

## Chapt. 33 – Invertebrates

### Characteristics of the **Animal Kingdom**

None of the following are unique to animals, but together distinguish animals from other organisms: Multicellular; heterotrophic; no cell walls; motile during some stage(s) in life

A great diversity of **body plans** occur; some key features include:

Organized federation of cells vs. cells in tissues

**Tissue** – integrated group of cells with a common structure and function

**Tissues** are generally further integrated into **organs**

**Organs** are generally further integrated into **organ systems**

For organisms with tissues: two vs. three principal **embryonic tissues** [Figs. 32.2 & 32.9]

**Endoderm** – Innermost “**germ layer**”; differentiates into some of the internal tissues and the lining of most hollow organs, if these are present

**Ectoderm** – Outermost “**germ layer**”; differentiates into tissues that cover the body and into the nervous tissues

**Mesoderm** – Middle “**germ layer**”; differentiates into muscles, circulatory and skeletal systems, and sex organs, if these are present

### **Radial** vs. **bilateral symmetry** [Fig. 32.7]

**Radial** - Any plane that passes through the central axis produces roughly mirror-image halves

**Bilateral** - A single midline plane produces roughly mirror-image halves; generally accompanied by distinct **cephalization**

Among organisms with 3 germ layers [Fig. 32.8] :

**Acoelomate**: lack a coelom, *i.e.*, lack a body cavity between digestive tract and body wall

**Pseudocoelomate**: Fluid-filled body cavity between digestive tract and body wall partially lined by mesoderm

**Coelomate**: fluid-filled body cavity between digestive tract and body wall completely lined by mesoderm

### **Protostome** vs. **deuterostome** development [See Fig. 32.9]

**The Animal Kingdom** ~ 35 phyla [Figs. 32.11 & 33.2; Table 33.7]

### **Phylum Porifera – Sponges**

Organized aggregation of cells

Probably the most similar extant group to the protistan colonial precursors to the animals

Three main cell types, but no true tissues

Asymmetric body plan

Mostly marine, but some inhabit fresh water

Internal skeleton of protein **spicules**, *e.g.*, natural bath sponge

## **Eumetazoa**

All animals except sponges belong to the clade Eumetazoa  
All eumetazoans have true tissues

### **Phylum Cnidaria – Corals, Jellyfish, Anemones**

Radially symmetric animals with 2 germ layers (true tissues), but generally lacking true organs  
Gastrovascular cavity; mouth and anus are the same opening  
Rudimentary nerve net and contractile tissue  
Tentacles contain **cnidocytes** [Fig. 33.6]  
**Polyp** and **medusa** forms [See Fig. 33.5]

### **Phylum Ctenophora – Comb jellies**

8 rows of comblike plates of **cilia**

## **Bilateria**

Bilaterally symmetric, cephalized animals with 3 germ layers

### **Phylum Platyhelminthes – Flat worms**

**Gastrovascular cavity** (if a gut is present)  
Some true organs are present (tissues grouped into functional structures)  
**Hermaphroditic** and capable of self-fertilization  
Acoelomate  
Mostly free-living  
Some parasitic, *e.g.*, tapeworms

### **Phylum Rotifera – Rotifers**

Distinguishing feature is a “**crown of cilia**” around the mouth  
Complete digestive tract surrounded by pseudocoelom  
**Parthenogenesis** (development from unfertilized eggs) is the most common mode of reproduction

### **Phyla Ectoprocta, Phoronida & Brachiopoda**

All bear a **lophophore** – fold of the body wall bearing ciliated tentacles surrounding the mouth  
Coelomate

### **Phylum Ectoprocta (a.k.a. bryozoans)**

Colonial  
Many contribute to marine reefs

### **Phylum Phoronida**

A group of tube-dwelling marine worms

### **Phylum Brachiopoda (a.k.a. lamp shells)**

Marine, mostly extinct

### **Phylum Nemertea (a.k.a. proboscis or ribbon worms)**

Structurally acoelomate, with a small fluid-filled sac that may be a vestigial coelom  
**Closed circulatory system**, but no heart

### **Phylum Mollusca (a.k.a. mollusks)**

**Coelomate** body with a muscular **foot**, **visceral mass**, and **mantle** (which secretes a **shell** in many species)

8 classes, including:

**Class Polyplacophora (chitons)** – Shell divided into 8 plates

**Class Gastropoda (snails and slugs)** – Single shell or lacking shell

**Class Bivalvia (clams, oysters, mussels, etc.)** – Hinged, two-part shell

**Class Cephalopoda (squids, octopuses, nautilus)** – Only mollusks with **closed circulatory system** and complex **brain**

### **Phylum Annelida (a.k.a. segmented worms)**

Segmented

Coelomate

Closed circulatory system

3 classes:

**Class Oligochaeta** – Earthworms and their kin

**Class Polychaeta** – Bristled parapodia on each segment

**Class Hirudinea** – Leeches

**Phylum Nematomorpha (a.k.a. horsehair/Gordian worms)** [NOT REQUIRED TO KNOW]

**Phylum Priapulida (a.k.a. penis worms)** [NOT REQUIRED TO KNOW]

**Phylum Tardigrada (a.k.a. water bears)** [NOT REQUIRED TO KNOW]

**Phylum Onychophora (a.k.a. velvet worms)** [NOT REQUIRED TO KNOW]

### **Phylum Nematoda (a.k.a. roundworms)**

Non-segmented

No circulatory or respiratory systems

Pseudocoelomate

Free living or parasitic, *e.g.*, dog heartworm

### **Phylum Arthropoda**

Segmented

Coelomate

**Exoskeleton of chitin**

**Jointed appendages**

**Open circulatory system**

**Hemolymph** (the open-circulation system equivalent of blood) carries dissolved gases through short vessels and the **hemocoel** (main body cavity in adults, since coelom is reduced)

As in much of modern systematics, classes are in flux; nevertheless, here are 5 main groups:

**Trilobites** – all extinct during Permian mass extinction ~250 mya

**Cheliceriforms – horseshoe crabs, sea spiders, arachnids (spiders, ticks, scorpions, mites)**

**Arachnids**

Adults generally have 4 pairs of walking **legs**

Some produce **silk**

**Simple eyes** (each with a single lens)

**Myriapods**

**millipedes**; 2 pairs of legs per segment

**centipedes**; 1 pair of legs per segment

**Hexapods: insects**

Adult often has 2 pairs of **wings**

Sometimes 1 pair of wings; sometimes none

Adult generally has 3 pairs of **legs**

**Metamorphosis** – transition between distinct (often dramatically different) developmental stages

**Larva** (maggot, caterpillar); **Pupa** (transition to adult); **Adult** (often winged) – adult generally has compound eyes

[See Fig. 33.37 – **YOU DO NOT NEED TO MEMORIZE THE INSECT ORDERS**]

**Crustaceans (waterfleas, sowbugs, crabs, barnacles, etc.)**

As in all arthropods, crustaceans have **segmented body plans**

Often have 5 or more pairs of **legs**

Generally have **compound eyes**

**Deuterostomia**

**Deuterostome** developmental pathway

Coelomates

**Phylum Echinodermata (e.g., brittle stars, sand dollars, sea urchins, sea cucumbers, etc.)**

At first glance they may seem more radially than bilaterally symmetrical...

However, their larvae are obviously bilaterally symmetrical

Calcium carbonate endoskeleton

Unique water vascular system of hydraulic canals branching into tube feet for locomotion, feeding, and gas exchange

**Phylum Chordata**

At some stage in development, all chordates possess:

**Notochord; dorsal, hollow nerve cord; pharyngeal slits; postanal tail**