary metabolism . . . . .	112
Plant polysaccharides . . . . .	42	Regulatory mechanisms . . . . .	114
Glycosaminoglycans and glycoproteins . . . . .	44	Allosteric regulation . . . . .	116
<b>Lipids</b>		Transcription control . . . . .	118
Overview . . . . .	46	Hormonal control . . . . .	120
Fatty acids and fats . . . . .	48	<b>Energy Metabolism</b>	
Phospholipids and glycolipids . . . . .	50	ATP . . . . .	122
Isoprenoids . . . . .	52	Energetic coupling . . . . .	124
Steroid structure . . . . .	54	Energy conservation at membranes . . . . .	126
Steroids: overview . . . . .	56	Photosynthesis: light reactions . . . . .	128
<b>Amino Acids</b>		Photosynthesis: dark reactions . . . . .	130
Chemistry and properties . . . . .	58	Molecular models: membrane proteins . . . . .	132
Proteinogenic amino acids . . . . .	60	Oxoacid dehydrogenases . . . . .	134
Non-proteinogenic amino acids . . . . .	62	Tricarboxylic acid cycle: reactions . . . . .	136
<b>Peptides and Proteins</b>		Tricarboxylic acid cycle: functions . . . . .	138
Overview . . . . .	64	Respiratory chain . . . . .	140
Peptide bonds . . . . .	66	ATP synthesis . . . . .	142
Secondary structures . . . . .	68	Regulation . . . . .	144
		Respiration and fermentation . . . . .	146
		Fermentations . . . . .	148

**Carbohydrate Metabolism**

Glycolysis . . . . .	150
Pentose phosphate pathway . . . . .	152
Gluconeogenesis . . . . .	154
Glycogen metabolism . . . . .	156
Regulation . . . . .	158
Diabetes mellitus . . . . .	160

**Lipid Metabolism**

Overview . . . . .	162
Fatty acid degradation . . . . .	164
Minor pathways of fatty acid degradation . . . . .	166
Fatty acid synthesis . . . . .	168
Biosynthesis of complex lipids . . . . .	170
Biosynthesis of cholesterol . . . . .	172

**Protein Metabolism**

Protein metabolism: overview . . . . .	174
Proteolysis . . . . .	176
Transamination and deamination . . . . .	178
Amino acid degradation . . . . .	180
Urea cycle . . . . .	182
Amino acid biosynthesis . . . . .	184

**Nucleotide Metabolism**

Nucleotide degradation . . . . .	186
Purine and pyrimidine biosynthesis . . . . .	188
Nucleotide biosynthesis . . . . .	190

**Porphyrin Metabolism**

Heme biosynthesis . . . . .	192
Heme degradation . . . . .	194

**Organelles****Basics**

Structure of cells . . . . .	196
Cell fractionation . . . . .	198
Centrifugation . . . . .	200
Cell components and cytoplasm . . . . .	202

**Cytoskeleton**

Components . . . . .	204
Structure and functions . . . . .	206

**Nucleus**

Structure and functions . . . . .	210
Transport systems . . . . .	212

**Mitochondria**

Structure and functions . . . . .	210
Transport systems . . . . .	212

**Biological Membranes**

Structure and components . . . . .	214
Functions and composition . . . . .	216
Transport processes . . . . .	218
Transport proteins . . . . .	220
Ion channels . . . . .	222
Membrane receptors . . . . .	224

**Endoplasmic Reticulum and Golgi Apparatus**

ER: structure and function . . . . .	226
Protein sorting . . . . .	228
Protein synthesis and maturation . . . . .	230
Protein maturation . . . . .	232

**Lysosomes**

Overview . . . . .	234
--------------------	-----

**Molecular Genetics**

Overview . . . . .	236
Genome . . . . .	238
Replication . . . . .	240
Transcription . . . . .	242
Transcriptional control . . . . .	244
RNA maturation . . . . .	246
Amino acid activation . . . . .	248
Translation I: initiation . . . . .	250
Translation II: elongation and termination . . . . .	252
Antibiotics . . . . .	254
Mutation and repair . . . . .	256

**Genetic engineering**

DNA cloning . . . . .	258
DNA sequencing . . . . .	260
PCR and protein expression . . . . .	262
Genetic engineering in medicine . . . . .	264

**Tissues and organs****Digestion**

Overview . . . . .	266
Digestive secretions . . . . .	268
Digestive processes . . . . .	270
Resorption . . . . .	272

**Blood**

Composition and functions . . . . .	274
Plasma proteins . . . . .	276
Lipoproteins . . . . .	278
Hemoglobin . . . . .	280
Gas transport . . . . .	282
Erythrocyte metabolism . . . . .	284
Iron metabolism . . . . .	286
Acid–base balance . . . . .	288
Blood clotting . . . . .	290
Fibrinolysis, blood groups . . . . .	292

**Immune system**

Immune response . . . . .	294
T-cell activation . . . . .	296
Complement system . . . . .	298
Antibodies . . . . .	300
Antibody biosynthesis . . . . .	302
Monoclonal antibodies, immunoassay . . . . .	304

<b>Liver</b>		
Functions . . . . .	306	
Buffer function in organ metabolism . .	308	
Carbohydrate metabolism . . . . .	310	
Lipid metabolism . . . . .	312	
Bile acids . . . . .	314	
Biotransformations . . . . .	316	
Cytochrome P450 systems . . . . .	318	
Ethanol metabolism . . . . .	320	
<b>Kidney</b>		
Functions . . . . .	322	
Urine . . . . .	324	
Functions in the acid–base balance . . .	326	
Electrolyte and water recycling . . . . .	328	
Renal hormones . . . . .	330	
<b>Muscle</b>		
Muscle contraction . . . . .	332	
Control of muscle contraction . . . . .	334	
Muscle metabolism I . . . . .	336	
Muscle metabolism II . . . . .	338	
<b>Connective tissue</b>		
Bone and teeth . . . . .	340	
Calcium metabolism . . . . .	342	
Collagens . . . . .	344	
Extracellular matrix . . . . .	346	
<b>Brain and Sensory Organs</b>		
Signal transmission in the CNS . . . . .	348	
Resting potential and action potential . .	350	
Neurotransmitters . . . . .	352	
Receptors for neurotransmitters . . . . .	354	
Metabolism . . . . .	356	
Sight . . . . .	358	
<b>Nutrition</b>		
<b>Nutrients</b>		
Organic substances . . . . .	360	
Minerals and trace elements . . . . .	362	
<b>Vitamins</b>		
Lipid-soluble vitamins . . . . .	364	
Water-soluble vitamins I . . . . .	366	
Water-soluble vitamins II . . . . .	368	
<b>Hormones</b>		
<b>Hormonal system</b>		
Basics . . . . .	370	
Plasma levels and hormone hierarchy . .	372	
<b>Lipophilic hormones</b> . . . . .	374	
Metabolism of steroid hormones . . . . .	376	
Mechanism of action . . . . .	378	
<b>Hydrophilic hormones</b> . . . . .	380	
Metabolism of peptide hormones . . . . .	382	
Mechanisms of action . . . . .	384	
Second messengers . . . . .	386	
Signal cascades . . . . .	388	
<b>Other signaling substances</b>		
Eicosanoids . . . . .	390	
Cytokines . . . . .	392	
<b>Growth and development</b>		
<b>Cell proliferation</b>		
Cell cycle . . . . .	394	
Apoptosis . . . . .	396	
Oncogenes . . . . .	398	
Tumors . . . . .	400	
Cytostatic drugs . . . . .	402	
<b>Viruses</b> . . . . .	404	
<b>Metabolic charts</b> . . . . .	406	
Calvin cycle . . . . .	407	
Carbohydrate metabolism . . . . .	408	
Biosynthesis of fats and membrane liquids . . . . .	409	
Synthesis of ketone bodies and steroids	410	
Degradation of fats and phospholipids .	411	
Biosynthesis of the essential amino acids . . . . .	412	
Biosynthesis of the non-essential amino acids . . . . .	413	
Amino acid degradation I . . . . .	414	
Amino acid degradation II . . . . .	415	
Ammonia metabolism . . . . .	416	
Biosynthesis of purine nucleotides . . . .	417	
Biosynthesis of the pyrimidine nucleotides and C <sub>1</sub> metabolism . . . . .	418	
Nucleotide degradation . . . . .	419	
<b>Annotated enzyme list</b> . . . . .	420	
<b>Abbreviations</b> . . . . .	431	
<b>Quantities and units</b> . . . . .	433	
<b>Further reading</b> . . . . .	434	
<b>Source credits</b> . . . . .	435	
<b>Index</b> . . . . .	437	
<b>Key to color-coding:</b> see front and rear inside covers		