

Contents

Preface	ix
Acknowledgements	xi
Part I Introduction	1
1 Microbiology: What, Why and How?	3
What is microbiology?	3
Why is microbiology important?	3
How do we know? Microbiology in perspective: to the 'golden age' and beyond	4
Light microscopy	10
Electron microscopy	15
2 Biochemical Principles	17
Atomic structure	17
Acids, bases, and pH	25
Biomacromolecules	27
Test yourself	48
3 Cell Structure and Organisation	51
The procaryotic cell	54
The eucaryotic cell	65
Cell division in procaryotes and eucaryotes	72
Test yourself	75
Part II Microbial Nutrition, Growth and Metabolism	77
4 Microbial Nutrition and Cultivation	79
Nutritional categories	81
How do nutrients get into the microbial cell?	83
Laboratory cultivation of microorganisms	84
Test yourself	89
5 Microbial Growth	91
Estimation of microbial numbers	91
Factors affecting microbial growth	96
The kinetics of microbial growth	101

Growth in multicellular microorganisms	105
Test yourself	106
6 Microbial Metabolism	109
Why is energy needed?	109
Enzymes	110
Principles of energy generation	118
Anabolic reactions	148
The regulation of metabolism	154
Test yourself	155
Part III Microbial Diversity	157
A few words about classification	158
7 Procaryote Diversity	163
Domain: Archaea	164
Domain: Bacteria	169
Bacteria and human disease	192
Test yourself	195
8 The Fungi	197
General biology of the Fungi	198
Classification of the Fungi	199
Fungi and disease	208
Test yourself	209
9 The Protista	211
'The Algae'	211
'The Protozoa'	224
The slime moulds and water moulds (the fungus-like protists)	230
Protistan taxonomy: a modern view	234
Test yourself	234
10 Viruses	237
What are viruses?	237
Viral structure	238
Classification of viruses	243
Viral replication cycles	244
Viroids	255
Prions	256
Cultivating viruses	256
Viral diseases in humans	259
Test yourself	264
Part IV Microbial Genetics	267
11 Microbial Genetics	269
How do we know genes are made of DNA?	269
DNA replication	271

What exactly do genes do?	275
Regulation of gene expression	285
The molecular basis of mutations	288
Genetic transfer in microorganisms	299
Test yourself	312
12 Microorganisms in Genetic Engineering	315
Introduction	315
Plasmid cloning vectors	319
Bacteriophages as cloning vectors	323
Expression vectors	326
Eucaryotic cloning vectors	328
Polymerase chain reaction (PCR)	333
Test yourself	335
Part V Control of Microorganisms	337
13 The Control of Microorganisms	339
Sterilisation	339
Disinfection	344
The kinetics of cell death	347
Test yourself	351
14 Antimicrobial Agents	353
Antibiotics	355
Resistance to antibiotics	364
Antibiotic susceptibility testing	367
Antifungal and antiviral agents	368
The future	371
Test yourself	372
Part VI Microorganisms in the Environment	375
15 Microbial Associations	377
Microbial associations with animals	377
Microbial associations with plants	379
Microbial associations with other microorganisms	383
Test yourself	386
16 Microorganisms in the Environment	389
The carbon cycle	390
The nitrogen cycle	390
The sulphur cycle	393
Phosphorus	394
The microbiology of soil	394
The microbiology of freshwater	396
The microbiology of seawater	397
Detection and isolation of microorganisms in the environment	398
Beneficial effects of microorganisms in the environment	399

Harmful effects of microorganisms in the environment	402
Test yourself	403
Part VII Microorganisms in Industry	405
17 Industrial and Food Microbiology	407
Microorganisms and food	407
Microorganisms <i>as</i> food	413
The microbial spoilage of food	414
Microorganisms in the production of biochemicals	414
Products derived from genetically engineered microorganisms	418
Microorganisms in wastewater treatment and bioremediation	420
Microorganisms in the mining industry	420
Test yourself	422
Glossary	425
Appendix	447
Further Reading	449
Index	454