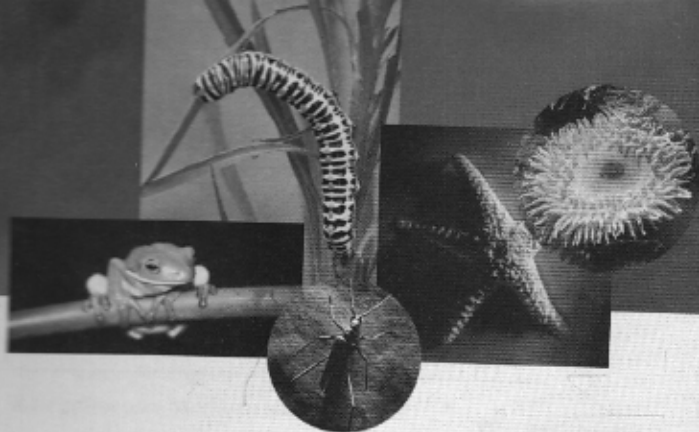


Brief Contents

Contents	vii
Preface	xiii
Laboratory Safety	xvi
Comparative Safety of Preservatives	xviii
Handling and Care of Animals in the Laboratory	xix
Hints for Dissection	xxi

1	Microscopy	1
2	Animal Cells and Tissues	15
3	Mitosis and Meiosis	33
4	Development	47
5	Systematics and Morphology	67
6	Animal-like Protista (Protozoa)	79
7	Porifera	99
8	Cnidaria	109
9	Platyzoa: Platyhelminthes, Gastrotricha, and Rotifera	129

10	Mollusca	151
11	Annelida	173
12	Nematoda and Nematomorpha	189
13	Arthropoda	203
14	Echinodermata	237
15	Chordata	251
16	Shark Anatomy	261
17	Perch Anatomy	281
18	Frog Anatomy	293
19	Fetal Pig Anatomy	317
20	Rat Anatomy	349



Contents

Preface	xiii
Laboratory Safety	xvi
Comparative Safety of Preservatives	xviii
Handling and Care of Animals in the Laboratory	xix*
Hints for Dissection	xxi

1 Microscopy 1

Objectives	1
Introduction	1
The Compound Microscope	2
Parts of the Microscope	2
Magnification	3
Measurements Using an Ocular Micrometer	5
Resolving Power	5
Illumination	5
Focusing	6
Procedure for Use of the Compound Microscope	7
Returning the Microscope after Use	7
Special Precautions	7
Exercises Using the Compound Microscope	8
Estimating Magnification	8
Hair Thickness Microscope Exercise	8
The Stereoscopic Microscope	9
Exercises Using the Stereomicroscope	10
Other Types of Microscopes	10
Phase Contrast Microscopy	10
Dark Field Microscopy	10
Interference Microscopy	10
Electron Microscopy	11
Key Terms	13
Internet Resources	13
Questions for Critical Thinking	14
Suggested Readings	14

2 Animal Cells and Tissues 15

Objectives	15
The Cell Theory	15

Basic Cell Structure	16
Animal Tissues	17
Epithelial Tissue	18
Connective Tissue	21
Muscular Tissue	27
Nervous Tissue	29

Key Terms 31

Internet Resources 32

Questions for Critical Thinking 32

Suggested Readings 32

3 Mitosis and Meiosis 33

Objectives	33
Introduction	33
Mitosis	34
The Mitotic Apparatus	34
Stages of Mitosis	36
Timing in the Cell Cycle	37
Meiosis	40
Gametogenesis	42
Principal Stages of Meiosis	42
Meiosis as a Source of Genetic Variability	42
Ways to Study Meiosis	43
Comparison of Mitosis and Meiosis	44
Key Terms	45
Internet Resources	46
Questions for Critical Thinking	46
Suggested Readings	46

4 Development 47

Objectives	47
Introduction	47
Component Processes of Development	48
Growth	48
Determination	48
Differentiation	48

Morphogenesis	48
Postembryonic Development	48
Gametes	49
Embryonic Cleavage	49
Influence of Yolk	49
Patterns of Cleavage	49
Sea Star Embryology	51
Summary of Early Sea Star Development	52
Frog Development	53
Chick Development	57
Extraembryonic Membranes	58
Whole Mount of 24-Hour Chick Embryo	58
Whole Mount of 48-Hour Chick Embryo	59
Whole Mount of 72-Hour Chick Embryo	62
Later Stages of Chick Development	62
Living Chick Embryos (Optional Exercise)	62
Key Terms	65
Internet Resources	66
Questions for Critical Thinking	66
Suggested Readings	66

5 Systematics and Morphology 67

Objectives	67
Introduction	67
Systematics	68
Morphology	71
Body Symmetry	71
Grade of Tissue Construction	72
Body Cavity	72
Metamerism or Segmentation	73
Cephalization	73
Embryological Features	74
Evolution of the Metazoa	74
Evolutionary Trends in the Animal Kingdom	76
Key Terms	76
Internet Resources	76
Questions for Critical Thinking	76
Suggested Readings	77

6 Animal-like Protista (Protozoa) 79

Objectives	79
Introduction	79
Classification and Phylogeny	80
Flagellated Protozoa	80
Ancient Flagellates	83

Amoeboid Protozoa	84
Alveolata	88
Key Terms	98
Internet Resources	98
Questions for Critical Thinking	98
Suggested Readings	98

7 Porifera 99

Objectives	99
Introduction	99
Phylogeny	101
Morphology	101
Body Types	102
Classification	102
Class Demospongiae	103
Class Calcarea (Calcispongiae)	103
Class Hexactinellida (Hyalospongiae)	103
Leucosolenia: An Asconoid Sponge	103
Scypha: A Syconoid Sponge	103
Leuconoid Sponge	104
Boring Sponges	106
Freshwater Sponges	107
Regeneration and Reconstitution (Optional Exercise)	107
Procedure	107
Collecting and Preserving Sponges	108
Key Terms	108
Internet Resources	108
Questions for Critical Thinking	108
Suggested Readings	108

8 Cnidaria 109

Objectives	109
Introduction	110
Classification	111
Class Hydrozoa (Hydroids and Siphonophores)	111
Class Scyphozoa (True Jellyfish)	112
Class Cubozoa (Sea Wasps or Box Jellyfish)	112
Class Anthozoa (Sea Anemones and Corals)	112
A Hydrozoan Polyp: Hydra	112
Class Hydrozoa	112
General Appearance and Morphology	112
Behavior	112
Cnidocytes and Nematocysts	112
Histological Structure	115
Cellular Structure	115
Nervous System	115
Feeding Behavior	116

Reproduction	116
Regeneration (Optional Exercise)	116
A Hydromedusa: <i>Gonionemus</i>	116
Class Hydrozoa	116
A Colonial Hydrozoan Polyp: <i>Obelia</i>	118
Class Hydrozoa	118
Alternation of Generations	119
A Colonial Hydrozoan: <i>Physalia</i>	120
Class Hydrozoa	120
A Scyphozoan Medusa: <i>Aurelia</i>	121
Class Scyphozoa	121
Reproduction and Life Cycle	122
An Anthozoan Polyp: <i>Metridium</i>	123
Class Anthozoa	123
Reproduction and Life Cycle	124
Corals	124
Class Anthozoa	124
Collecting and Preserving Cnidaria	126
Key Terms	127
Internet Resources	128
Questions for Critical Thinking	128
Suggested Readings	128

9 Platyzoa: Platyhelminthes, Gastrotricha, and Rotifera 129

Objectives	129
Introduction	130
Classification	130
Phylum Platyhelminthes (Flatworms)	130
Phylum Gastrotricha (Gastrotrichs)	131
Phylum Rotifera (Rotifers)	131
Free-living Flatworms: Class Turbellaria	132
A Planarian: <i>Dugesia</i>	132
The Flukes: Class Trematoda	136
The Human Liver Fluke: <i>Clonorchis (Opisthorchis) sinensis</i>	136
The Sheep Liver Fluke: <i>Fasciola hepatica</i>	139
Monogeneans: Class Monogenea	141
The Tapeworms: Class Cestoda	141
Dog and Cat Tapeworms: <i>Dipylidium caninum</i> and <i>Taenia pisiformis</i>	142
Adaptations for Parasitism	142
Collecting and Preserving Flatworms	145
Phylum Gastrotricha	145
Gastrotrichs: <i>Chaetonotus</i>	145
Phylum Rotifera	146
Classification	147
A Rotifer: <i>Philodina</i>	147
Collecting Rotifers	149

Key Terms	149
Internet Resources	150
Questions for Critical Thinking	150
Suggested Readings	150

10 Mollusca 151

Objectives	151
Introduction	151
Classification and Phylogeny	153
Class Solenogastres	154
Class Caudofoveata	154
Class Polyplacophora (Amphineura)	154
Class Monoplacophora	154
Class Bivalvia (Pelecypoda)	154
Class Scaphopoda	154
Class Gastropoda	154
Class Cephalopoda	154
A Freshwater Mussel	156
Class Bivalvia (Pelecypoda)	156
Feeding, Digestion, and Respiration	158
Muscles	160
Circulation	160
Excretion, Osmoregulation, and Reproduction	160
Nervous Coordination	161
<i>Helix</i>: The Garden Snail (Demonstration)	162
Class Gastropoda	162
A Squid: <i>Loligo</i>	164
Class Cephalopoda	164
External Anatomy	164
Internal Anatomy (Demonstration)	165
Octopus (Demonstration)	169
Class Cephalopoda	169
Collecting and Preserving Molluscs	169
Chitons	169
Gastropods	169
Bivalves	170
Key Terms	170
Internet Resources	170
Questions for Critical Thinking	170
Suggested Readings	171

11 Annelida 173

Objectives	173
Introduction	173
Classification	174
Phylogeny of the Annelida	174
Class Polychaeta (Polychaete Worms)	175
Class Oligochaeta (Bristleworms)	175

Class Hirudinea (Leeches)	175
Class Echiura (Spoon Worms)	175
A Marine Annelid: <i>Nereis virens</i>	176
Class Polychaeta	176
External Anatomy	176
Cross Section	179

The Earthworm 180

Class Oligochaeta	180
External Anatomy	180
Internal Anatomy	181
Cross Sections	184

Leeches 185

Class Hirudinea	185
External Anatomy	185
Internal Anatomy (Demonstration)	186

Collecting and Preserving Annelids 186

Key Terms 188

Internet Resources 188

Questions for Critical Thinking 188

Suggested Readings 188

12 Nematoda and Nematomorpha 189

Objectives 189

Introduction 189

Classification 191

Phylum Nematoda (Nemathelminthes or Roundworms)	191
Phylum Nematomorpha (Horsehair or Gordian Worms)	191

Phylum Nematoda 191

A Parasitic Roundworm: <i>Ascaris lumbricoides</i>	191
A Parasitic Roundworm: <i>Trichinella spiralis</i>	195
Hookworms: <i>Ancylostoma duodenale</i> and <i>Necator americanus</i>	195
Pinworm: <i>Enterobius vermicularis</i>	196

Free-living Nematodes 196

<i>Caenorhabditis</i> : An Important Research Animal	196
The Vinegar Eel: <i>Turbatrix aceti</i>	198
Cockroach Pinworms (Optional Exercise)	200
Collecting Free-living Nematodes	200

Phylum Nematomorpha 200

A Gordian Worm	200
----------------	-----

Key Terms 201

Internet Resources 202

Questions for Critical Thinking 202

Suggested Readings 202

13 Arthropoda 203

Objectives 203

Introduction 204

Exoskeleton	204
Appendages	204
Molting and Metamorphosis	204

Classification 206

Subphylum Trilobita (Trilobitomorpha)	206
Subphylum Chelicerata	207
Subphylum Myriapoda	208
Subphylum Crustacea	208
Subphylum Hexapoda (Insects and Relatives)	209

Subphylum Chelicerata 211

The Horseshoe Crab: <i>Limulus</i>	211
A Spider: <i>Argiope</i>	212

Subphylum Crustacea, Class Branchiopoda 216

A Water Flea: <i>Daphnia</i>	216
External Anatomy	216
Internal Anatomy	218

Subphylum Crustacea, Class Malacostraca 218

The Crayfish: <i>Procambarus</i>	218
External Anatomy	218
Internal Anatomy	223

Subphylum Hexapoda, Class Insecta 226

A Cockroach: <i>Periplaneta americana</i>	226
External Anatomy	227
Internal Anatomy	228
A Grasshopper: <i>Romalea microptera</i>	230
External Anatomy	230
Internal Anatomy	232

Insect Metamorphosis 234

Collecting and Preserving Arthropods 234

Key Terms 235

Internet Resources 236

Questions for Critical Thinking 236

Suggested Readings 236

14 Echinodermata 237

Objectives 237

Introduction 237

Classification 238

Phylogeny and Evolution	238
Class Echinoidea	239
Class Holothuroidea	239
Class Crinoidea	239
Class Asteroidea	240
Class Ophiuroidea	240

The Common Sea Star: *Asterias* 241

Class Asteroidea 241

External Anatomy 241

Internal Anatomy 241

A Sea Urchin 246

Class Echinoidea 246

A Sea Cucumber 247

Class Holothuroidea 247

Collecting and Preserving Echinoderms 248

Key Terms 248

Internet Resources 249

Questions for Critical Thinking 249

Suggested Readings 249

15 Chordata 251

Objectives 251

Introduction 251

Classification 252

Subphylum Urochordata (Tunicates or Sea Squirts) 253

Subphylum Cephalochordata (Lancelets) 253

Subphylum Vertebrata (or Craniata) 253

Subphylum Urochordata, Tunicates or Sea Squirts 254

The Tunicate Larva 254

The Adult Tunicate 254

Collecting and Preserving Tunicates 256

A Lancelet: *Branchiostoma* 256

Subphylum Cephalochordata 256

External Anatomy 256

Internal Anatomy 257

Cross Sections 258

Collecting and Preserving Lancelets 259

Key Terms 259

Internet Resources 259

Questions for Critical Thinking 259

Suggested Readings 260

16 Shark Anatomy 261

Objectives 261

The Dogfish Shark: *Squalus acanthias* 261

External Anatomy 262

Internal Anatomy 263

Key Terms 278

Internet Resources 278

Questions for Critical Thinking 278

Suggested Readings 279

17 Perch Anatomy 281

Objectives 281

The Perch *Perca* sp. 281

External Anatomy 282

Internal Anatomy 284

Key Terms 291

Internet Resources 292

Questions for Critical Thinking 292

Suggested Readings 292

18 Frog Anatomy 293

Objectives 293

***Rana pipiens* or *R. catesbeiana* 293**

External Anatomy and

Behavior 294

Skeletal System 295

Muscular System

(Optional) 298

Oral Cavity 302

Internal Anatomy 302

Digestive System 304

Respiratory System 304

Circulatory System 304

Nervous System 311

Key Terms 314

Internet Resources 316

Questions for Critical Thinking 316

Suggested Readings 316

19 Fetal Pig Anatomy 317

Objectives 317

The Fetal Pig: *Sus scrofa* 317

External Anatomy 318

Skeletal System 320

Muscular System 324

General Internal Anatomy 324

Neck Region 324

The Coelom and Its

Divisions 328

The Urogenital System 330

Circulatory System 335

Nervous System 342

Key Terms 347

Internet Resources 348

Questions for Critical Thinking 348

Suggested Readings 348

20 Rat Anatomy 349

Objectives 349

Introduction 349

External Anatomy	350
Skeletal System	351
Muscular System	351
Internal Anatomy	354
Digestive System	355

Respiratory System 356

Circulatory System 357

Urogenital System 362

Nervous System 364

Key Terms 366

Internet Resources 366

Questions for Critical Thinking 366

Suggested Readings 366