

Contents

	<i>Preface</i>	<i>page</i> ix
	<i>Acknowledgements</i>	xi
1	Biological Evolution: The Beginnings of the Story	1
	The Development of Evolution as a Science	1
	The Years before Publication of <i>Origin of Species</i>	3
	So, What Is Evolution?	4
	Change and Species Formation	6
	Natural History and Classification	6
	Exploring the Development and Progress of Life on Earth	8
	The Galapagos Islands and Darwin’s Finches: A Case Study	10
	The Finches	13
	Classification and the Galapagos Finches	15
	Darwin’s Finches and the Origin of Species	20
	The Galapagos Islands and Natural Selection	22
2	Reviewing the Evidence for Evolution	25
	Homology and Comparative Anatomy	25
	Embryology	29
	Vestigial Organs	32
	The Fossil Record	35
	Fossils and Phylogeny	38
	Biogeography	41
	Observational and Experimental Evidence	43
3	Genetic Variation within Populations	45
	Inheritance and Variation	45
	Early Ideas Regarding the Continuity of Life	50
	Biological Inheritance and the Work of Gregor Mendel	50
	Mapping the Genome	53
	Origins and Maintenance of Variation	56
	Mutation	57
	What Sorts of Genes Are Needed by Living Things?	61
	Genotypic and Phenotypic Variation	63

	Genes in Populations	65
	Variation within Populations	66
	Variation between Populations	70
	Population Genetics	72
4	Natural Selection and Adaptive Change	74
	Natural and Artificial Selection	76
	Selection in Populations	80
	Polymorphism	81
	Heterozygote Advantage	85
	Directional Selection and Local Adaptation	86
	Sexual Selection	88
	Genetic Drift and the Adaptive Landscape	91
	The Unit of Selection	91
5	Evolution and Development	94
	Evolutionary Developmental Biology (Evo-Devo)	94
	The Epigenetic Landscape	96
	Homeosis	97
	Hox Genes	98
	The Body Axes and Segmentation	100
	The Dorsoventral Axis	102
	Functional Analogy	104
	The History of Hox Genes	105
	The Divergence of Body Plans	106
	Homeotic Genes and Control of Development in Higher Plants	108
	Evolutionary Developmental Repatterning	111
6	The Origins of Biodiversity	112
	Species Concepts	113
	Isolating Mechanisms	116
	Speciation	117
	Speciation through Polyploidy	119
	Parapatric Distribution, Speciation and Hybrid Zones	120
	Sympatric Speciation	125
	The Explosive Speciation of Cichlids	126
7	Taxonomy and the Diversity of Life	130
	Linnaeus and Classification	131
	Lamarck and the Scala Naturae	133
	Classification and Evolution	135
	Chasing Ancestors	136
	Developing a Modern, Biological Classification	138
	An Objective Classification?	139

	Contents	vii
	Phenetics	139
	Cladistics	142
	Molecular Taxonomy	147
	Nomenclature	149
	Classification and Big Data	152
8	The History and Origins of Life on Earth	153
	What Is Life: Characteristics of Living Things	154
	Origins of Life	156
	The First Organisms	160
	Origins of the Eukaryotes and the Evolution of Sex	161
	Multicellularity and the Higher Taxa	164
	The Evolution of Animals	168
	The Evolution of Plants	177
	Movement onto Land	179
9	Molecules and Evolution	182
	The Early Earth	182
	Replication and the RNA World	185
	Gene Trees	186
	DNA and RNA Phylogenies	190
	Rates of Molecular Evolution	191
	Molecular Clocks	192
	Phylogenomics and Transposable Elements	193
	Lateral Gene Transfer	195
	Genomics and ‘Big Science’	196
10	Human Evolution	198
	Looking at Mammals	199
	Becoming Human	202
	Palaeobiology and the Human Lineage	206
	Modern Humans	211
	Evidence from the Human Genome	212
	Human Success	215
	Human Cultural Evolution	219
	Are We Still Evolving?	221
11	Trends and Patterns in Evolution	223
	Rates of Evolution	224
	Measuring Rates of Evolutionary Change	226
	Extinction and Patterns of Mass Extinction	230
	Heterochrony and Life History Strategies	234
	Are Trends in Evolution Progressive?	237
	Biological Evolution As Science	238

viii	Contents	
12	Questions, Debate and Controversy	241
	Questions in Evolutionary Biology	241
	Life’s Continuing Existence	246
	Evolution and Religion	247
	From So Simple a Beginning	250
	<i>References</i>	251
	<i>Recommended Reading</i>	255
	<i>List of Figure Credits</i>	262
	<i>List of Chapter Reviewers</i>	264
	<i>Index</i>	265

Colour plates can be found between pages 148 and 149.