

Contents

	<i>Acknowledgments</i>	page xi
	<i>Introduction</i>	xiii
1	The energy around us	1
	1.1 Forms of energy	1
	1.2 Ambient energy	3
	1.3 Molecular energy	5
	1.4 Molecular energy absorbance	6
	1.5 Molecular transduction	7
	1.6 Ionizing radiation	9
	1.7 Magnetic resonance	11
	1.8 Sound	16
2	Molecular contacts	21
	2.1 Dissociation constants	21
	2.2 Promotor sites and autoimmune diseases	24
	2.3 Methods of measuring dissociation constants	30
	2.4 Metal–molecular coordination bonds	33
	2.5 Hydrogen bonds	37
	2.6 Non-bonded molecular interactions	43
3	Diffusion and directed transport	50
	3.1 Forces and flows	50
	3.2 Fick’s laws of diffusion	55
	3.3 Brownian motion	58
	3.4 Physiological diffusion of ions and molecules	60
	3.5 Molecular motors	68
	3.6 Intracellular cargo transport	76

4	Energy production	80
4.1	Energetics of human performance	80
4.2	ATP, ADP and P_i	82
4.3	Phosphocreatine	86
4.4	Glycolysis	90
4.5	Mitochondria	92
5	Force and movement	97
5.1	The skeletal length–tension relation	97
5.2	Muscle contractions after windup	100
5.3	Cardiac and smooth muscle length–tension relations	101
5.4	The Hill formalism of the crossbridge cycle	103
5.5	Muscle shortening, lengthening and power	105
5.6	Calcium dependence of muscle velocity	110
5.7	Smooth muscle latch	113
5.8	Muscle tension transients	114
5.9	The Law of Laplace for hollow organs	116
5.10	Non-muscle motility	119
6	Load bearing	123
6.1	Stress and strain	123
6.2	Teeth and bone	125
6.3	Blood vessels	130
6.4	Tendons, ligaments and cartilage	138
7	Fluid and air flow	144
7.1	Fluid properties	144
7.2	Synovial fluid flow	150
7.3	Arterial blood flow	151
7.4	Arteriole blood flow	154
7.5	Viscosity and hematocrit	157
7.6	Arterial stenosis	160
7.7	Arterial asymmetry: atherosclerosis and buckling	162
7.8	Lung air flow	165
8	Biophysical interfaces: surface tension and membrane structural properties	169
8.1	Surface tension	169
8.2	Action of surfactant on lung surface tension	174
8.3	Membrane lipids	175
8.4	Membrane curvature	177
8.5	Membrane protein and carbohydrate environment	179

8.6	Membrane protein transporters	182
8.7	Membrane organization	187
8.8	Ultrasonic pore formation	191
8.9	Membrane diffusion and viscoelasticity	192
8.10	Membrane ethanol effects	195
9	Membrane electrical properties	199
9.1	Membrane potential	199
9.2	Goldman and Nernst equations	203
9.3	The dielectric constant of water and water surface binding	206
9.4	Induced dipole orientation in solution	208
9.5	Membrane electric field complex dissociation	211
9.6	Membrane electrical conductance	217
9.7	The electrocardiogram	221
9.8	Channel ion selectivity	223
10	Agonist activation and analysis	230
10.1	Membrane receptor proteins	230
10.2	Pharmacokinetics	233
10.3	The dose–response curve and the Hill equation	239
10.4	Intracellular molecular diffusion and elimination	240
10.5	Statistical analysis	245
10.6	Drug development and orphan diseases	251
11	Stability, complexity and non-linear systems	256
11.1	System control	257
11.2	Negative feedback and metabolic control	260
11.3	Positive feedback	264
11.4	Models of state stability	267
11.5	State transitions	269
11.6	Non-linear systems: fractals and chaos	274
11.7	Apoptosis	281
12	Concluding remarks	285
	<i>Index</i>	286