

Contents

Preface, xi

Chapter 1

Science of Zoology and Evolution of Animal Diversity 1

- Principles of Science, 2
- Origins of Darwinian Evolutionary Theory, 5
- Darwin's Theory of Evolution, 8
- Evidence for Darwin's Five Theories of Evolution, 12
- Revisions of Darwinian Evolutionary Theory, 25
- Microevolution: Genetic Variation and Change
Within Species, 26
- Macroevolution: Major Evolutionary Events and Processes, 31

Summary, 32

Review Questions, 33

Selected References, 34

Custom Website, 34

Chapter 2

Animal Ecology 35

- Environment and the Niche, 37
- Populations, 38
- Community Ecology, 42
- Ecosystems, 47
- Biodiversity and Extinction, 51

Summary, 53

Review Questions, 53

Selected References, 54

Custom Website, 54

Chapter 3

Animal Architecture 55

- The Hierarchical Organization of Animal Complexity, 56
- Animal Body Plans, 57
- How Many Body Plans Are There?, 62

- Components of Metazoan Bodies, 63
- Complexity and Body Size, 69

Summary, 70

Review Questions, 71

Selected References, 71

Custom Website, 71

Chapter 4

Taxonomy and Phylogeny of Animals 72

- Linnaeus and Taxonomy, 73
- Species, 75
- Taxonomic Characters and Reconstruction of Phylogeny, 76
- Theories of Taxonomy, 79
- Major Divisions of Life, 84
- Major Subdivisions of the Animal Kingdom, 84

Summary, 86

Review Questions, 87

Selected References, 87

Custom Website, 88

Chapter 5

Protozoan Groups 89

- Form and Function, 91
- Protozoan Taxa, 98
- Phylogeny and Adaptive Diversification, 108

Summary, 110

Review Questions, 110

Selected References, 110

Custom Website, 111

Chapter 6

Sponges: Phylum Porifera 112

- Ecological Relationships, 113
- Form and Function, 114

Brief Survey of Sponges, 119
Phylogeny and Adaptive Diversification, 120

Summary, 121

Review Questions, 121

Selected References, 121

Custom Website, 122

Chapter 7

Radiate Animals: Cnidarians and Ctenophores 123

Phylum Cnidaria, 124

Phylum Ctenophora, 142

Phylogeny and Adaptive Diversification, 143

Summary, 144

Review Questions, 145

Selected References, 145

Custom Website, 146

Chapter 8

Acoelomate Bilateral Animals: Flatworms,
Ribbon Worms, and Mesozoans 147

Phylum Acoelomorpha, 148

Phylum Platyhelminthes, 148

Phylum Mesozoa, 159

Phylum Nemertea (Rhynchocoela), 159

Phylogeny and Adaptive Diversification, 161

Summary, 162

Review Questions, 162

Selected References, 163

Custom Website, 163

Chapter 9

Gnathiferans and Smaller
Lophotrochozoans 164

Clade Gnathifera, 165

Phylum Gnathostomulida, 165

Phylum Micrognathozoa, 166

Phylum Rotifera, 167

Phylum Acanthocephala, 168

Phylum Cycliophora, 169

Phylum Gastrotricha, 170

Phylum Entoprocta, 170

Lophophorates, 171

Phylum Ectoprocta, 172

Phylum Brachiopoda, 174

Phylum Phoronida, 175

Phylogeny and Adaptive Diversification, 175

Summary, 176

Review Questions, 176

Selected References, 177

Custom Website, 177

Chapter 10

Molluscs 178

Ecological Relationships, 179

Economic Importance, 179

Form and Function, 180

Classes Caudofoveata and Solenogastres, 184

Class Monoplacophora, 184

Class Polyplacophora: Chitons, 184

Class Scaphopoda, 185

Class Gastropoda, 186

Class Bivalvia (Pelecypoda), 192

Class Cephalopoda, 196

Phylogeny and Adaptive Diversification, 199

Summary, 202

Review Questions, 202

Selected References, 203

Custom Website, 203

Chapter 11

Annelids and Allied Taxa 204

Phylum Annelida, 206

Phylum Echiura, 217

Phylum Sipuncula, 218

Phylogeny and Adaptive Diversification, 219

Summary, 220

Review Questions, 220

Selected References, 221

Custom Website, 221

Chapter 12

Smaller Ecdysozoans 222

Phylum Nematoda: Roundworms, 224

Phylum Nematomorpha, 229

Phylum Kinorhyncha, 229

Phylum Priapulida, 230

Phylum Loricifera, 230

Clade Panarthropoda, 230

Phylum Onychophora, 231

Phylum Tardigrada, 231

Phylogeny and Adaptive Diversification, 232

Summary, 233

Review Questions, 233

Selected References, 233

Custom Website, 234

Chapter 13

Arthropods 235

Ecological Relationships, 236

Why Are Arthropods So Diverse and Abundant, 236

Subphylum Trilobita, 240

Subphylum Chelicerata, 240

Subphylum Myriapoda, 245

Subphylum Crustacea, 245
 Subphylum Hexapoda, 255
 Phylogeny and Adaptive Diversification, 273

Summary, 276

Review Questions, 277

Selected References, 277

Custom Website, 278

Chapter 14

Chaetognaths, Echinoderms, and Hemichordates 279

Phylum Chaetognatha: Arrow Worms, 280
 Clade Ambulacraria, 281
 Phylum Echinodermata, 281
 Phylum Hemichordata, 295

Summary, 298

Review Questions, 298

Selected References, 298

Custom Website, 299

Chapter 15

Vertebrate Beginnings: The Chordates 300

Traditional and Cladistic Classification of the Chordates, 301
 Five Chordate Hallmarks, 304
 Ancestry and Evolution, 305
 Subphylum Urochordata (Tunicata), 306
 Subphylum Cephalochordata, 307
 Subphylum Vertebrata, 308

Summary, 314

Review Questions, 315

Selected References, 315

Custom Website, 316

Chapter 16

Fishes 317

Ancestry and Relationships of Major Groups of Fishes, 318
 Living Jawless Fishes, 318
 Cartilaginous Fishes: Class Chondrichthyes, 322
 Bony Fishes: The Osteichthyes, 325
 Structural and Functional Adaptations of Fishes, 330

Summary, 339

Review Questions, 339

Selected References, 340

Custom Website, 340

Chapter 17

The Early Tetrapods and Modern Amphibians 341

Movement onto Land, 342
 Early Evolution of Terrestrial Vertebrates, 342
 Modern Amphibians, 346

Summary, 354

Review Questions, 355

Selected References, 355

Custom Website, 355

Chapter 18

Amniote Origins and Nonavian Reptiles 356

Origin and Early Evolution of Amniotes, 357
 Characteristics of Nonavian Reptiles That
 Distinguish Them from Amphibians, 361
 Characteristics and Natural History of Reptilian Orders, 363

Summary, 372

Review Questions, 373

Selected References, 373

Custom Website, 374

Chapter 19

Birds 375

Origin and Relationships, 376
 Structural and Functional Adaptations for Flight, 377
 Flight, 386
 Migration and Navigation, 388
 Social Behavior and Reproduction, 390
 Humans and Bird Populations, 393

Summary, 397

Review Questions, 397

Selected References, 397

Custom Website, 398

Chapter 20

Mammals 399

Origin and Evolution of Mammals, 400
 Structural and Functional Adaptations of Mammals, 403
 Mammalian Populations, 413
 Human Evolution, 414

Summary, 420

Review Questions, 421

Selected References, 422

Custom Website, 422

General References, 423

Glossary, 425

Credits, 446

Index, 449