Animal Evolution – The Invertebrates

Chapter 25 Part 3
Roundworms (phylum Nematoda) are unsegmented, pseudocoelomate worms with a secreted cuticle that is molted.

Most are decomposers, some are parasites:
- Parasitic roundworms include *Trichinella*, *Ascaris*, hookworms, *Wuchereria*, and pinworms.
Roundworm Body Plan

- pharynx
- intestine
- eggs in uterus
- gonad
- false coelom (unlined body cavity)
- muscular body wall
- anus

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pharynx  intestine  eggs in uterus  gonad

false coelom (unlined body cavity)  muscular body wall  anus
Animation: Roundworm body plan
Roundworms

larva in a muscle fiber, longitudinal section
Arthropods (phylum Arthropoda) are the most diverse animal phylum – with more than a million species

- Trilobites are an extinct group
- Modern arthropods include horseshoe crabs, spiders, ticks, crabs, lobsters, centipedes, and insects
## Living Arthropod Subgroups

<table>
<thead>
<tr>
<th>Group</th>
<th>Representatives</th>
<th>Named Species</th>
</tr>
</thead>
<tbody>
<tr>
<td>Chelicerates</td>
<td>Horseshoe crabs</td>
<td>4</td>
</tr>
<tr>
<td></td>
<td>Arachnids (scorpions, spiders, ticks, mites)</td>
<td>70,000</td>
</tr>
<tr>
<td>Crustaceans</td>
<td>Crabs, shrimp, lobsters, barnacles, pill bugs</td>
<td>42,000</td>
</tr>
<tr>
<td>Myriapods</td>
<td>Millipedes and centipedes</td>
<td>2,800</td>
</tr>
<tr>
<td>Insects</td>
<td>Beetles, ants, butterflies, flies</td>
<td>&gt;1 million</td>
</tr>
</tbody>
</table>

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Key Arthropod Adaptations

- A hardened exoskeleton (cuticle)
  - Hormones control molting

- Jointed appendages for movement
  - Some legs are modified for special tasks

- Highly modified segments
  - *Example*: wings
Key Arthropod Adaptations

- Sensory specializations
  - Compound eyes
  - Antennae that detect touch and chemicals

- Specialized developmental stages
  - Body plans may change by metamorphosis
  - *Example*: Caterpillar and butterfly
Key Arthropod Adaptations

a) Centipede
b) Spider
![c) Insect Wing](image)
d) Butterfly Larval Stage
Chelicerates are arthropods without antennae

- Marine chelicerates include the oldest living arthropod lineage (horseshoe crabs)
- All land chelicerates are arachnids, including spiders, scorpions, ticks, and mites
Chelicerates
Fig. 25-32b, p. 422

telson
(with stinger)

pedipalp

cephalothorax

abdomen

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Chelicerates: The Spiders

- Spiders bite with fanglike chelicerae that deliver venom from poison glands
- Paired spinners in the abdomen eject silk
- Open circulatory system mingles blood with tissue fluids; **Malpighian tubules** move excess water and wastes to gut for disposal
Body Plan of a Spider

- eye
- brain
- poison gland
- pedipalp
- chelicera
- mouth
- digestive gland
- heart
- Malpighian tubules
- anus
- book lung
- ovary
- spinners
- sperm receptacle
- silk gland

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Crustaceans are mostly marine arthropods with two pairs of antennae

- Small crustaceans include krill, copepods, and barnacles
- Decapod crustaceans include lobsters, crayfish, crabs and shrimps
Crustaceans
abdomen segments

cephalothorax (fused segments)

eyes (two)

antennae (two pairs)

food-handling appendages (three pairs)

first leg

walking legs (five pairs)

tail fan

swimmerets

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Fig. 25-35, p. 423
juvenile

adult female

egg

larva

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Fig. 25-36, p. 423

Stepped Art

adult female

juvenile

larva

egg
Animation: Crab life cycle
Myriapods (“many feet”) are arthropods with two antennae and many body segments

- Centipedes are predators
- Millipedes are scavengers
Myriapods

- Centipede and millipede
Insects have a three-part body plan
- The head has compound eyes, a pair of antennae, and specialized mouthparts
- The thorax has three pairs of legs; some lineages have wings
- Malpighian tubules in the abdomen eliminate wastes and save water
Insect Body Plan: Bedbug

- abdomen
- thorax with six legs
- head with two eyes, and two antennae
abdomen

thorax with six legs

head with two eyes, and two antennae
Specialized Mouthparts

- antenna
- labrum
- compound eye
- mandible
- maxilla
- palps
- labium
- maxilla

© Brooks/Cole, Cengage Learning
antenna

compound eye

mandible

maxilla

palps

labium

labium

maxilla

Fig. 25-39, p. 425
Animation: Insect head parts
Insects

- Arthropods are the most successful animals, and insects are the most successful arthropods.

- Insects are adapted to life on land; a system of tracheal tubes delivers air to their tissues.

- Development may be direct, or through incomplete or complete metamorphosis.
Insect Development

**a** Direct development: Growth in size between molts but no change in body form

**b** Incomplete metamorphosis: gradual change with each molt until the nymph becomes adult

**c** Complete metamorphosis: larvae grow, then molt into a pupa, which is remodeled into the adult form
a Direct development: 
Growth in size between molts but no change in body form

b Incomplete metamorphosis: 
gradual change with each molt until the nymph becomes adult

c Complete metamorphosis: 
larvae grow, then molt into a pupa, which is remodeled into the adult form
It would be hard to overestimate the importance of insects, for either good or ill.

Insects help provide us with food crops, are food for animals, and help dispose of wastes.
- The four most diverse groups of insects all include pollinators of flowering plants.

A few insects eat our crops or carry pathogens.
Insect Diversity
One major lineage of animals with tissues includes the flatworms, annelids, mollusks, nematodes, and arthropods.

All are bilaterally symmetrical.

The arthropods, which include the insects, are the most diverse of all animal groups.
The Protostome-Deuterostome Split

- So far, all of the animals with a three-layered embryo – from flatworms to arthropods – have been protostomes

- All of the following animals – from echinoderms to vertebrates – are deuterostomes
Echinoderms (phylum Echinodermata) have “spiny skins” embedded with interlocking spines and plates of calcium carbonate.

They begin life as bilateral larvae and develop into spiny-skinned, radial adults.

They are brainless and have a unique water-vascular system for locomotion.
Echinoderm Body Plan: Sea Star

ampulla of a tube foot

canal of water-vascular system

upper stomach

anus

gonad

spine

digestive gland

eyespot

tube feet

© Brooks/Cole, Cengage Learning
ampulla of a tube foot
canal of water-vascular system
Animation: Body plan of a sea star
Echinoderm Diversity

- Echinoderms include about 6,000 marine invertebrates such as sea stars, brittle stars, sea urchins, and sea cucumbers.

- Echinoderms can regenerate lost body parts; any portion of a sea star with some of the central disc can regrow missing parts.
Echinoderms
Echinoderms are on the same branch of the animal family tree as the vertebrates.

They are invertebrates with bilateral ancestors, but adults now have a decidedly radial body plan.
Animation: Chelicerates

- Spider
- Scorpion
- Horse crab
- Tick
Animation: Crustaceans
Animation: Insect development
Video: Old genes, new drugs
Video: Water vascular system
Video: Rotifers
Video: Beetle
Video: Brittle star
Video: Giant clam, octopus
Video: Nudibranch
Video: Otter eating
Video: Sea anemones