

# Contents

<b>Preface</b>	<b>xi</b>	Kinetic structure of a biochemical pathway	61
<b>Abbreviations</b>	<b>xiii</b>	Regulation of enzyme activity	63
<b>I INTRODUCTION</b>	<b>1</b>	<b>4 Transport into the Body: The Gastrointestinal Tract, Digestion and Absorption</b>	<b>69</b>
<b>1 The Structural and Biochemical Hierarchy of a Cell and a Human</b>	<b>3</b>	Gross structure of the gastrointestinal tract	70
Cell structure	3	Biochemistry of cooking and food preparation	73
Tissues	8	Digestion and absorption	75
The whole human	10	The gastrointestinal tract and disease	82
The biochemical hierarchy	13	<b>5 Transport into the Cell: Particles, Molecules and Ions</b>	<b>85</b>
<b>II ESSENTIAL TOPICS IN DYNAMIC BIOCHEMISTRY</b>	<b>15</b>	Structure of the plasma membrane	85
<b>2 Energy: In the Body, Tissues and Biochemical Processes</b>	<b>17</b>	Diffusion through membranes	87
Energy transformations in the whole body	18	Active transport	89
Energy transformations in tissues and organs	26	Endocytosis and exocytosis	91
Energy transformation in biochemical reactions and pathways	28	Physiological importance of some transport systems	93
Adenosine triphosphate: its role in the cell	32	<b>III ESSENTIAL METABOLISM</b>	<b>95</b>
<b>3 Enzymes: Activities, Properties, Regulation and Physiology</b>	<b>35</b>	<b>6 Carbohydrate Metabolism</b>	<b>97</b>
Nomenclature and classification	36	Glycolysis	98
Basic facts	37	The biochemical and physiological importance of <i>anaerobic</i> glycolysis	104
Mechanisms by which an enzyme enhances the rate of a reaction	38	Regulation of the flux through glycolysis	107
Cofactors and prosthetic groups	40	Glycogen synthesis	108
Factors that change the activity of an enzyme	41	Synthesis of Fructose and lactose	110
Allosteric inhibition	48	The pentose phosphate pathway	110
The physiological significance of $K_m$ and $V_{max}$ values	51	Gluconeogenesis: glucose formation from non-carbohydrate sources	112
Enzymes as tools	54	Role of the liver in the regulation of the blood glucose concentration	117
Enzymes in diagnosis	58	Hormones and control of gluconeogenesis	123
Enzymes as therapeutic agents	59	Regulation of glycolysis and gluconeogenesis by ATP/ADP concentration ratio in the liver	124
Enzymes as targets for therapy	59	Hypoglycaemia	125
		Hyperglycaemia	126



**7 Fat Metabolism**

Fats in nutrition  
 Fat fuels  
 Physiological importance of fat fuels  
 Limitations or drawbacks of fats as a fuel  
 Genetic defects in fatty acid oxidation  
 Pathological concentrations of fat fuels

**8 Amino Acid and Protein Metabolism**

Introduction  
 Sources of amino acids  
 Protein and amino acid requirements  
 Fate of amino acids  
 Central role of transdeamination  
 Amino acid metabolism in different tissues  
 Glutamine: an amino acid of central importance  
 Urea 'salvage'

**9 Oxidation of Fuels and ATP Generation: Physiological and Clinical Importance**

The Krebs cycle  
 The electron transfer chain  
 Oxidative phosphorylation  
 Coupling of electron transfer with oxidative phosphorylation  
 Transport into and out of mitochondria  
 'Energy' transport in the cytosol:  
   the creatine/phosphocreatine shuttle  
 Regulation of fluxes  
 The physiological importance of mitochondrial ATP generation  
 The effect of ageing on ATP generation

**10 Metabolism of Ammonia and Nucleic Acids**

Roles of ammonia  
 Urea synthesis  
 Degradation of nucleic acids, nucleotides,  
   nucleosides and bases: the generation of ammonia  
 Ammonia toxicity  
 Deficiencies of urea cycle enzymes

**11 Synthesis of Fatty Acids, Triacylglycerol, Phospholipids and Fatty Messengers: The Roles of Polyunsaturated Fatty Acids**

Synthesis of long-chain fatty acids  
 Unsaturated fatty acids  
 Essential fatty acids  
 Phospholipids  
 Fatty messenger molecules  
 Fatty acids in neurological and behavioural disorders

<b>127</b>	<b>12 Hormones: From Action in the Cell to Function in the Body</b>	<b>253</b>
128	Endocrine hormones: traditional and novel	253
128	The action, effects and functions of a hormone	256
142	Action of hormones	257
145	The biochemical and physiological effects of a hormone	258
146	Pheromones	264
146	Kinetic principles that apply to hormone action	266
<b>149</b>	<b>IV ESSENTIAL PROCESSES OF LIFE</b>	<b>273</b>
<b>149</b>	<b>13 Physical Activity: In Non-Athletes, Athletes and Patients</b>	<b>275</b>
151	The mechanical basis of movement by skeletal muscle	275
155	Structure of muscle	276
157	Proteins involved in muscle action	279
165	Mechanism of contraction: the cross-bridge cycle	282
167	Regulation of contraction	282
172	Fuels for muscle	286
177	Fuels for various athletic events and games	291
<b>181</b>	Fatigue	294
181	Fatigue in patients	299
184	Physical training	300
185	Development of muscle	301
186	Health benefits of physical activity	303
190	Health hazards of physical activity	303
193	Skeletal muscle diseases	305
194	<b>14 Mental Activity and Mental Illness</b>	<b>307</b>
200	Mental activity	307
206	Cells in the brain	308
	Electrical communication	310
	Chemical communication	311
<b>211</b>	Fuels and energy metabolism in the brain	319
211	Mental illnesses: biochemical causes	320
212	Recreational drugs	325
217	<b>15 Nutrition: Biochemistry, Physiology and Pathology</b>	<b>331</b>
219	Basic information required for discussion of some biochemical aspects of nutrition	331
220	Vitamins	332
	Minerals	345
<b>223</b>	A healthy diet	350
223	Nutrition for specific activities or conditions	351
229	Overnutrition	355
233	Malnutrition	356
239	Functional foods and nutraceuticals	358
243	Nutrition for patients with genetic disorders	359
251	Vegetarian diets	359
	Eating disorders	360



## 16 Starvation: Metabolic Changes, Survival and Death

- Mechanisms for the regulation of the blood glucose concentration
- Metabolic responses to starvation
- Sequence of metabolic changes from intermediate starvation to death
- Progressive decrease in protein degradation in starvation

## 17 Defence Against Pathogens: Barriers, Enzymes and the Immune System

- When the physical barrier is breached
- The immune system
- Adaptive immunity
- Cytokines
- Mechanisms for killing pathogens
- Killing of intracellular bacteria and large parasites in the extracellular fluid
- Allergy
- Fuels and generation of ATP in immune cells: consequences for a patient
- Essential fatty acids and proliferation
- The lymph nodes
- Tolerance
- Chronic inflammation and autoimmunity
- Immunosuppressive agents
- Conditions that reduce the effectiveness of the immune system
- Factors that increase the effectiveness of the immune system
- Return of the 'old' infectious diseases
- New infectious diseases
- Defence in the intestine

## 18 Survival after Trauma: Metabolic Changes and Response of the Immune System

- Physiological and metabolic responses the ebb & flow phases
- Nutrition
- Mobilisation of triacylglycerol and protein in trauma
- Metabolic changes in trauma and in starvation
- Fever
- Summary of the effects of trauma on the immune system and the whole body

<b>19 Sexual Reproduction</b>	<b>429</b>
363 Male reproductive system	429
Female reproductive system	433
365 The menstrual cycle	434
367 Ovulation	435
Chemical communication in male and female reproduction	436
372 Coitus and the sexual response in the male and female	440
373 Fertilisation	442
Pregnancy	444
Parturition	445
Contraception	446
The menopause	448
375 Sexually transmitted diseases	448
<b>20 Growth and Death of Cells and Humans: The Cell Cycle, Apoptosis and Necrosis</b>	<b>451</b>
375 Introduction to cell proliferation	451
377 The cell cycle	452
380 Death	477
390	
391	
400	
402	
<b>V SERIOUS DISEASES</b>	<b>483</b>
<b>21 Cancer: Genes, Cachexia and Death</b>	<b>485</b>
402 Basic information	486
404 Oncogenes and proto-oncogenes	488
405 Proteins expressed by oncogenes	489
406 Processes by which proto-oncogenes can be activated or converted to oncogenes	492
407 Tumour suppressor genes	493
408 Telomeres and telomerase in tumour cells	495
411 Metastasis	495
415 Metabolic changes in cancer patients	496
Overview of cancer	500
Cancer-causing agents or conditions	500
Chemotherapy	505
Radiotherapy	507
<b>22 Atherosclerosis, Hypertension and Heart Attack</b>	<b>509</b>
417 Atherosclerosis	509
420 Hypertension	521
422 Heart attack (myocardial infarction)	524
423	
424	
<b>Index</b>	<b>529</b>