

Chapter 12: Arthropoda (Greek=jointed foot/appendage)

75% of all described species

>1,100,000 species described >1,000,000 species still undescribed

rich fossil history dating to the late Precambrian >600 mya



Demodex folliculorum

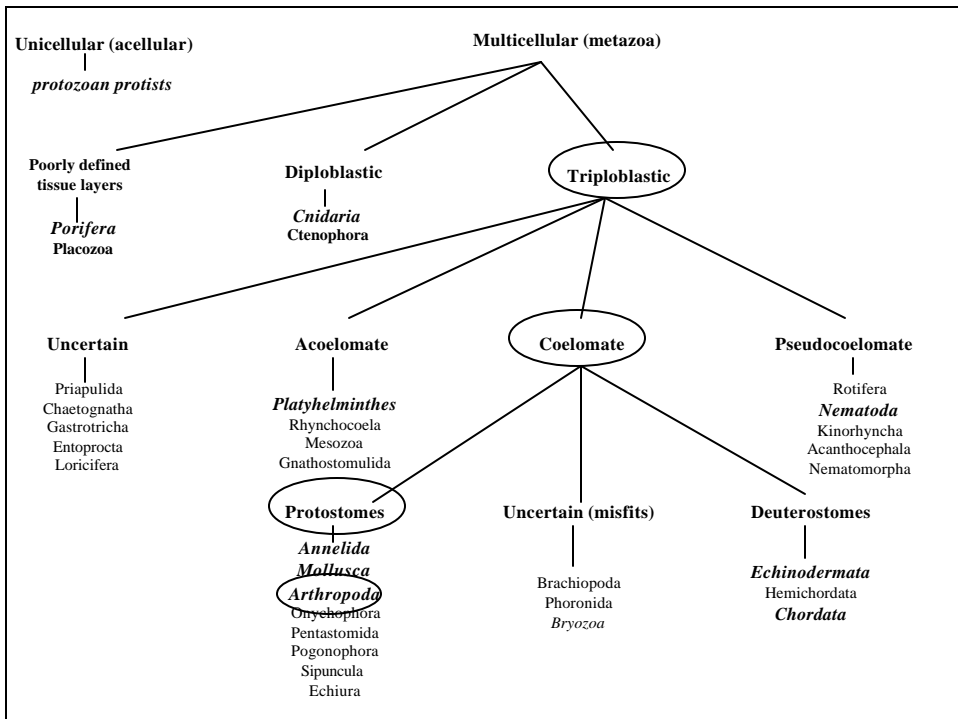


size ranges: Japanese crab (4 m leg span) follicle mite (0.1 mm long)

abundance/wide ecological distribution → most diverse animal group

serious disease agents & compete with humans for food; others beneficial

all feeding modes: but most herbivorous



General Arthropodan Characteristics

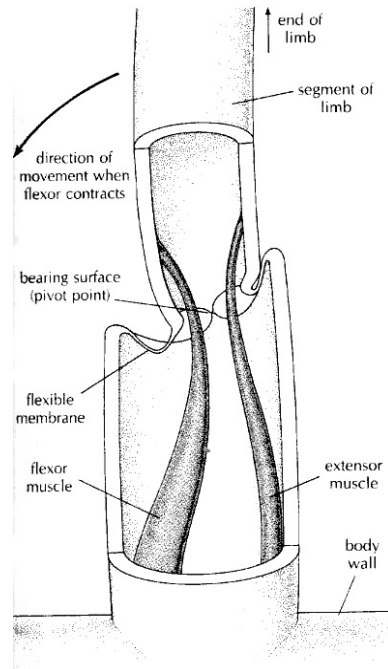
- 1) exoskeleton
- 2) eucoelomate protostomes with well-developed organ systems
- 3) similar to annelids → distinct segments
 - a) molecular analyses: annelids & arthropods from different ancestor
 - b) primitive pattern: linear series of **somites** with **jointed appendages**
 - c) many somites fused/combined into specialized groups → **tagmata**
 - d) appendages often highly specialized for division of labor

Arthropodan Evolution

- 1) ancestral arthropodan soft cuticle:
stiffened by deposition of protein & inert polysaccharide chitin
- 2) joints provide flexibility:
sequence of molts necessary to allow for growth
- 3) molting required hormonal control
- 4) hydrostatic skeleton function lost:
coelom regressed; open sinuses replaced them
- 5) motile cilia lost
- 6) if this not a monophyletic group:
these features would all have to arise independently
- 7) **exoskeleton**: cuticle highly protective but jointed for mobility

Segmentation & Appendages for Efficient Locomotion

- 1) usually each somite → pair of jointed appendages
- 2) segments & appendages modified for various adaptive functions
- 3) limb segments: hollow levers with internal striated muscles
- 4) function
 - a) sensing
 - b) food handling
 - c) walking
 - d) swimming

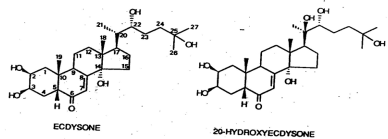
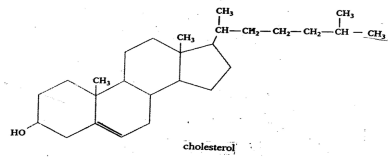
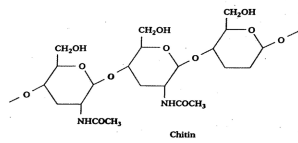
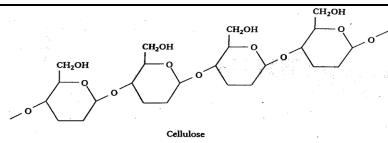
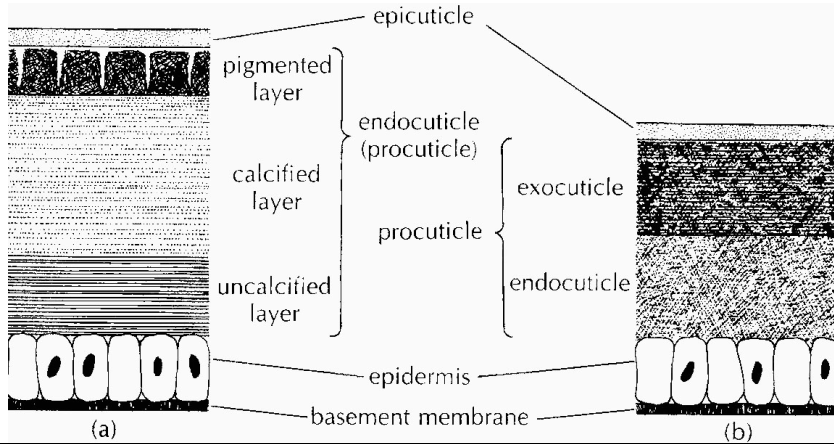


Modern Exoskeleton

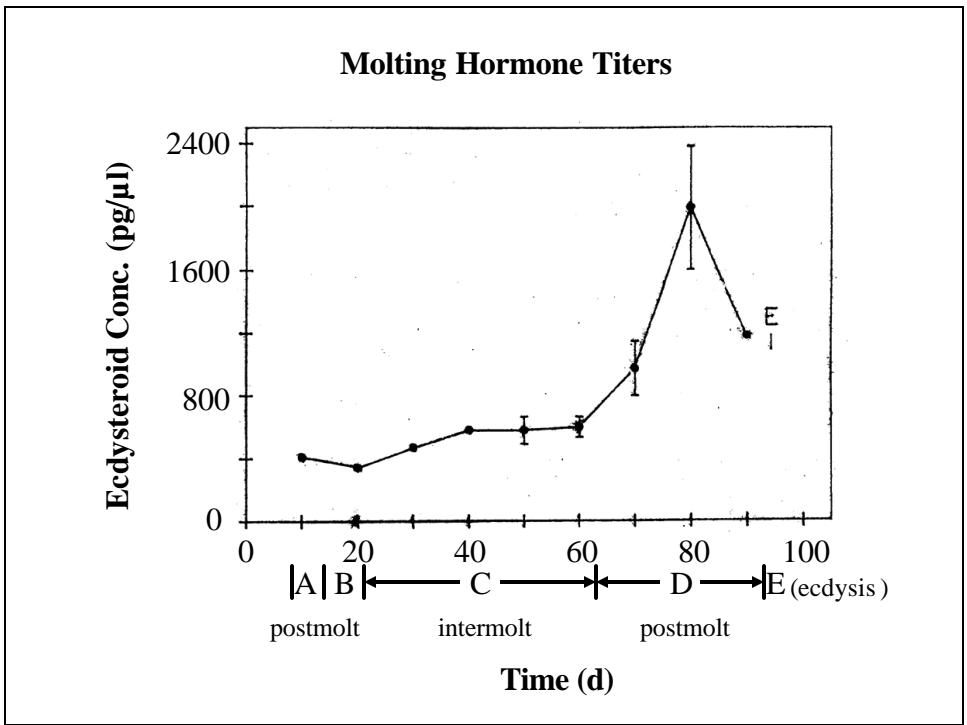
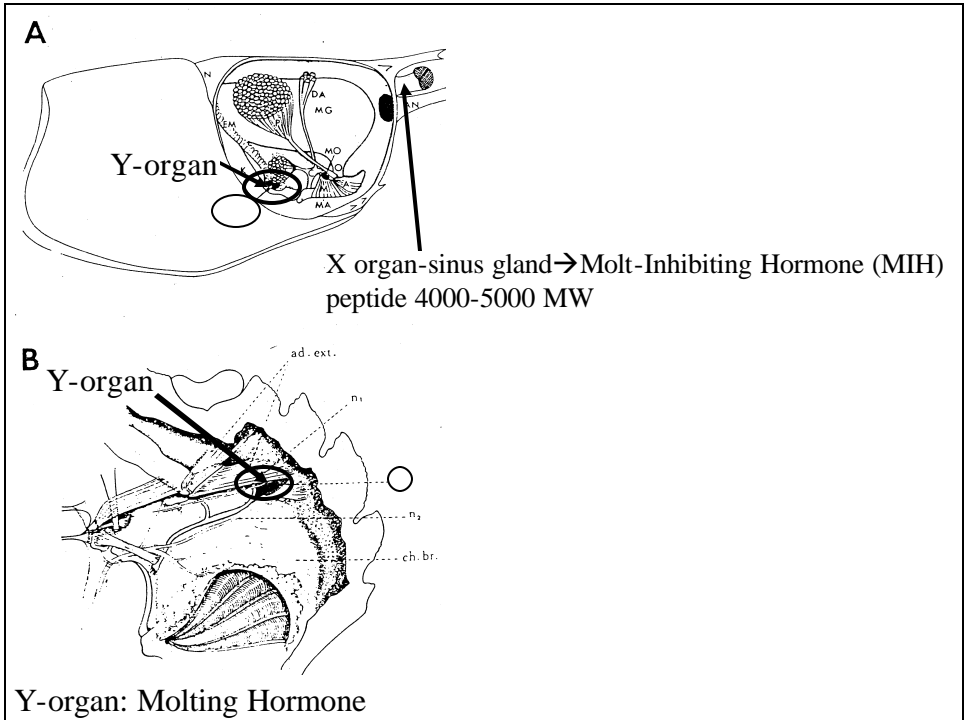
- 1) procuticle lightweight, flexible → protection against dehydration
- 2) chitin: 40% of the procuticle in insects: 80% in crustaceans
- 3) impregnation with calcium salts: procuticle very hard in lobsters/crabs
- 4) cuticle: laminated & further hardened by a chemical tanning process
- 5) cuticle thin between segments → allows movement at joints
- 6) cuticle folds inward to line the foregut, hindgut & trachea
- 7) molting (ecdysis): process of shedding old exoskeleton & replacing with a larger one
- 8) typically molt 4 to 7 times: weight limit to ultimate body size

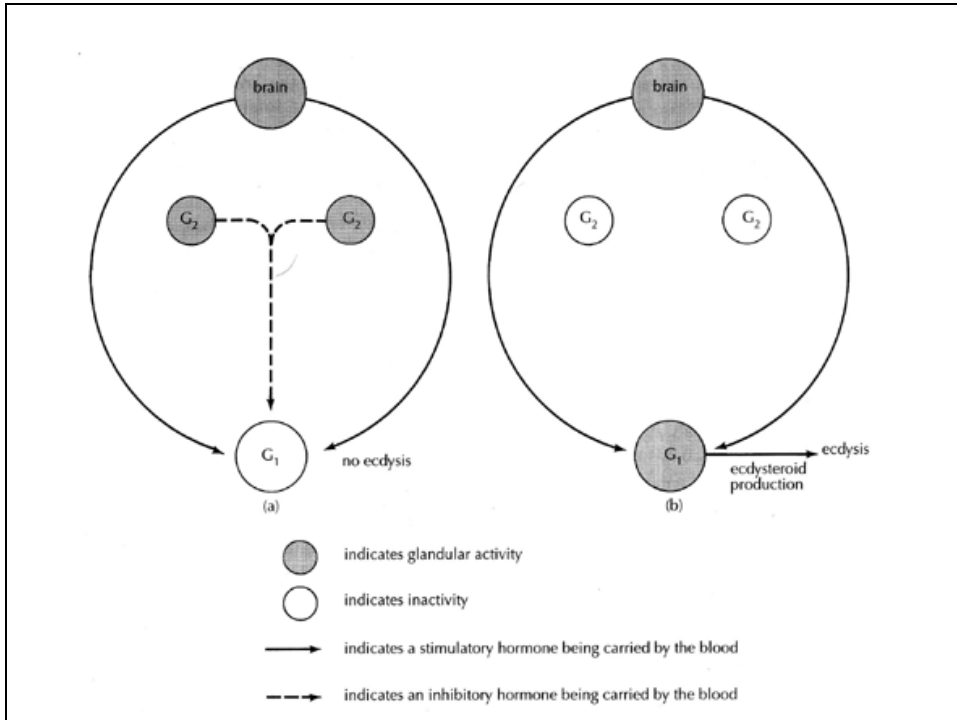
Exoskeleton

- 1) outer thin **epicuticle**
- 2) inner thick **procuticle**
 - a) **exocuticle** secreted before a molt
 - b) **endocuticle** secreted after molting
 - c) both layers contain **chitin** bound with protein



Molting Hormone (MH)





Phylum: Arthropoda

Subphylum: Trilobitomorpha

Class: Trilobita

Subphylum: Chelicerata

Class: Merostomata

Class: Arachnida

Class: Pycnogonida

Subphylum: Crustacea

Class: Malacostraca

Order: Decapoda

Order: Euphausiacea

Order: Amphipoda

Order: Isopoda

Class: Maxillopoda

Subclass: Copepoda

Subclass: Cirripedia

Class: Branchiopoda

Subphylum: Uniramia

Class: Chilopoda

Class: Diplopoda

Class: Hexapoda

Phylum: Arthropoda

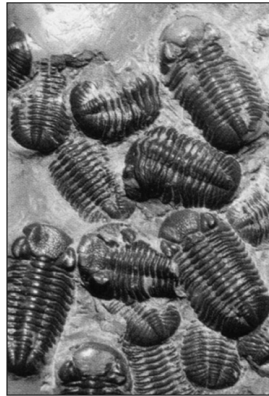
Subphylum: Trilobitomorpha

Class: Trilobita (no living species)

4,000 spp. fossil records

before Cambrian >600 mya; common 500 mya

extinct 250 mya; end of Paleozoic

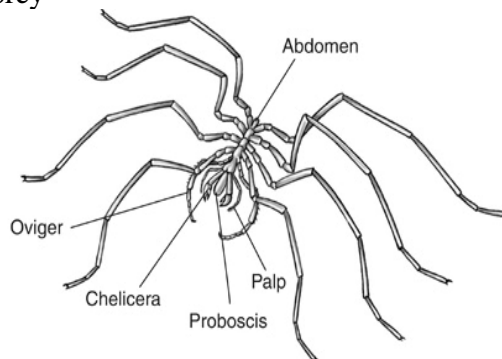


2 to 67 cm length

Subphylum: Chelicerata (claw) 75,000 spp

Cheliceratan Characteristics

- 1) 6 pairs of cephalothoracic appendages
 - a) chelicerae
 - b) pedipalps
 - c) four pair of legs
- 2) lack mandibles & antennae
- 3) most suck liquid food from prey



Subphylum: Chelicerata

Class: Merostomata (extinct except for 4 spp)

eurypterid (3 m)
Cambrian → Permian
570-----245 mya



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horseshoe crab (3 m) *Limulus*
Triassic 245-208 mya

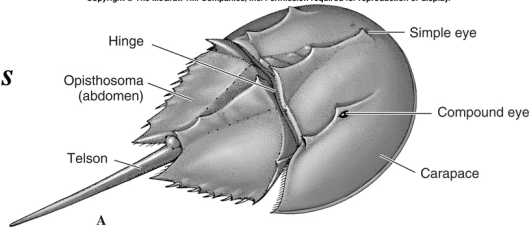
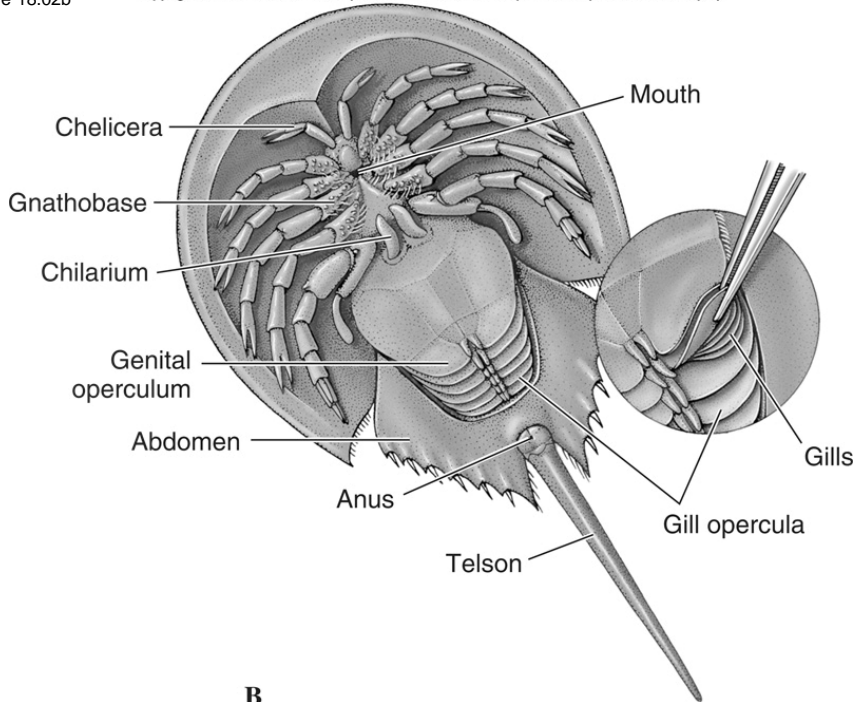


Figure 18.02b

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Subphylum: Chelicerata

Class: Arachnida (Greek: spiders) 74,000 spp ancestors → marine

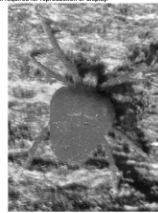
50% spiders



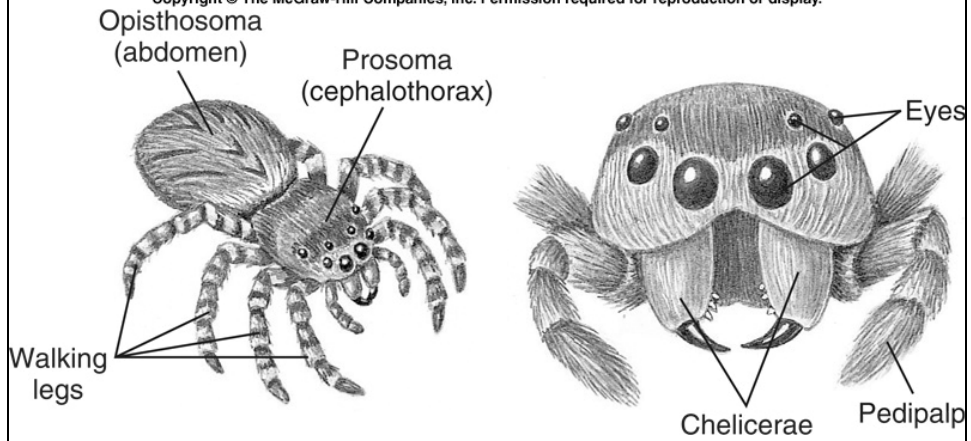
1400 scorpions

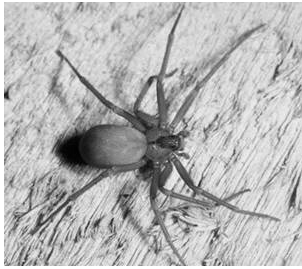


40000 mites & ticks

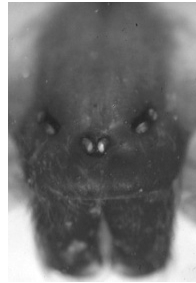


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Brown Recluse Spider
violin shape on cephalothorax



6 eyes (3 pairs separated)
most spiders: 8 eyes (two rows of four)

Other Characteristics

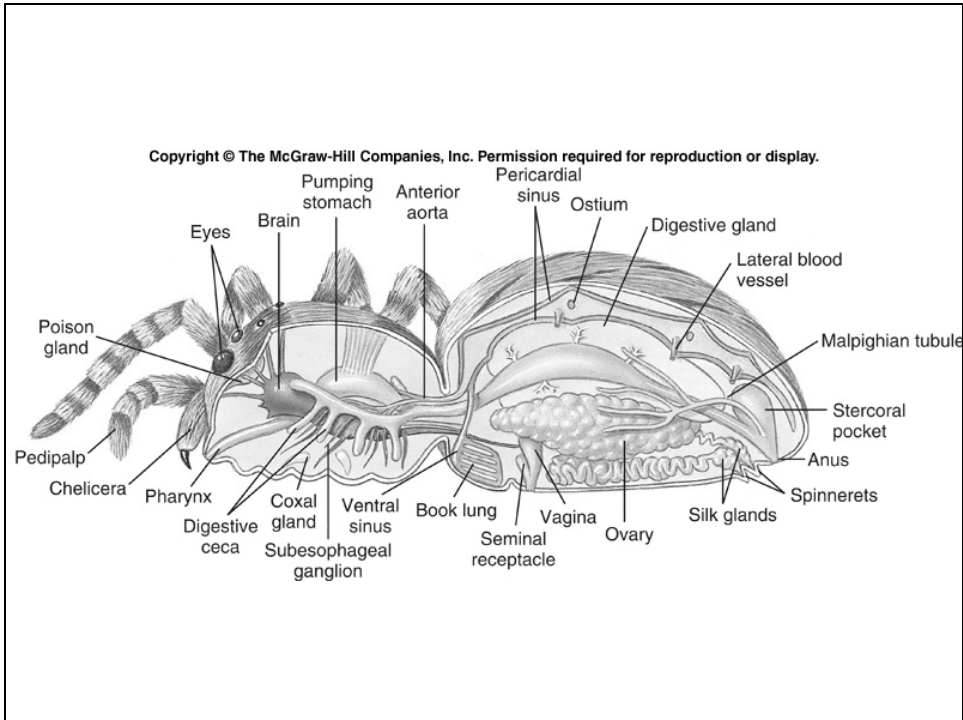
- Uniformly light-colored legs - no stripes, no bands
- Uniformly colored abdomen: vary from cream to dark brown (dependent on food)
- Never have two colors of pigment at the same time.
- No spines on the legs, only fine hairs
- Small retreat webs behind objects, never out in open
- Body length ~3/8 inch



Hobo spider

Characteristics

- Legs show no distinct rings and have short hairs.
- Abdomens several chevron shaped markings
- Males: two large palps that look like boxing gloves
- Palps mistaken for fangs or venom sacs, but are male genitalia
- Females: palps, but the ends are not 'swollen' like males
- Females larger abdomen when compared to males
- Body length: ~12 to 18 mm



Subphylum: Chelicerata

Class: Pycnogonida (Greek = thick knees or all legs)
(sea spiders) 1000 spp

