Chapter 5
Marine Protozoans and Invertebrates

I. The Protozoans
   A. Kingdom Protista – a “catch-all” category
   B. Characteristics
      1. Mode of nutrition
      2. Single-celled or multicellular?
      3. Cell structure
      4. Reproduction
      5. Free-living and parasitic representatives
      6. Motility
   C. Phylum Sarcomastigophora
      1. General characteristics
      2. Foraminiferans (figure 5.2, page 129)
         a. Habitats
         b. Characteristics
            i. Mostly microscopic
            ii. Shells + what’s inside
            iii. Cytoplasmic filaments
      3. Radiolarians
         a. Habitats
         b. Characteristics
      4. Ciliates
         a. Habitats
         b. Most distinctive characteristic (figure 5.4, page 131)
   D. Ecological importance of protozoa

II. The Kingdom Animalia
   A. Characteristics
      1. Mode of nutrition
      2. Single-celled or multicellular?
      3. Cell structure
      4. Specialized cells (muscles and neurons)
      5. Reproduction
         a. Asexual
         b. Sexual
         c. Monoecy and Dioecy
      5. Motility

III. Symmetry
   A. Asymmetry
      1. No tissues
      2. Reproduction
   B. Radial symmetry (figure 5.8, page 133)
      1. Oral and aboral surfaces
      2. Presence of tissues
      3. Simple nervous system
   C. Bilateral symmetry (figure 5.14, page 136)
      1. Anterior and posterior, dorsal and ventral surfaces
      2. Specialized organs and organs systems
      3. Complex nervous systems
      4. Cephalization

IV. Body Cavity
   A. Acoelomates
   B. Pseudocoelomates
   C. Coelomates
V. Animals with No Symmetry
   A. Phylum Porifera
      1. Habitats
      2. Characteristics
         a. Loosely aggregated cells
         b. The spongocoel
         c. Specialized cells (figure 5.6, page 132)
         d. Pores and the osculum
         e. Skeleton
      3. Importance
   B. Phylum Placozoa
      1. Only one known species?
      2. Simplest multicellular animal

VI. Animals With Radial Symmetry
   A. Phylum Cnidaria
      1. Habitats
      2. Characteristics
         a. Body composition
         b. Gastrovascular cavity (figure 5.10, page 134)
         c. Tentacles + nematocysts inside cnidocytes (figure 5.9, page 133)
         d. Two body forms
            i. Medusa
            ii. Polyp
      3. Three classes
         a. Hydrozoa (hydroids and siphonopores)
         b. Scyphozoa
         c. Anthozoa
      4. Importance
   B. Phylum Ctenophora
      a. Habitat
      b. Characteristics

VII. Acoelomate Animals with Bilateral Symmetry
   A. General Characteristics
      1. No complex specialized organ systems
      2. Small size
      3. Open circulatory systems
      4. Incomplete digestive systems
   B. Phylum Platyhelminthes
      1. Habitats
      2. Characteristics
         a. Flat (why is that important?)
         b. Cilia
         c. Free living forms are mostly carnivorous
      3. Importance
   C. Phylum Gnathostomulida
      1. Habitat
      2. Characteristics
         a. Jaws
      3. Hermaphroditic
   D. Phylum Nemertea
      1. Habitat
      2. Characteristics
         a. Complete digestive system
         b. More complex nervous system
         c. Proboscis
      3. Importance
VIII. Pseudocoelomate Animals with Bilateral Symmetry
A. Phylum Gastrotricha
1. Habitat
2. Characteristics
3. Importance
B. Phylum Kinorhyncha
1. Habitat
2. Characteristics
C. Phylum Nematoda
1. Habitat
2. Abundance
3. Characteristics
   a. Cuticle
   b. No cilia, flagella, or horizontal muscles
3. Importance

IX. Coelomate Animals with Bilateral Symmetry
A. General characteristics
1. Coelom
2. Closed circulatory system
3. Complete digestive system
4. Diverse reproductive strategies
5. Well-developed muscular systems
B. Protostomes and deuterostomes
1. Differences in cleavage (figure 5.17, page 138)
   a. Protostomes: spiral
   b. Deuterostomes: radial
2. Structure of the blastula
   a. Protostomes: cells of unequal size
   b. Deuterostomes: cell of equal size
3. Cell fate
   a. Protostomes: cell fate is predetermined
   b. Deuterostomes: cells are indeterminate
4. Formation of the blastopore
   a. Protostomes: blastopore develops into the mouth
   b. Deuterostomes: blastopore develops into the anus

X. Protostomes
A. Phylum Entoprocta
1. Habitat
2. Characteristics
   a. Colonial
   b. Calcareous
   c. Lophophore
B. Phylum Bryozoa
1. Habitat
2. Characteristics
   a. Colonial, calcareous
   c. Lophophore
C. Phylum Phoronida
1. Habitat
2. Characteristics
   a. Colonial, calcareous
   c. Lophophore
D. Phylum Brachiopoda
1. Habitat
2. Characteristics
   a. Colonial, calcareous
   c. Burrowing
d. Lophophore

E. Phylum Mollusca
   1. The most diverse and abundant phylum in the oceans (#2 on Earth overall)
   2. Habitats
   3. General characteristics
      a. Unsegmented
      b. Shell
      c. Foot
      d. Specialized sense organs
      e. Specialized feeding apparatus
      f. Reproduction
      g. Different larval stages
   4. Class Amphineura (chitons)
      a. Habitat
      b. Characteristics
   5. Class Gastropoda
      a. Different types (snails, slugs, limpets, nudibranchs)
      b. Different habitats
      c. Different feeding styles
      d. Characteristics
   6. Class Scaphopoda (tusk shells)
      a. Habitat
      b. Structure and feeding
   7. Class Bivalvia (mussels, calms, oysters, scallops)
      a. Habitats
      b. Characteristics
         i. Hinged shells
         ii. Gills
         iii. Filter feeders
      c. Importance
   8. Class Cephalopoda (squid, octopus, cuttlefish, nautilus)
      a. Habitats
      b. Characteristics
         i. Tentacles with suckers
         ii. Shell mostly reduced or absent
         iii. Well-developed sense organs
         iv. Large brains
         v. Mobility

F. Phylum Priapulida
   1. Characteristics of all worm-like protostomes
      a. Live in soft sediments
      b. Hydrostatic skeleton
      c. Longitudinal and circular muscles
   2. Habitat
   3. Feeding strategy

G. Phylum Sipunculida
   1. Habitat
   2. Feeding

H. Phylum Echiurida
   1. Habitats
   2. The proboscis

I. Phylum Pogonophora
   1. Habitat
   2. Why they don’t need a digestive system

J. Phylum Annelida
   1. Different habitats
   2. Characteristics
      a. Segmentation
      b. Different feeding types
c. Gills

K. Phylum Arthropoda
   1. The most diverse and abundant phylum on Earth (#2 in the oceans)
   2. Characteristics
      a. Jointed legs
      b. Segmentation
      c. Chitinous exoskeleton
         i. Advantages
         ii. Disadvantages
   3. Class Merostomata
   4. Class Pycnogonida
   5. Class Crustacea (shrimp, crabs, lobsters, barnacles, copepods, cladocerans)
      a. Abundance and success
      b. Life cycle (figure 5.33, page 147)
      c. Importance

XI. Deuterostomes
    A. Phylum Hemichordata
       1. Habitat
       2. Characteristics
          a. Soft body
          b. Proboscis
    B. Phylum Chaetognatha
       1. Habitat
       2. Characteristics
    C. Phylum Echinodermata
       1. Habitat
       2. Characteristics
          a. Radially symmetric as adults
          b. Pentamerous
          c. Calcareous skin
          d. Water vascular system
       3. Six classes: sea stars, feather stars, sea cucumbers, brittle stars, sea urchins, sea daisies
       4. Importance
    D. Phylum Chordata
       1. Characteristics
          a. Notochord
          b. Dorsal hollow nerve cord
          c. Postanal tail
          d. Pharyngeal gill slits
       2. Subphylum Urochordata
       3. Subphylum Cephalochordata
       4. Subphylum Vertebrata