CHAPTER 44: THE NONCOELOMATE ANIMALS

CHAPTER SYNOPSIS

Animals are distinctly different from other life forms studied thus far. They have no cell walls, move actively, exhibit primarily sexual reproduction, and undergo embryonic development. The animal kingdom is divided into two subkingdoms: Parazoa and Eumetazoa. Both are derived from the same unicellular choanoflagellate ancestor. Sponges are the most familiar parazoans; they are typically asymmetrical and lack both tissues and organs. The 35 phyla of eumetazoans possess definite shape and symmetry. They also have three distinct embryonic cell layers that differentiate into the tissues of the adult and tissues that are organized into organs and organ systems. The simplest invertebrates comprise 14 phyla that are less complex than the other invertebrates.

Animal phyla show five key transitions in body plan as they evolve from simple to more complex forms. The sponges lack tissues, all other animals possess tissues, the first major evolutionary advance. Bilateral symmetry is the second advance. Radiata (cnidarians and ctenophora) exhibit radial symmetry while all other animals are bilaterally symmetrical. Animals in the Bilateria exhibit left and right halves that are mirror images to each other. This advance allows for the differential adaptation of various parts of the body. It also supports the evolution of cephalization with the localization of sensory organs at one end. The third key transition is the evolution of a body cavity. Acoelomates like flatworms possess no true body cavity and are commonly called solid-bodied worms. Pseudocoelomates like roundworms, have a pseudocoel located between the embryonic mesoderm and endoderm. Seven animal phyla are pseudocoelomate. Most members of the animal kingdom are coelomates. Coelomates possess a true, fluid-filled body cavity that develops entirely within the mesoderm. The gut and other internal organs are suspended within the coelom. The advent of this type of body cavity necessitated the development of a more complex circulatory system to ensure that all organs receive oxygen and nutrients. The fourth transition separates protostome and deuterstome development. In protostomes the blastopore becomes the mouth while in deuterostomes the blastopore becomes the anus. The evolution of segmentation is the fifth key transition. Segmentation provides for more efficient locomotion and increased protection from damage due to the replication of organs in each segment. True segmentation is found only in annelids, arthropods, and chordates.

The phylum Porifera includes sessile, generally colonial marine, and freshwater sponges. They are filter feeders dependent on food-laden water circulating through pores in their body wall. Their internal cavity is lined with flagellated choanocytes that strongly resemble a choanoflagellate protist, their likely ancestor. There is little coordination between cells in a sponge, although there is some specialization according to function. The internal cavity is lined with flagellated choanocytes that strongly resemble protist Zoomastigina choanoflagellates. The intermediate mesenchyme layer containing amoeboid cells may be impregnated with spongin fibers or glass-like spicules.

Cnidaria and Ctenophora are radially symmetrical acoelomates that have two distinct tissue layers. Most Cnidarians exhibit two diploid body forms: the cylindrical, upward-facing polyp and the umbrella-shaped, downward-facing medusa. They are carnivores that secrete digestive enzymes into a primitive gut. The gut opening serves as both mouth and anus. They are the first organisms capable of digesting particles larger than a single cell, although the particles must still be degraded intracellularly. Cnidarians also possess unique stinging cells, or cnidocytes that contain harpoon-like nematocysts. They are divided into four classes: Hydrozoa (hydroids), Scyphozoa (jellyfish), Cubozoa (box jellyfish) and Anthozoa (sea anemones and corals). Members of the phylum Ctenophora (comb jellies) are abundant in the open ocean. They are structurally quite different from the cnidarians; they have anal pores, two retractable tentacles, and eight comb-like plates of fused cilia.

The phylum Platyhelminthes possess three distinct tissue layers and complete organ systems. They are bilaterally symmetrical, dorsoventrally flattened animals, hence the common name of the group, the flatworms. Their digestive system is similar to that of the cnidarians, but more highly branched. They additionally possess excretory and nervous systems; the latter includes specialized anterior sensory systems used to find food. One class of flatworms, the turbellarians, is free-living. The trematodes and cestodes are external and internal parasites respectively and are commonly called flukes and tapeworms. The ribbon worms comprise the phylum Nemertea. They are the simplest animals in which blood flows in specific vessels and that possess a complete digestive system. Both of these phyla are acoelomate; they lack any internal body cavity other than the digestive cavity.

The phylum Nematoda includes the nematodes, eelworms, and roundworms. They are bilaterally symmetrical, cylindrical, unsegmented worms that whip from side-to-side as they possess only longitudinal muscles. The pseudocoel serves as a hydrostatic skeleton against which the body muscles contract. Their digestive system is one-way with a mouth, pharynx, gut, and anus. These worms are generally parasitic, either on plants or in animals and cause enormous agricultural damage. Rotifers are another common phylum of pseudocoelomates. They are ubiquitous microscopic animals characterized by an anterior crown of cilia that is adapted for feeding and locomotion. Cydiophora are a newly discovered phylum of tiny animals with circular mouths surrounded by a ring of fine cilia.

CHAPTER OBJECTIVES

ä Understand how the animals are organized and how this organization is different from that of plants, fungi, protists, and prokaryotes.

ä Know the five key transitions in body plan and how they show evolutionary trends.

ä Compare and contrast Parazoa and Eumetazoa in terms of evolution, complexity, symmetry, and organization of embryonic cell layers.

ä Compare bilateral symmetry to primary and secondary radial symmetry.

ä Differentiate among acoelomate, pseudocoelomate, and coelomate organisms; indicate how they are evolutionarily related and give examples of each.

ä Understand the advantages of segmentation; give at least one example of segmentation in each of the coelomate phyla.

ä Differentiate between protostomes and deuterostomes.

ä Understand the general organization of a sponge, including reproduction and metabolism.

ä Understand how the body plan and reproductive strategy of a cnidarian differs from other animals.

ä Describe each of the four classes of cnidarians.

ä Understand the general organization of the phylum Platyhelminthes and how their various organ systems compare to those of the other simple invertebrates.

ä Explain the structural and physiological changes that occur in parasitic organisms using the flatworms as examples.

ä Understand the general organization of the phylum Nematoda and compare their systems to those of the acoelomate invertebrates.

KEY TERMS

acoelomate
bilateral symmetry
blastopore
blastula
cephalization
cercaria
choanocyte
circulatory system
closed circulatory system
cnidocyte
coelom
coelomate
complete digestive system
deuterostome
diploblastic
ectoderm
endoderm
Eumetazoa
flame cell
gastrodermis
gastrula
hermaphroditic
invertebrate
mesoderm
mesoglea
mesohyl
metacercaria
miracidium
morula
neck
nematocyst
open circulatory system
osculum
Parazoa
parietal peritoneum
pharynx
planula larva
primary induction
proglottid
protostome
pseudocoel
pseudocoelomate
radial symmetry
redia
scolex
segmentation
segments
sessile
spicule
spongin
stylet
tissue
triploblastic
vertebrate
visceral peritoneum

CHAPTER OUTLINE

44.0 Introduction

I. ANIMALS ARE AMONG THE MOST ABUNDANT LIVING THINGS

A. Noncoelomates Are Simple Animals that Lack a Coelom Body Cavity fig 44.1

B. Basic Animal Body Plan Evolved First in these Animals

44.1 Animals are multicellular heterotrophs without cell walls

I. SOME GENERAL FEATURES OF ANIMALS

A. Animals Depend on Other Organisms for Nourishment
1. Feed directly or indirectly on plants, algae, or autotrophic bacteria
2. Animals are mobile in their search for food
3. Food is ingested and digested in an internal cavity

B. Major Characteristics of Animals
1. Multicellular heterotrophs
   a. Encompass all animal species
   b. Unicellular heterotrophs, "Protozoa," are classified as Protists
2. Diverse in form
   a. Most animals are invertebrates
   b. Only 1% of all species are vertebrates
   c. Include 35 phyla
      1) Size ranges from microscopic forms to enormous whales and giant squid
      2) Most are marine, some are freshwater, few are terrestrial
      3) Arthropods, mollusks, and chordates dominate the land
3. No cell walls
   a. Lack cell walls and are relatively flexible
   b. Cells are generally organized into tissues, except for sponges
   c. Tissue: Collection of cells specialized to perform specific function
4. Active movement
   a. Directly related to flexibility of cells

b. Evolution of nerve and muscle cells
c. Flying is the most specialized form of locomotion
5. Sexual reproduction
a. Nonmotile eggs are much larger than motile sperm
b. Cells formed by meiosis function directly as gametes
c. Haploid cells do not divide by mitosis, fuse directly to form zygote
d. There is no animal counterpart to plant gametophyte or sporophyte
6. Embryonic development
a. Zygote becomes an adult through process of embryonic development
b. During cleavage, zygote divides mitotically forming solid ball of cells, the morula
c. Divides further to form a hollow ball of cells, a blastula
d. This ball folds inward to form a hollow sac, a gastrula
e. Opening of sac called the blastopore
f. Cells subsequently grow and move in relation to one another
g. Details differ from one phylum to another, but provide clues regarding their evolutionary relationships

C. The Classification of Animals
1. Divided into two subkingdoms
a. Parazoa
1) Lack definite symmetry
2) Neither tissues nor organs are present
3) Consist primarily of sponges, phylum Porifera
b. Eumetazoa
1) Possess definite shape and symmetry
2) Have tissues organized into organs and organ systems
c. Evolved from common ancestor, possess most fundamental animal traits fig 44.2
2. Comparison of Parazoa and Eumetazoa
a. Eumetazoa form distinct embryonic layers that differentiate into adult tissues
b. Radially symmetrical Eumetazoa (Radiata) form two layers, are diploblastic
1) Outer ectoderm
2) Inner endoderm
c. Bilaterally symmetrical Eumetazoa (Bilateria) form three embryonic cell layers
1) Ectoderm, endoderm, and mesoderm in between them
2) Sponges lack tissue layers
3. Subgrouping of animals tbl 44.1
a. Simplest invertebrates comprise 14 phyla
b. Four major phyla
1) Porifera: Sponges lack tissue organization
2) Cnidaria: Radially symmetrical jelly fish, hydroids, sea anemones, corals
3) Platyhelminthes: Bilaterally symmetrical flatworms
4) Nematoda: Free-living and parasitic forms roundworms

II. FIVE KEY TRANSITIONS IN BODY PLAN

A. Evolution of Tissues
1. Tissues and organs lacking in Parazoa, the sponges
2. Sponges are aggregates of cells with minimal intercellular organization
3. Eumetazoa have distinct tissues with highly specialized cells
4. First major evolutionary advance

B. Evolution of Bilateral Symmetry
1. Sponges lack definite symmetry, grow as irregular masses
2. Others have symmetry defined along axis drawn through animal's body

3. Radial symmetry in the Radiata
    a. Exemplified by two phyla
        1) Cnidaria: Hydroids, jellyfish, sea anemones, and corals
        2) Ctenophora: Comb jellies
    b. Body parts arranged around a central axis
    c. Division through any plane of axis produces approximate mirror images fig 44.3a
4. Bilateral symmetry in the Bilateria
    a. All other animals are fundamentally bilaterally symmetrical
    b. Bilateral organisms exhibit right and left halves, mirror images fig 44.3b
        1) Possess dorsal (top) and ventral (bottom) halves
        2) Differentiate anterior (front) and posterior (back)
    c. Echinoderms are radial as adults, but bilateral as larvae
5. Second major evolutionary advance
    a. Allows for differential evolution of various parts of body
    b. Different organs located in different parts of body
    c. More efficient mobility
        1) Radiata are usually sessile
        2) Better at seeking food, locating mates, avoiding predators
    d. Evolved various sensory organs generally grouped at head end
        1) Help capture prey, avoid enemies
        2) Other functions located further back in body
        3) Number and complexity of sense organs greater than in Radiata
    e. Nerve system composed of major longitudinal nerve cords
        1) Grouped around anterior end of body
        2) First functioned to transmit impulses from sense organs to rest of body
        3) Evolution of cephalization, a definite head and brain

C. Evolution of a Body Cavity
1. Third key transition
2. Necessary for evolution of efficient organ systems
    a. Supports organs and enhances distribution of materials
    b. Fosters complex developmental interactions
3. Importance of a body cavity
    a. Allows digestive tract to be longer than animal's body length
        1) Allows for storage of undigested food
        2) Longer exposure of food to enzymes improves digestion
        3) Allows for storage and final processing of food remnants
        4) Limits exposure to predators
        5) Tube-within-a-tube design allows for more flexibility and greater mobility
    b. Internal body cavity provides space for expansion of gonads
        1) Allows for accumulation of eggs and sperm
        2) Advanced phyla able to evolve diverse reproductive strategies
        3) Large numbers of gametes stored and released under favorable conditions
4. Kinds of body cavity fig 44.4
    a. Acoelomate: Possess no body cavity
    b. Pseudocoelomate: Pseudocoel located between mesoderm, endoderm
    c. Coelomate: Fluid-filled body cavity entirely within mesoderm
        1) Body cavity called coelom, animals called coelomates
        2) Gut and internal organs suspended in coelom
        3) Coelom surrounded by epithelium layer, derived from mesoderm
            a) Parietal peritoneum lines outer wall
            b) Visceral peritoneum lines internal organs within cavity
    d. Requires circulation within the body cavity
        1) Pseudocoelomates churn fluid within body cavity

2) Coelomates developed sophisticated circulatory system
   a) Network of vessels carries fluid, blood, to all parts of body
   b) Blood carries nutrients and oxygen to tissues
   c) Removes wastes and carbon dioxide from tissues
   d) Circulation effected by contraction of muscular hearts
3) Open circulatory system: Blood mixes with body fluid
4) Closed circulatory system: Blood separate from body fluid

e. Supports various evolutionary relationships
   1) Acoelomates could give rise to coelomates or be derived from them
   2) Pseudocoelomate phyla could all have different origins

5. Advantages of a coelom
   a. Success of coelomate body cavity stems from embryonic development
   b. During primary induction, primary tissues interact with each other
   c. Coelomate body plan allows necessary contact between mesoderm and endoderm
      1) Permits development of localized portions of digestive tract, i.e. stomach
      2) Mesoderm and endoderm separated by body cavity in pseudocoelomates
      3) Limits developmental interactions

D. Evolution of Protostome and Deuterostome Development
1. Coelomates characterized into two groups by embryology
   a. Dissimilar echinoderms and chordates share key embryological features
   b. Four phyla share common ancestry, are deuterostomes
   c. Remaining coelomates are protostomes
   d. Deuterostomes clearly derived from protostomes 630 million years ago
2. Protostome versus deuterostome development fig 44.5
   a. Invagination in blastula forms blastopore
   b. Further development in protostomes
      1) Mouth develops from blastopore
      2) Anus develops at other end of embryo
   c. Further development deuterostome
      1) Anus forms from blastopore
      2) Mouth develops at other end
3. Present two different cleavage patterns, plane in which cells divide
4. Differences in developmental fate of cells
   a. Embryonic protostome cells contain different part of regulatory signals
   b. No single cell of protostome can develop into complete adult
   c. Any cell of deuterostome can become an adult

E. Evolution of Segmentation
1. Fifth key transition
2. Body built from series of similar segments
   a. Like prefabricated tunnel
   b. Segmentation obvious in mesoderm early on
   c. Later reflected in endoderm and ectoderm
3. Advantages to early embryonic segmentation
   a. Repetition of organ systems less lethal if one segment damaged
   b. Locomotion more effective when segments can move independently
4. Segmentation important to organization of all advanced animals
   a. Many arthropod segments are fused, apparent in embryologic development
   b. Vertebrate backbone and muscle areas are segmented
   c. True segmentation in annelids, arthropods, chordates

44.2 The simplest animals are not bilaterally symmetrical

I. PARAZOA

A. Unique Multicellular Animals
1. Sponges lack tissues, organs, and symmetry
2. Body contains several different types of cells
3. Activities of cells are only loosely coordinated

B. The Sponges
1. Primarily marine species, fewer freshwater varieties
2. Few radially symmetrical, but most lack any symmetry
3. Many are colonial, all are sessile as adults
4. Cellular organization
    a. Multiple cell types with little coordination among cells fig 44.7
    b. Simple mass of cells in a gelatinous matrix
    c. Cells readily recognize each other
    d. Cells are specialized for different functions
5. Basic structure of a young sponge shows three functional layers
    a. Inner choanocyte layer
        1) Specialized flagellated collar cells that face inward
        2) Line internal cavity or specialized chambers in large sponges
    b. Outer epithelial layer of flattened cells
        1) Frequently contractile in response to touch or chemicals
        2) May cause some pores to close
    c. Intervening mesohyl layer
        1) Intermediate gelatinous layer with amoeboid cells
        2) May possess minute, calcium carbonate needles called spicules
        3) May possess fibrous spongin protein network
6. Filter feeders
    a. Beating of flagella of inner cells creates water current
    b. Water flows through system of pores and canals
    c. Plankton, small organisms filtered from water
    d. Water forced out through a larger pore called the osculum fig 44.6
7. Choanocytes
    a. Structurally resembles a protist with a single flagellum fig 44.7
        1) Reflects evolutionary derivation
        2) Independent beating of flagella creates water currents
        3) Used to acquire food and oxygen and expel wastes
        4) Collectively create pressure to force water out osculum
        5) Body cavity inner wall may be convoluted to increase surface area
8. Reproduction in sponges
    a. Some reform when passed through silk mesh
    b. Frequent reproduction by fragmentation
    c. Sexual reproduction via production of egg and sperm
        1) Larval sponges may undergo development within adults
        2) Have external, flagellated cells when released
        3) Exist as free-swimming planktonic form for a short time
        4) Settle on a suitable substrate to begin a sessile adult life

II. EUMETAZOA: THE RADIATA

A. Eumetazoans Have Definite Tissues

1. First key transition
2. Possess two distinct cell layers in embryo form
   a. Outer ectoderm, inner endoderm
   b. Give rise to basic body plan
   c. Ectoderm produces body epidermal covering and nervous system
   d. Endoderm produces gastrodermis, digestive tissue
   e. Mesoglea lies between epidermis and gastrodermis, contains muscles
3. Eumetazoans divided into two main groups
   a. Cnidaria: Hydroids, jellyfish, sea anemones, and corals
   b. Ctenophora: Comb jellies

B. The Cnidarians

1. Nearly all are marine, only a few are freshwater
2. Basically gelatinous, have tissues but no organs
3. Carnivores, capture food with tentacles that surround mouth
4. Exhibit two body forms — fig 44.8
   a. Polyp: Cylindrical, generally attached to a substrate
      1) Solitary or colonial
      2) Mouth faces away from substrate, generally upward
      3) May form hard internal or external skeleton
   b. Medusa: Umbrella-shaped, free-floating
      1) Mouth faces substrate, generally downward
      2) Possess a thick jellylike mesoglea, between epidermis and gastrodermis
   c. May exist in only polyp or medusa forms, or alternate between the two phases
   d. Both phases are diploid
5. Reproduction
   a. Polyps reproduce asexually by budding, form polyps or medusae
   b. Sexual reproduction produces fertilized eggs
   c. Develops into a free swimming, multicellular, ciliated planula larva
6. Evolutionary advancement: Development of an internal digestive cavity — fig 44.9
   a. Digestive enzymes secreted into a primitive gut
   b. Food broken into smaller particles
   c. Particles further digested by cells lining gut
   d. Enable cnidarians to digest food larger than individual cells
7. Organization of tissues
   a. Nerve cells organized into nets to coordinate muscle contraction
   b. Lack blood vessels
   c. No respiratory or excretory systems
8. Cnidaria possess cnidocytes
   a. Located on tentacles, sometimes the body surface
   b. Structures specialized for food capture and defense
   c. Each cnidocyte contains a harpoon-like nematocyst
      1) Features a coiled, thread-like tube
      2) Inner wall lines with barbed spines
      3) Spears prey and draws it back to tentacle
   d. Propelled by water pressure
      1) High internal osmotic pressure built up via active transport
      2) Trigger stimulated to discharge barb
      3) Walls become permeable to water, water rushes in and pushes out barb
      4) Among fastest processes in nature, sufficient force to penetrate crab shell
   e. Stinging protein toxin often injected into prey

C. Classes of Cnidarians
  1. Class Hydrozoa: The hydroids — fig 44.10
     a. Have both polyp and medusa forms
     b. Mostly marine, colonial forms like *Obelia*
     c. Also includes Portuguese man-of-war and other luminescent marine forms
     d. Example: Freshwater *Hydra*
        1) Atypical, has polyp form only
        2) Readily glides on basal disk or somersaults
        3) May float to surface if detached from substrate
  2. Class Scyphozoa: The jellyfish — fig 44.11
     a. Conspicuous medusae alternate with inconspicuous polyp forms
     b. Medusa are bell-shaped, tentacles hang around margins
     c. Outer epithelial layer contains contractile epitheliomuscular cells
        1) Cells form muscular ring around margin
        2) Pulses rhythmically to propel animal through water
     d. Separate male and female individuals, fertilization produces planulae
     e. Polyp stage may be suppressed in forms that live in open ocean
  3. Class Cubozoa: The box jellyfish — fig 44.12
     a. Previously contained within class Scyphozoa
     b. Medusa is box-shaped, polyps are inconspicuous or unknown
     c. Tentacle found at each corner of box
     d. Strong swimmers, voracious predators
     e. Stings of some species fatal to humans
  4. Class Anthozoa: The sea anemones and corals — fig 44.13
     a. Solitary and colonial marine organisms
     b. Cylindrical plant-like body with tuft of hollow tentacles
     c. Shallow, warm water varieties may harbor photosynthetic algae
     d. No medusa form, planula form polyps
     e. Sea anemones are soft-bodied, abundant in tropics
        1) Retract tentacles and fold up when touched
        2) Highly muscular, complex organisms with divided internal cavities
     f. Corals secrete hard or protein skeletons that comprise coral reefs
        1) Waters that support corals are nutrient poor
        2) Corals are abundant due to algae within them

D. The Ctenophorans (The Comb Jellies)
  1. Spherical to ribbon-shaped individuals, also called sea walnuts
  2. Relationship to Cnidarians
     a. Traditionally thought to be closely related
     b. Recent research questions this assumption, structurally more complex
  3. Have anal pores, water and substances pass completely through body
  4. Abundant in the open ocean
     a. Transparent, few centimeters long
     b. Have two long retractable tentacles
     c. Possess eight comb-like plates of fused cilia for locomotion — fig 44.14
     d. Many are bioluminescent

44.3 Acoelomates are solid worms that lack a body cavity

I. EUMETAZOA: THE BILATERIAN ACOELOMATES

A. Characterized by Bilateral Symmetry
1. Second key transition
2. Allows for specialization within parts of body
3. Lack internal cavity other than digestive tract
4. Have three embryonic layers during development

B. Phylum Platyhelminthes: The Flatworms
1. General biology — fig 44.15
    a. Ribbon-shaped, softbodied, flattened dorsoventrally (top to bottom)
        1) Have definite head at anterior end
        2) Possess organs
    b. Many species are parasitic — fig 44.16
    c. Others species are free-living carnivores or scavengers
        1) Eat small animals and organic debris
        2) Move via ciliated epithelial cells on lower surface
2. Organ systems of flatworms
    a. Digestive system is incomplete with a single opening
        1) Cannot feed continuously
        2) Branched gut also functions to transport food
        3) Partial extracellular digestion, also phagocytosis
        4) Tapeworms lack digestive system, absorb food through body wall
    b. Excretory system of fine tubules with bulb-like flame cells
        1) Primarily regulate water balance
        2) Excretion evolved secondarily
    c. Lack a circulatory system, food and oxygen transported via diffusion
    d. Simple nervous system with longitudinal nerve cords
    e. Free-living forms possess eyespots on side of head
        1) Eye spots are light sensitive, pigmented cups
        2) Can distinguish light from dark, avoid strong light
    f. Reproductive systems are complex
        1) Most flatworms are hermaphroditic with internal fertilization
        2) Fertilized eggs deposited in cocoons, hatch into miniature adults
        3) May be complex succession of larval forms in parasitic flatworms
        4) Asexually reproduce by fragmentation followed by regeneration
3. Class Turbellaria: The turbellarians
    a. Free living organisms, found in water and moist habitats
    b. Example: *Dugesia*, the common planarian
4. Class Trematoda: The flukes
    a. Parasitic forms have epithelium resistant to host digestive enzymes
    b. Lack sensory and locomotive adaptations of free-living forms
    c. Take food in through mouth
    d. Have complex life cycles involving one, two, or more hosts
        1) Intermediate host often a snail
        2) Final host is usually a vertebrate
    e. Example: *Clonorchis sinensis*, human liver fluke — fig 44.17
        1) Usually cross-fertilize between individuals
        2) Eggs containing miracidium larva passed out in feces
        3) Ingested by snail, transformed into sporocyst
        4) Rediae produced inside sporocysts
        5) Nonciliated redia give rise to cercariae

6) Tadpole-like cercariae released in water, are free-swimming
7) Bore into muscles of fish, turn into metacercariae
8) Humans eat fish, cysts dissolve, flukes migrate to liver

f. Example: *Schistosoma* blood flukes
1) Disease schistosomiasis is spreading through the tropics
2) Coat selves with variety of host's own antigens
3) Investigations into effects on immune reaction, develop vaccine
4) Infestation treatable with drugs after infection

5. Class Cestoda: Tapeworms
a. Extremely specialized parasitic organisms
1) Attach to hosts with specialized terminal attachment organs
2) Absorb food through outer body wall, lack digestive cavities and enzymes

b. Bodies divided into scolex, neck, and reproductive proglottids fig 44.16
1) Scolex has suckers, may have hooks
2) Each proglottid is complete reproductive unit with male and female organs
3) Proglottids formed continuously from region behind neck
4) Eggs toward end mature, become fertilized
5) Embryos emerge from end proglottids, leave host in feces

c. Example: *Taenia saginata*, beef tapeworm
1) Juvenile form found in muscle of cattle
2) Becomes adult in human intestine
3) Infection possible when meat eaten rare

C. Phylum Nemertea: The Ribbon Worms fig 44.18
1. Mostly aquatic, free-living ribbon-shaped or thread-shaped worms
2. Have a long, muscular, retractable proboscis for capturing prey
3. Possess fluid-filled sac
a. May be primitive coelom
b. Is hydraulic power source for thrust of proboscis
4. Simplest organisms that possess complete digestive system with mouth and anus
5. Also possess a circulatory system

44.4 Pseudocoelomates have a simple body cavity

I. THE PSEUDOCOELOMATES

A. Pseudocoelomate Animals fig 44.4
1. Possess internal body cavity, third key transition
2. Include seven phyla, evolutionary relationships unclear
3. Pseudocoel serves as a hydrostatic skeleton against which muscles contract
4. Lack defined circulatory systems
5. Have complete, one-way digestive tract

B. Phylum Nematoda: The Roundworms
1. Include nematodes, eelworms, and other roundworms
2. Ubiquitous and abundant in marine, freshwater, and terrestrial habitats fig 44.19
3. Many parasitic of plants and animals, are microscopic in size and live in soil
4. General biology of nematodes
a. Bilaterally symmetrical, cylindrical, unsegmented worms fig 44.20
b. Covered by thick, flexible cuticle that is molted periodically
c. Have longitudinal muscles located beneath the epidermis
1) Pull against cuticle and pseudocoel
2) Results in side-to-side whipping movement

d. Specialized digestive system

1) Have 16 hair-like sensory organs near mouth
2) Mouth surrounded with piercing stylets
3) Food sucked into pharynx, travels through digestive tract
4) Water reabsorbed near end, food eliminated though anus

e. Completely lack cilia or flagella
f. Reproduction sexual, generally the sexes are separate
g. Development is simple, precise
1) *Caenorhabditid elegans* composed of 1,000 cells
2) Fate of each cell completely mapped out

5. Many nematodes parasitize humans
a. Example: *Trichinella*, pig intestinal roundworm
b. Trichinosis may occur if pork eaten raw or undercooked

C. Phylum Rotifera: Rotifers
1. Microscopic animals found in aquatic and soil habitats
2. Ancestors may have resembled flatworms
3. Have crown of cilia, the corona, at head for feeding and locomotion

D. A Relatively New Phylum: Cycliophora
1. Tiny organism with circular mouth surrounded by ring of fine cilia
2. Suck up stray food particles from lobsters on which they live
a. Most of life spent as symbiont on lobster, reproduces asexually there
b. When lobster molts, cyliophoran begins bizarre sexual reproduction
1) Dwarf males emerge, only brains and reproductive organs
2) Males seek out females, fertilizes eggs
3) Eggs produce free-swimming individuals that seek out new lobster

44.5 The coming revolution in animal taxonomy

I. REEVALUATING HOW THE ANIMAL BODY PLAN EVOLVED

A. Traditional Relationships Inferred from Fundamental Characters
1. Include segmentation, type of coelom
2. Characters are likely to be conserved during evolution
a. If characters shared groups are more closely related
b. If character not present groups are more distantly related
3. Traditional phylogeny produced from such examination fig 44.2

B. Variation from the Traditional Approach
1. Needed to examine groups like myzostomids fig 44.21
a. Marine animals that are parasites or symbionts of echinoderms
b. Long history of obligate association
1) Loss or simplification of many body parts
2) Have no body cavity (acoelomate) and incomplete segmentation
c. Strong disagreements about proper classification
1) Generally considered annelids, sometimes polychaetes
2) Sometimes considered separate phylum linked to annelids
2. Recent taxonomical comparisons using molecular data
a. Examine small ribosomal subunit rRNA gene and 1 alpha elongation factor gene
b. Information disagrees with any relationship to annelids
c. More closely aligned to flatworms
3. Key morphological characters are not conserved as previously supposed
a. Features may be gained and lost over evolutionary time
b. Will soon cause major revisions in relatedness of animal phyla

C. Molecular Phylogenies
   1. Recent wealth of data on molecular sequences of various animal groups
      a. Data often at odds with traditional phylogeny — fig 44.2
      b. New phylogenies like those derived from rRNA studies — fig 44.22
   2. Relatedness very different when comparing traditional or molecular data
   3. Molecular phylogenetic analysis is a very new science
      a. Use of different molecules suggests different evolutionary relationships
      b. Confusion may lessen as more data is obtained
      c. Expected consensus phylogeny is likely to be very different from traditional view

INSTRUCTIONAL STRATEGY

PRESENTATION ASSISTANCE:

Stress that the Cnidarian life cycle is NOT an alternation of generations. Although the medusa generally produces gametes, both the polyp and the medusa are diploid organisms. They are not analogous to sporophyte and gametophyte!

Suggest that your students prepare charts indicating how various physiological functions occur in each of the phyla presented in this and the next few chapters. Include nervous activities, reproduction, respiration, digestion, excretion, circulation, and locomotion. This type of chart makes it easier to see the functional and evolutionary relationships among the various phyla.

VISUAL RESOURCES:

Most students are not familiar with the appearance of a real sponge, not even a spongin skeleton. They are only familiar with the multicolored “Pseudospongia plastica.” Bring in examples and/or photographs of others, especially finger sponges and freshwater *Spongilla*.

They are similarly unfamiliar with the appearance of live corals. Find photos with the polyps extended. Recommend a trip to a nearby marine aquarium if possible.