



Trilobitomorpha
(extinct)



Tracheata

Ph. Arthropoda

Themes: abundance, diversity,
appendages, *land invasion*



Chelicerata



Crustacea



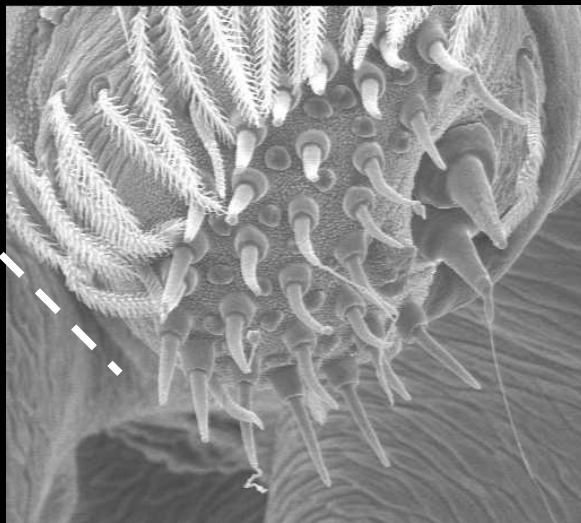
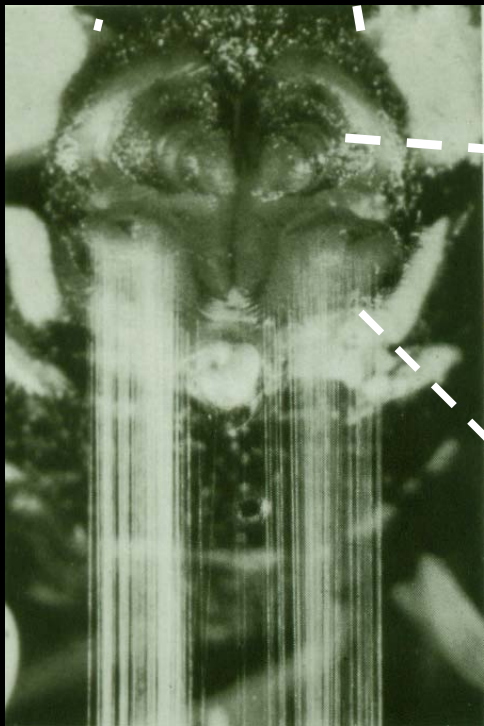


Class Arachnida

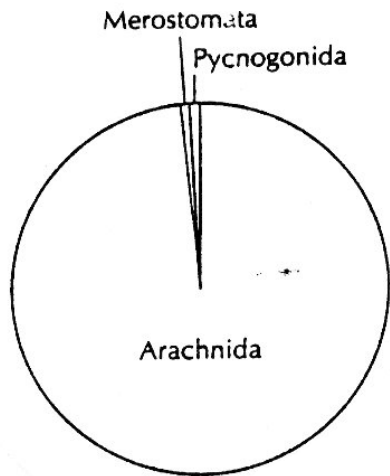
Class Merostomata

**Subph.
Chelicerata**

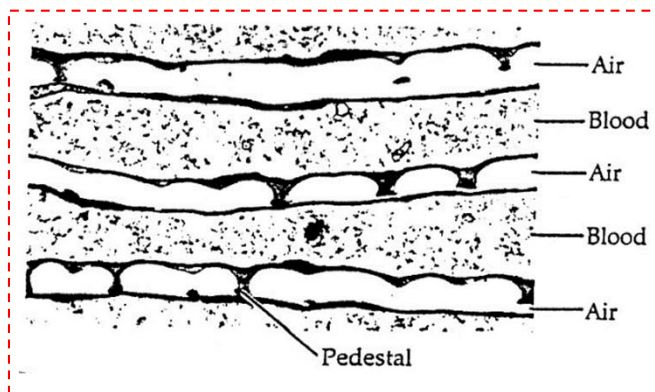
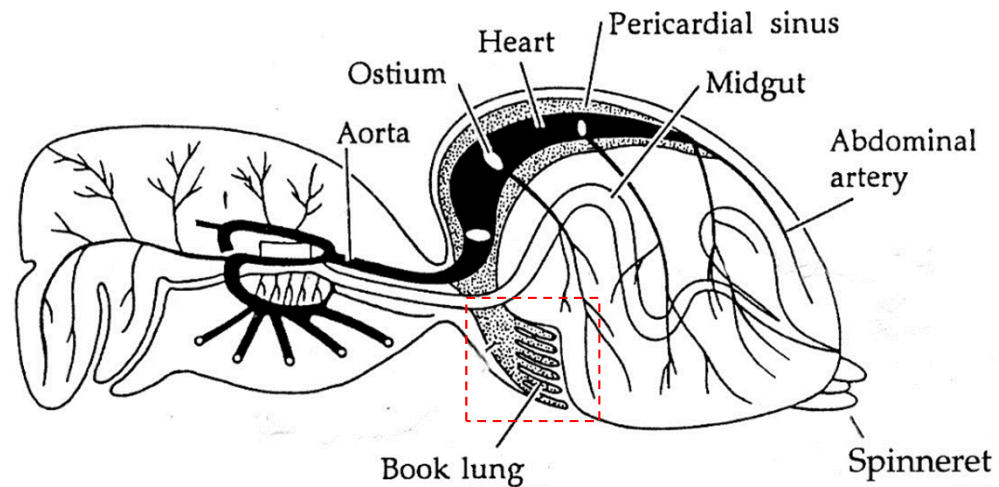
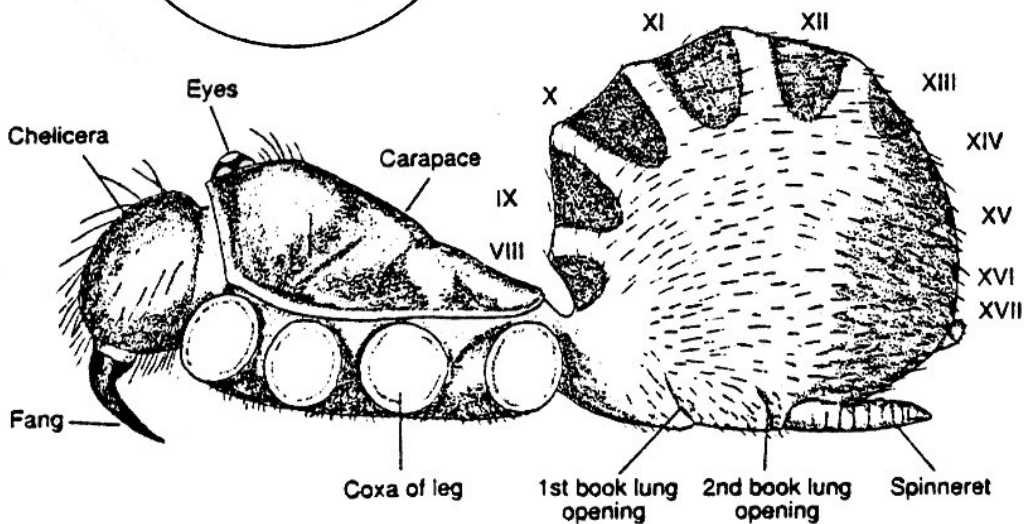
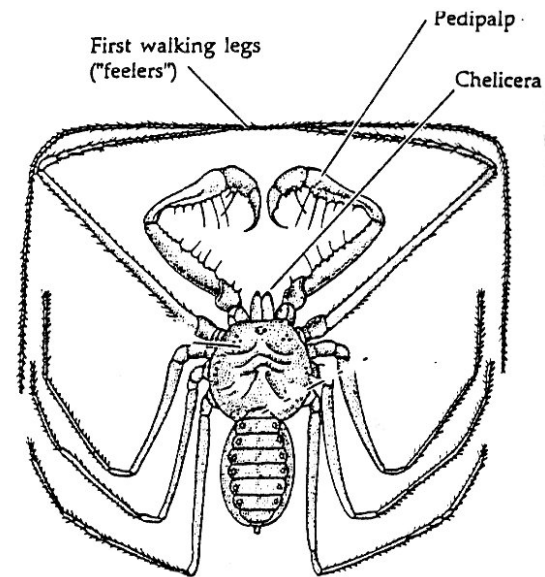
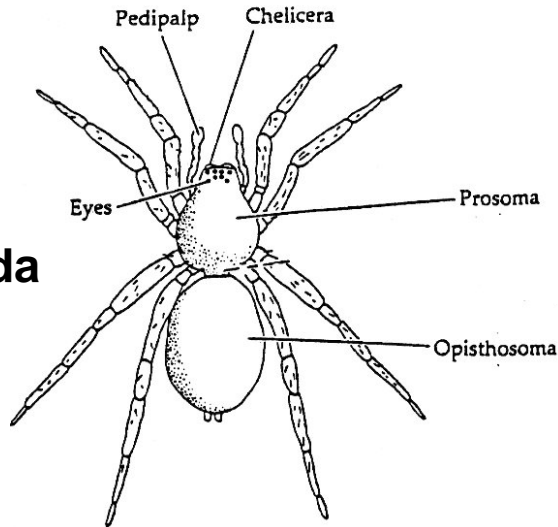
Class Pycnogonida



Subph. Chelicerata (approx. 75,000 species)

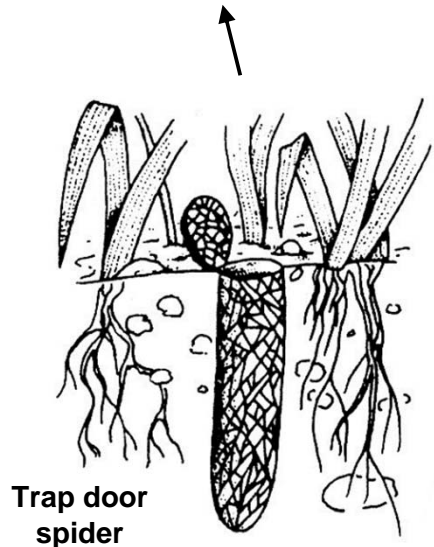
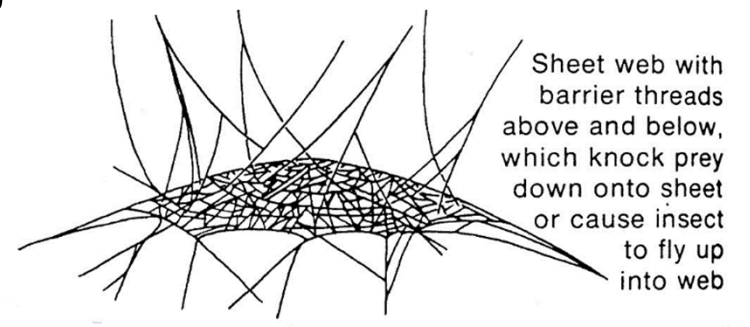
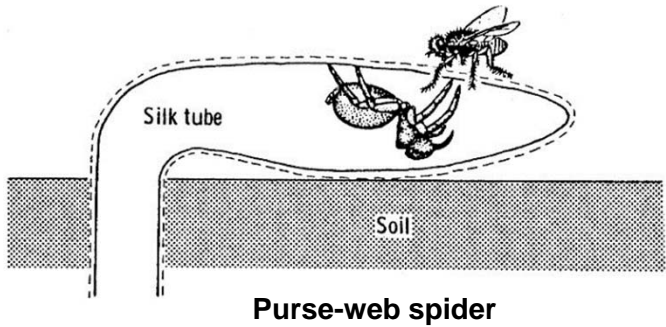


Cl. Arachnida

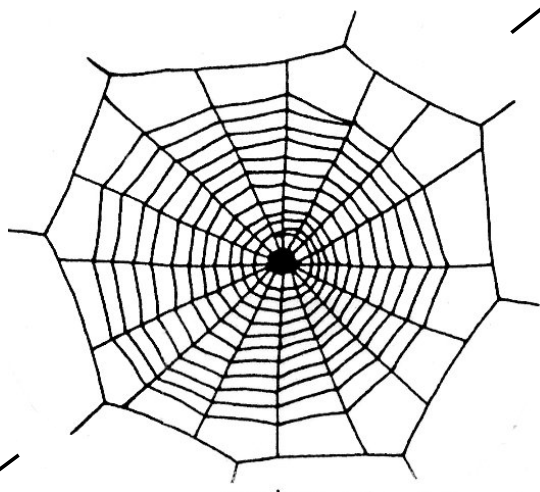


Life on land: feeding

Evolution of spider web design



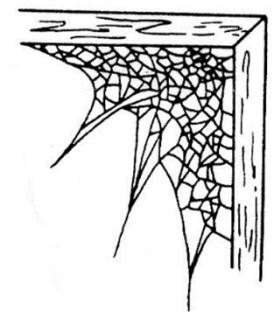
Orb web (viscid spiral) ?



Simple sheet on ground

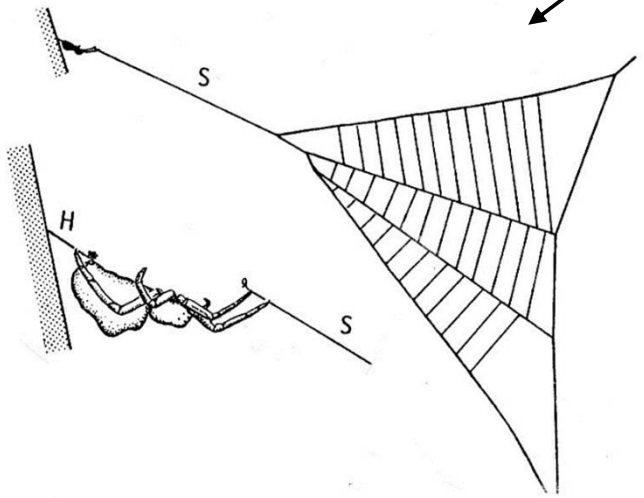


Irregular mesh webs, no tube or retreat



?

?



Bolas spiders

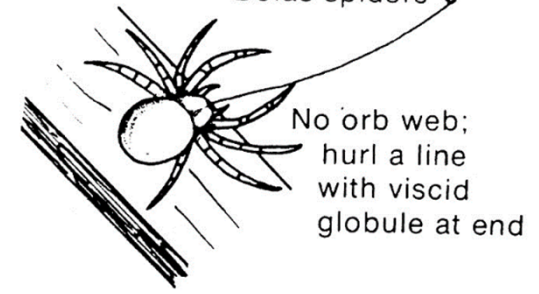


Fig. 100. The spring trap of *Hyptiotes*. The web consists of only three sectors of an orb. The spider itself forms a living bridge between a tension thread (S) and an attachment thread (H).

Life on land: reproduction ...and some other creative uses of silk

direct insemination

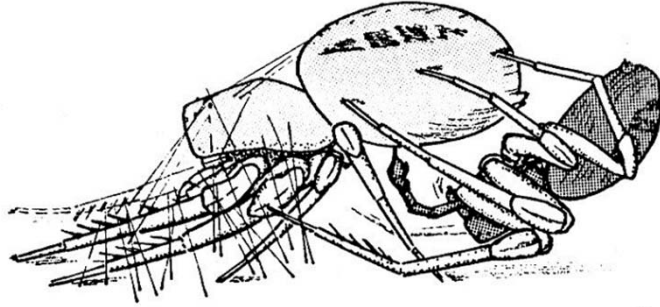
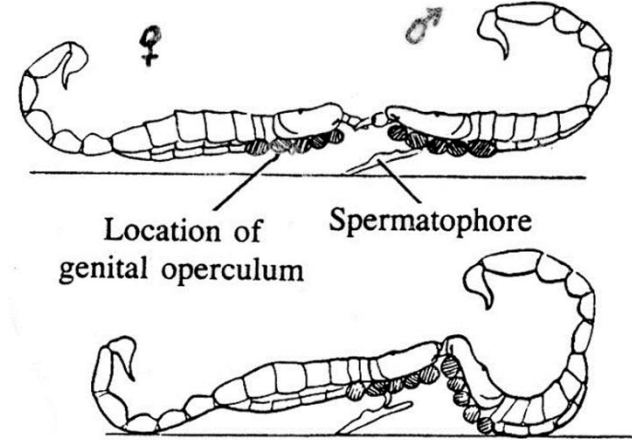
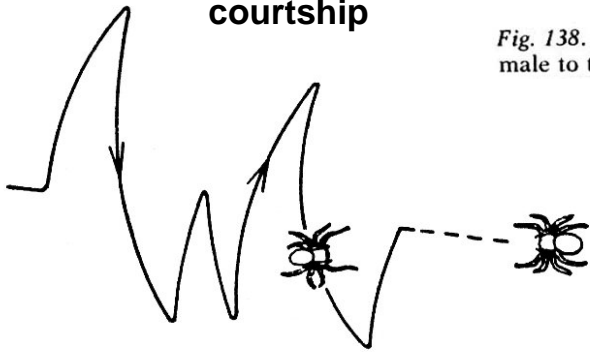


Fig. 138. Copulation of the crab spider *Xysticus*. The male "ties" the female to the ground and then crawls under her abdomen to start mating.

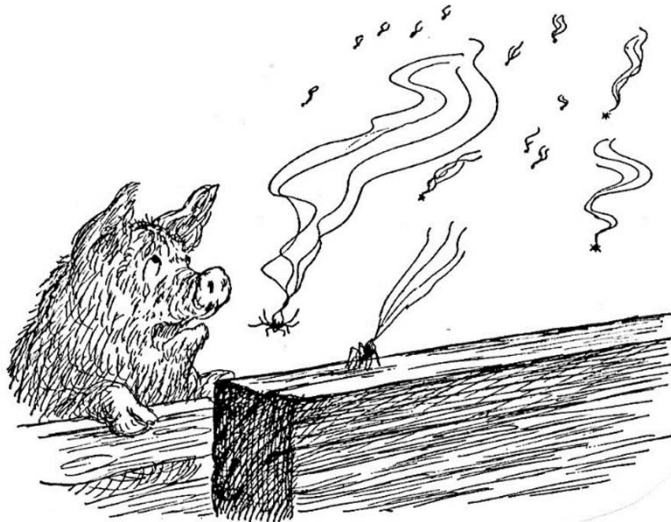
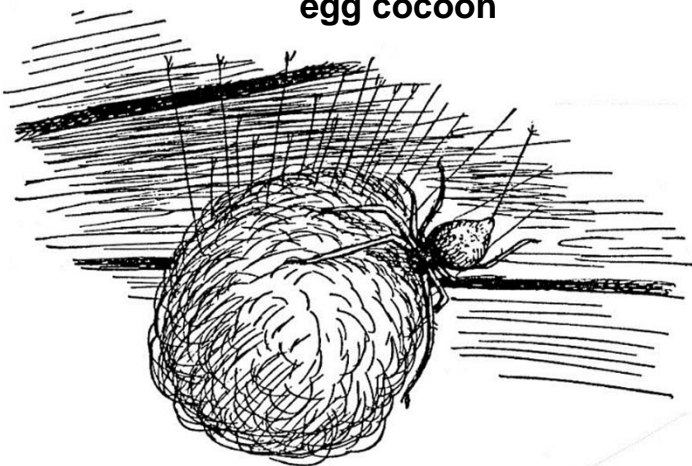
indirect insemination



courtship

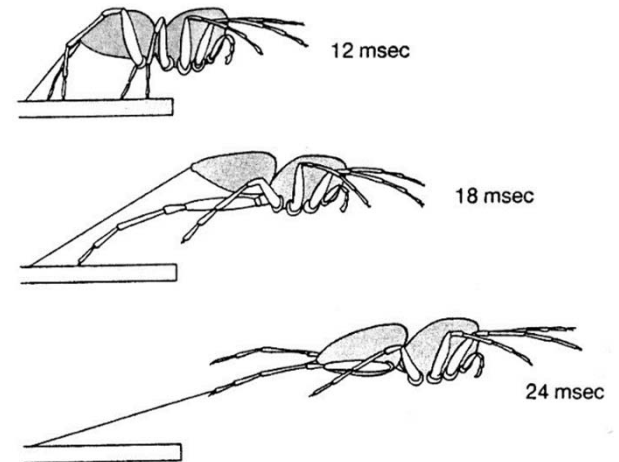


egg cocoon

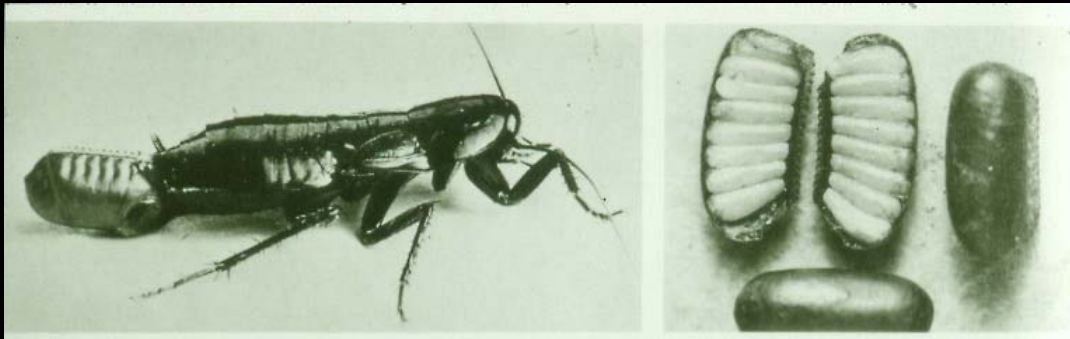
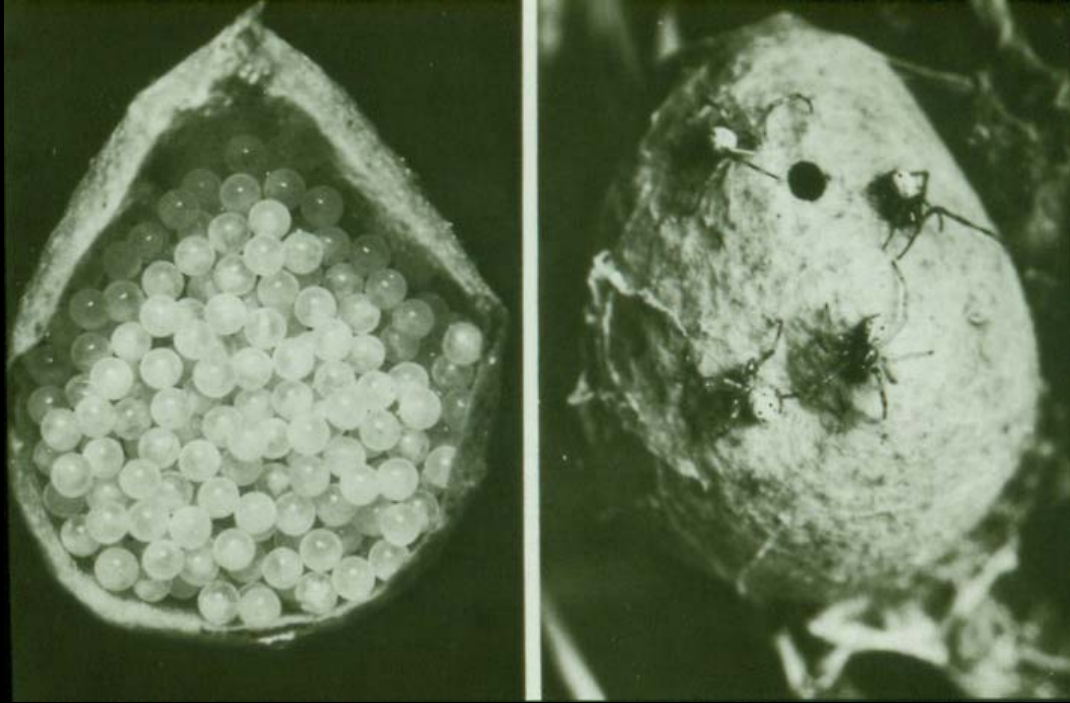


spiderlings ballooning!

drag line

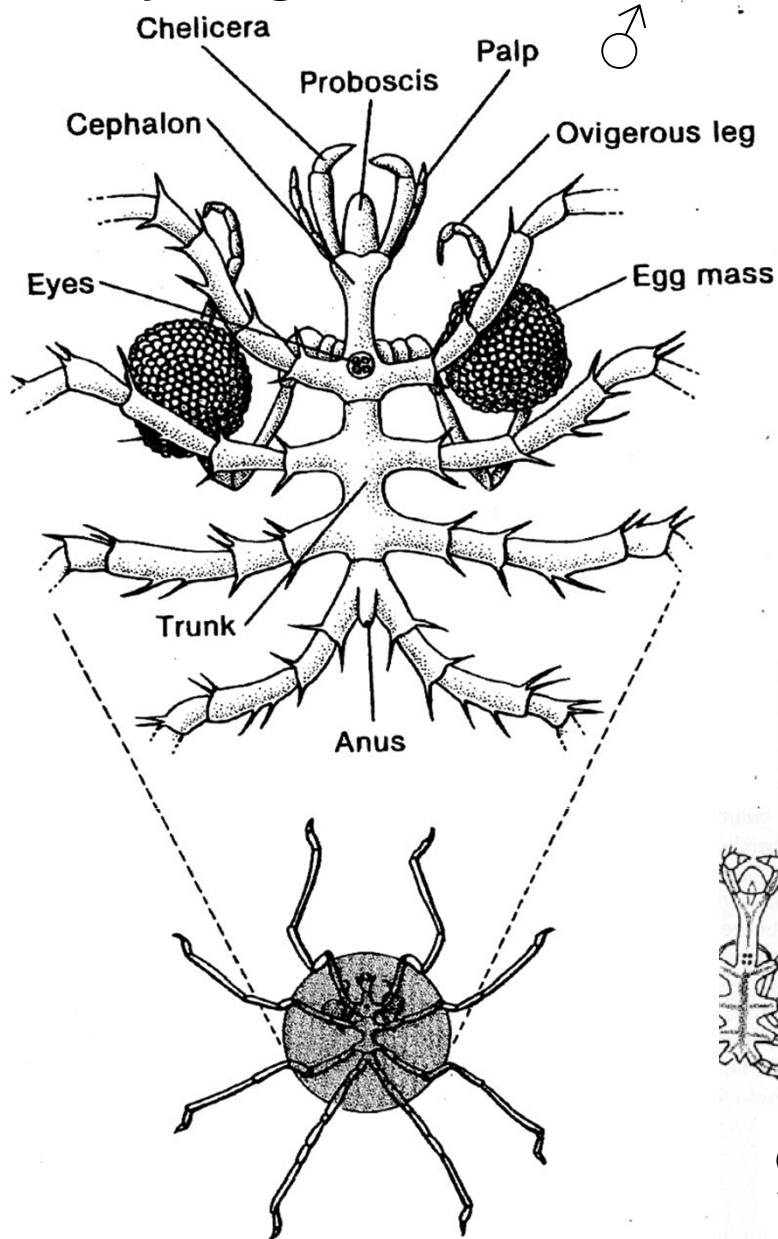


Life on land: reproduction

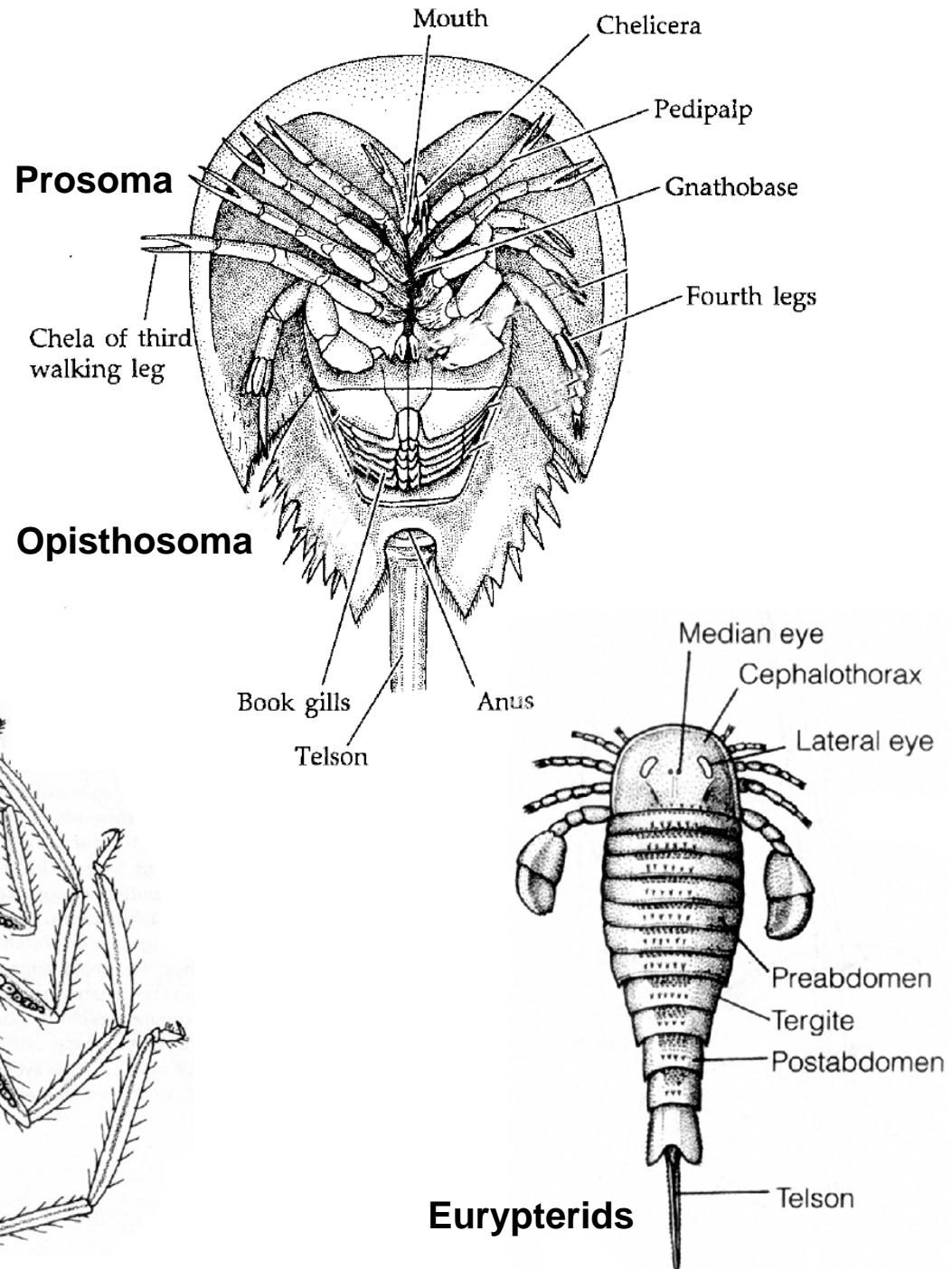


Subph. Chelicerata

Cl. Pycnogonida



Cl. Merostomata



Colossendeis australis
Antarctic pycnogonid





Chilopoda



Diplopoda

Cl. Myriapoda

Subph. Tracheata

Cl. Hexapoda



Coleoptera



Lepidoptera



Blattaria



Diptera

click here!



Hymenoptera



Orthoptera



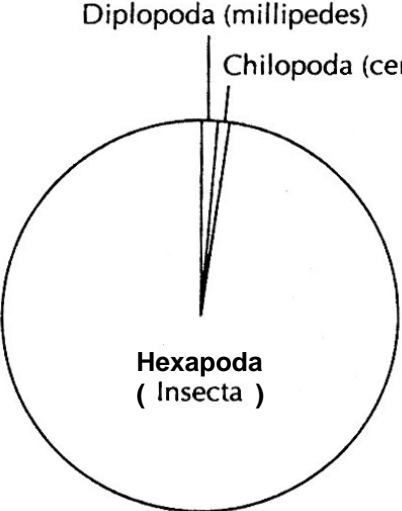
Hemiptera



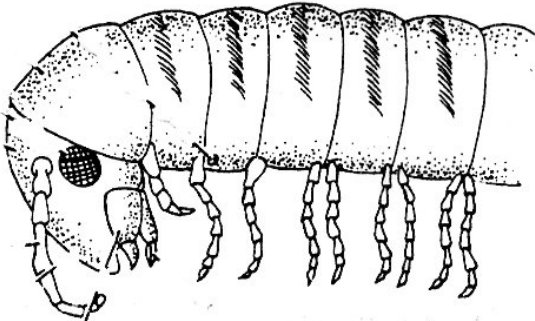
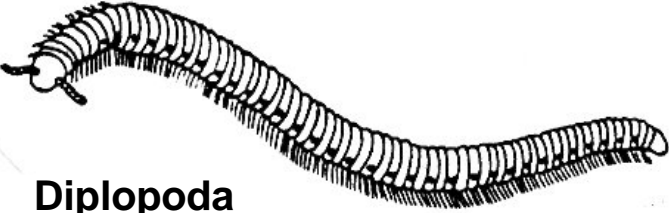
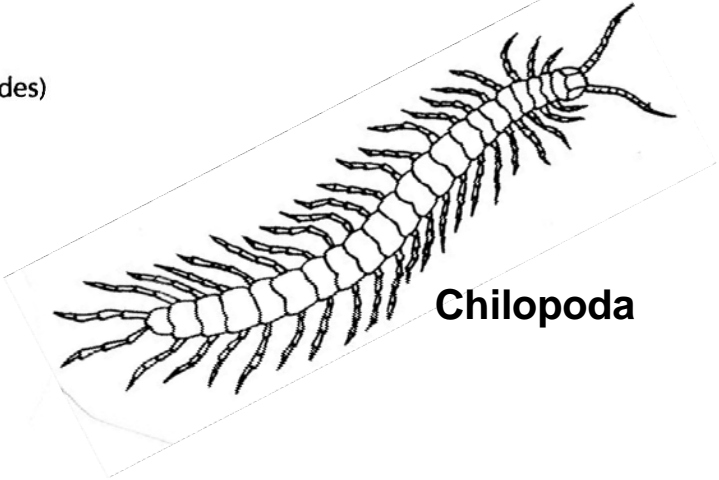
Odonata

Subph. Tracheata (= Uniramia)

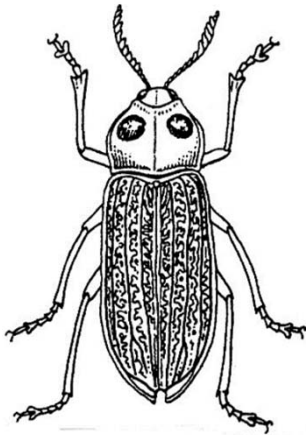
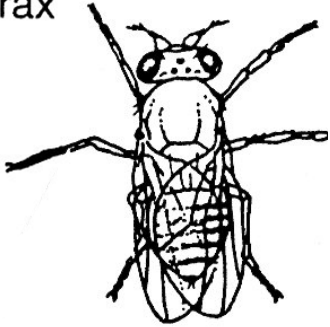
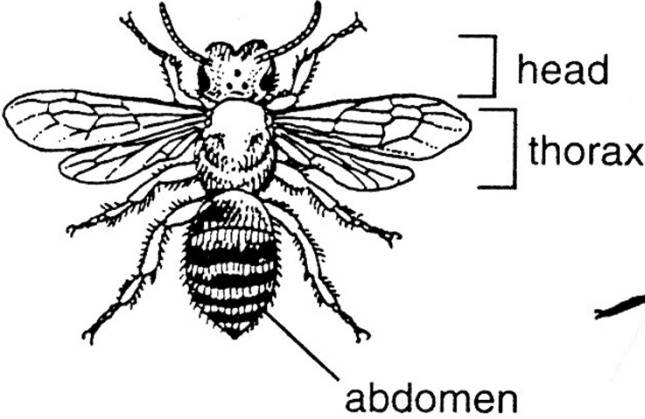
(approx. 750,000 species)



Cl. Myriapoda



Cl. Hexapoda (= Insecta)



Bees, wasps, ants
(O. Hymenoptera)

130,000!

Flies
(O. Diptera)

150,000!

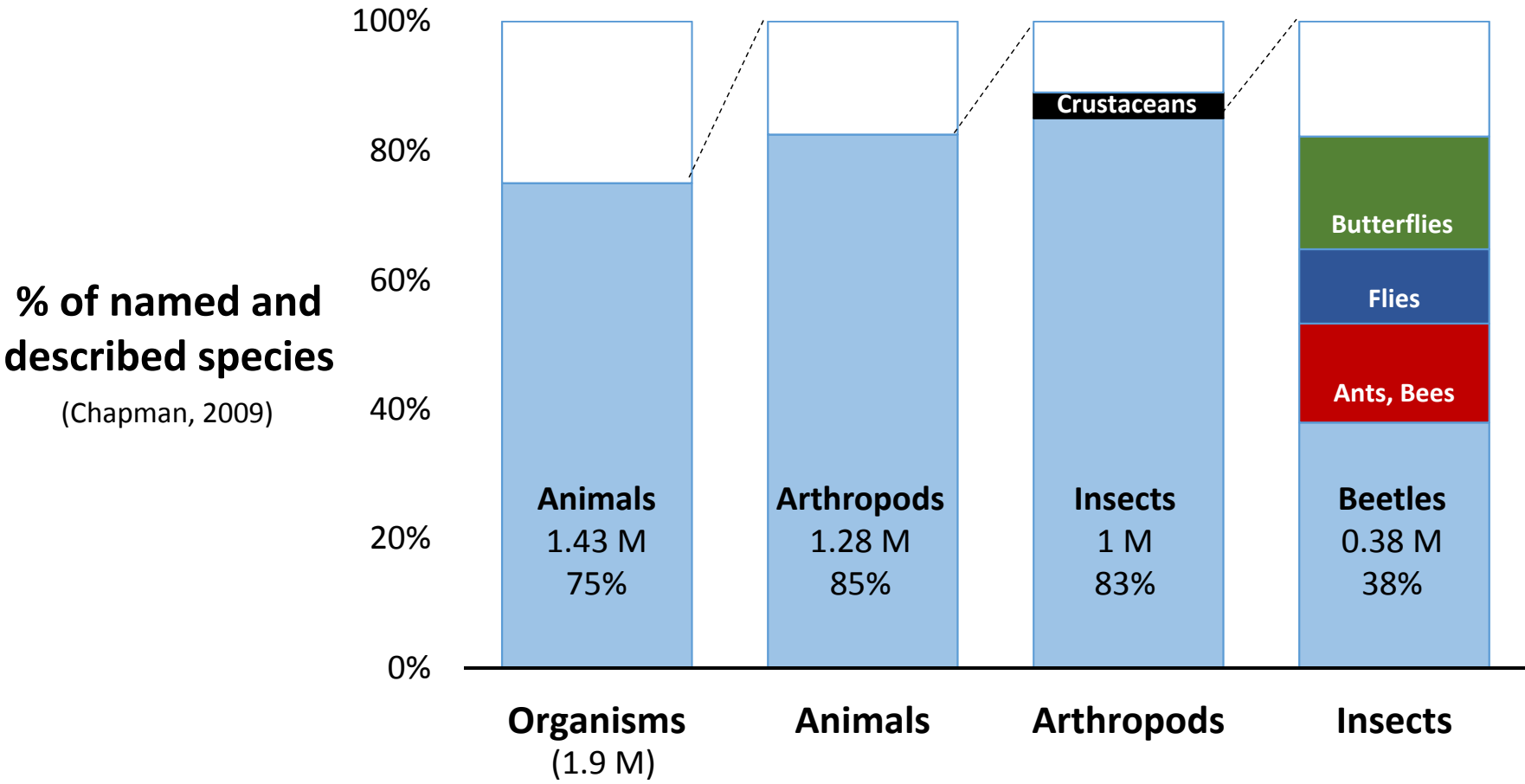
Butterflies and moths
(O. Lepidoptera)

160,000!

Beetles
(O. Coleoptera)

360,000!

Arthropods are mind-blowingly species rich

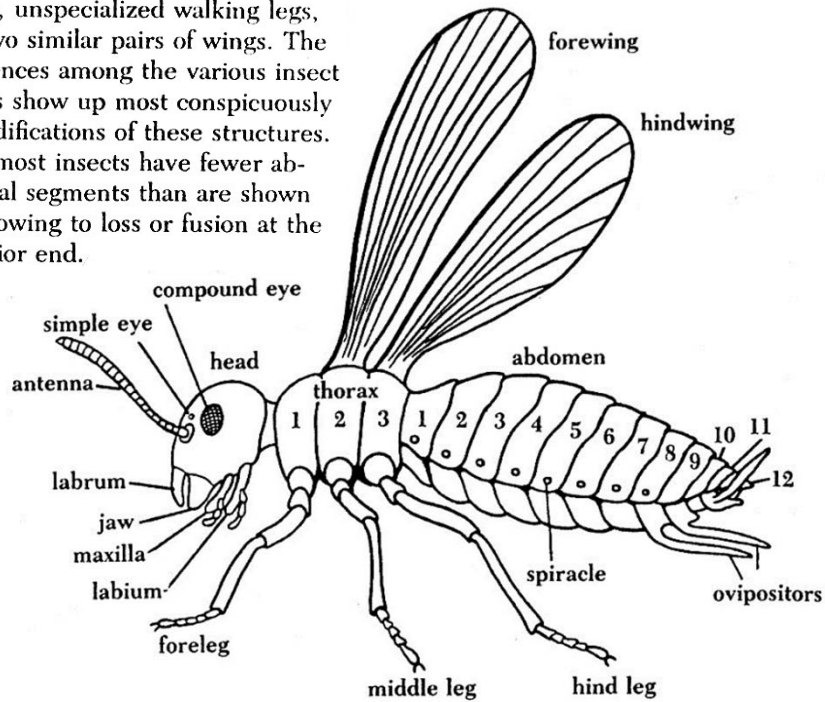


“God must have had an inordinate fondness for beetles” – *J.B.S. Haldane*



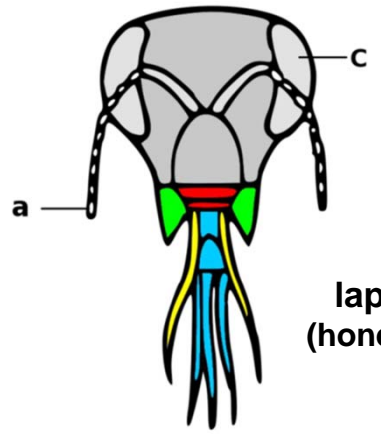
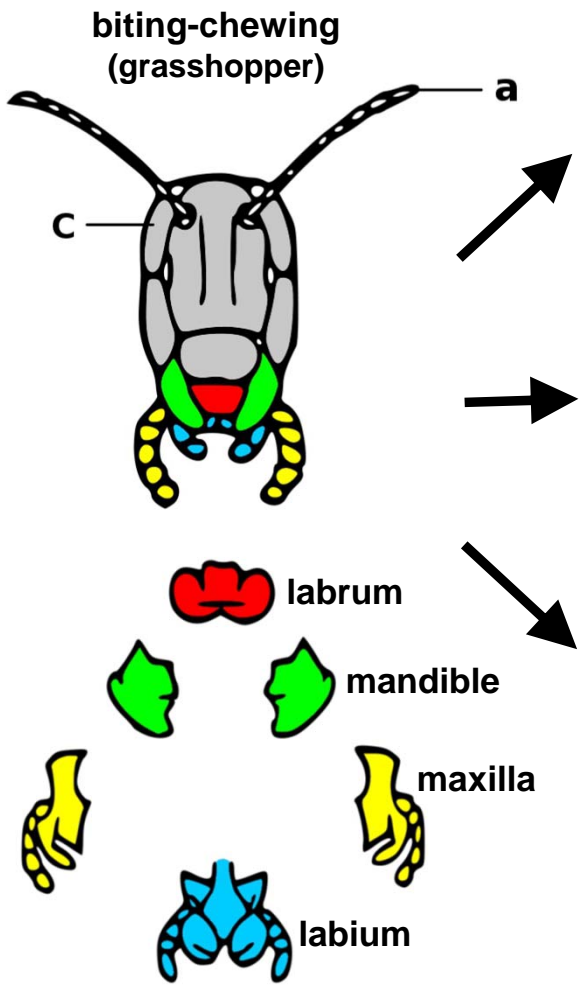
O. Coleoptera 40% of arthropods
25% of all named organisms

Diagram of a **generalized insect**, with antennas that are simple filaments, unspecialized walking legs, and two similar pairs of wings. The differences among the various insect groups show up most conspicuously in modifications of these structures. Also, most insects have fewer abdominal segments than are shown here, owing to loss or fusion at the posterior end.

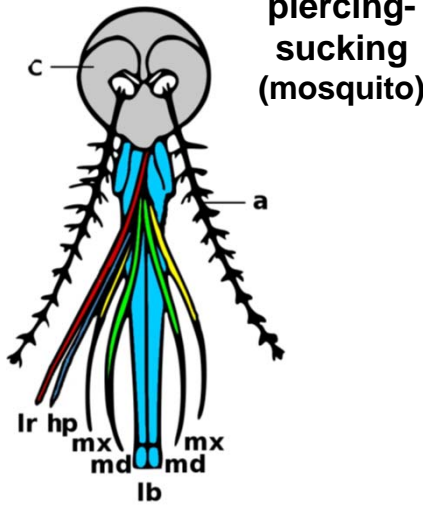


Life on land: feeding specialization of appendages

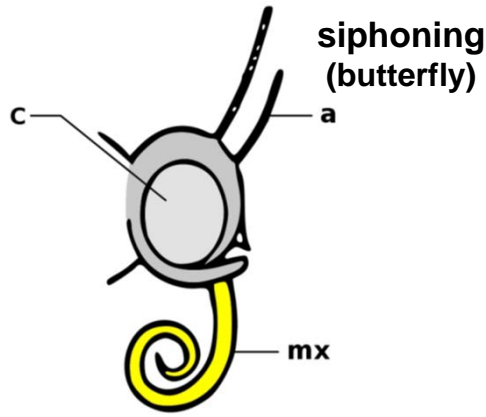
mouthparts



lapping (honey bee)

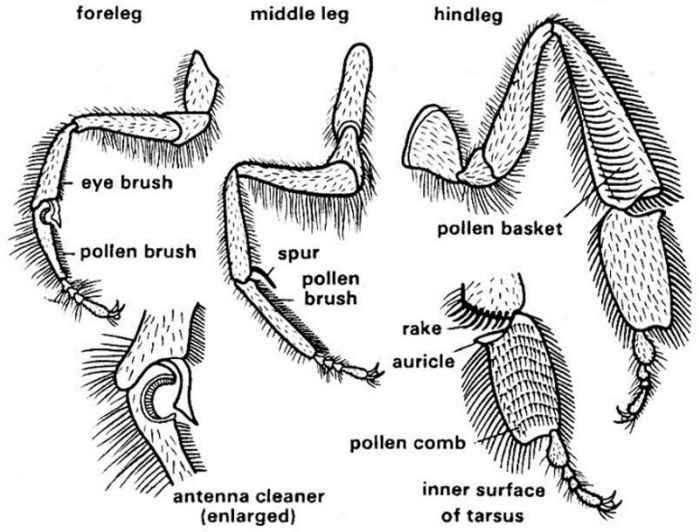


piercing-sucking (mosquito)



siphoning (butterfly)

legs

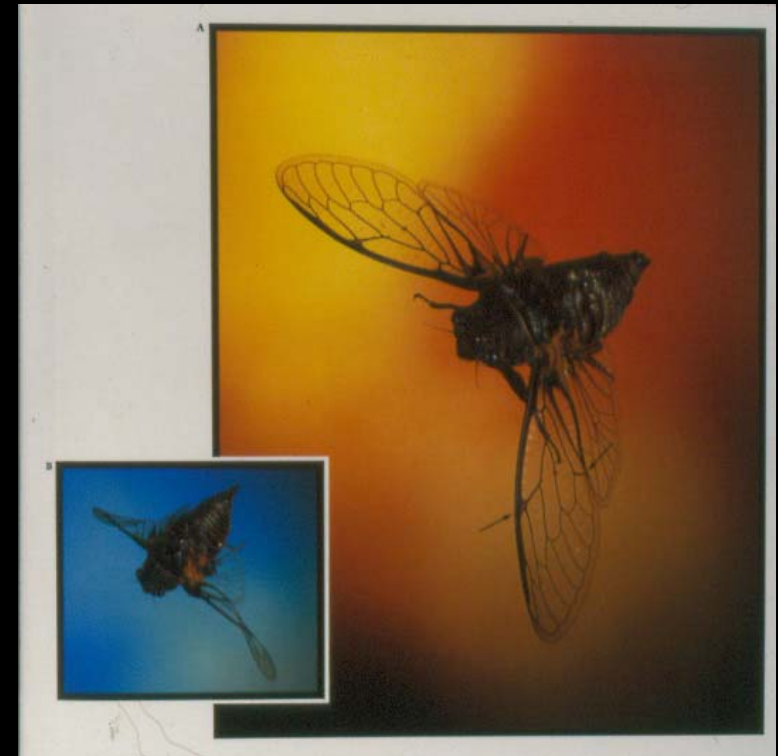


The legs of a honey bee are modified for collecting pollen. Each pair is different from the others, so that, together, they constitute a complete set of tools for manipulating the pollen upon which the bee feeds.

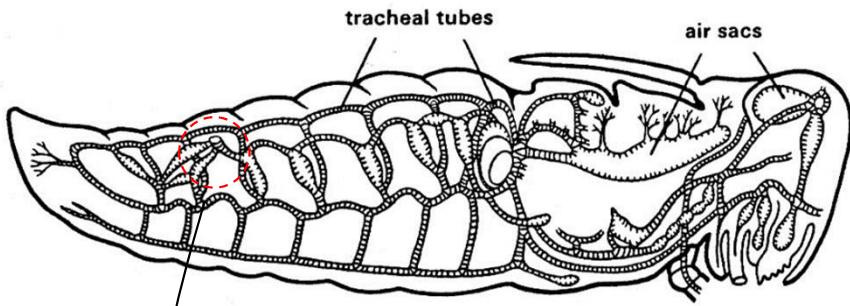
Credit: Xavier Vázquez

Life on land: locomotion and dispersal

> 99.5% of all insects are in Subcl. Pterygota



Life on land: respiration insect spiracle-tracheal system



Tracheal system of a grasshopper. Only the main tracheas and air sacs are shown.

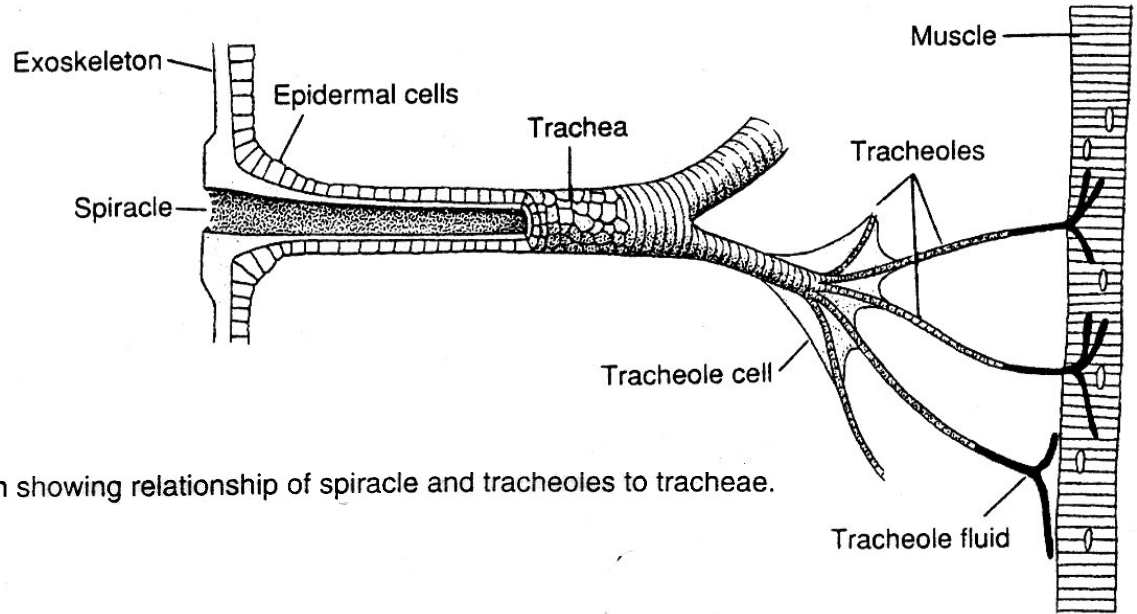
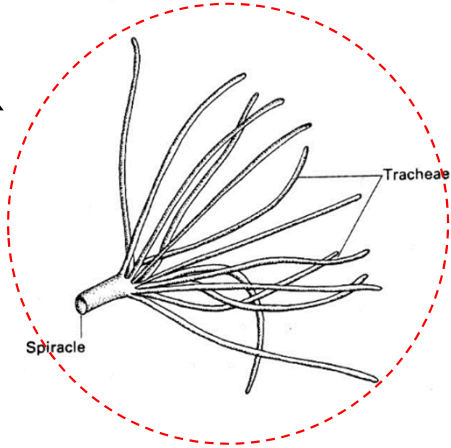


Diagram showing relationship of spiracle and tracheoles to tracheae.

comparison of subphyla

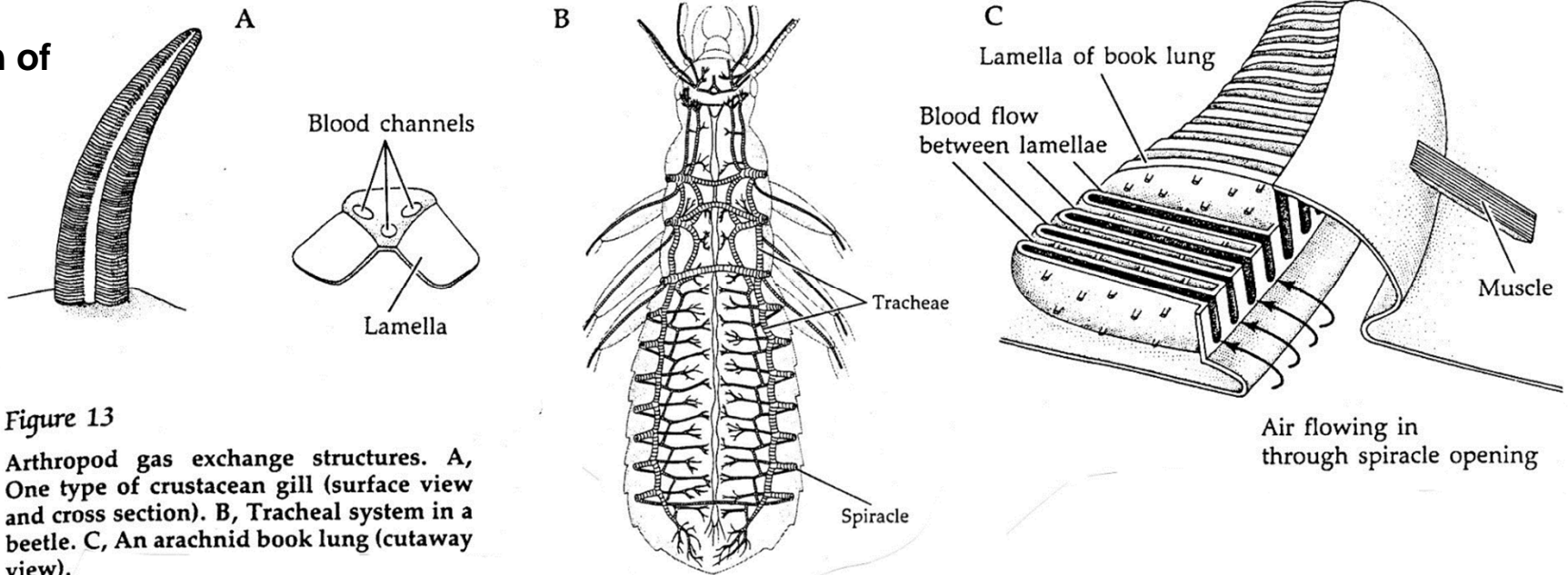
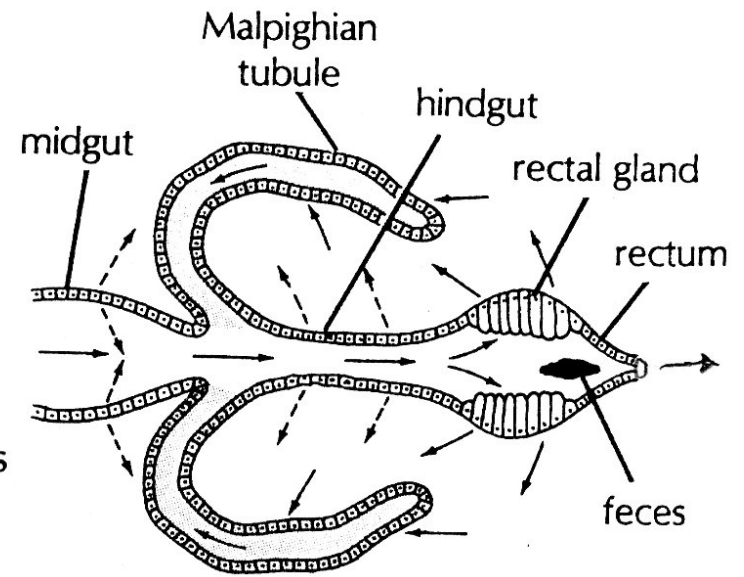
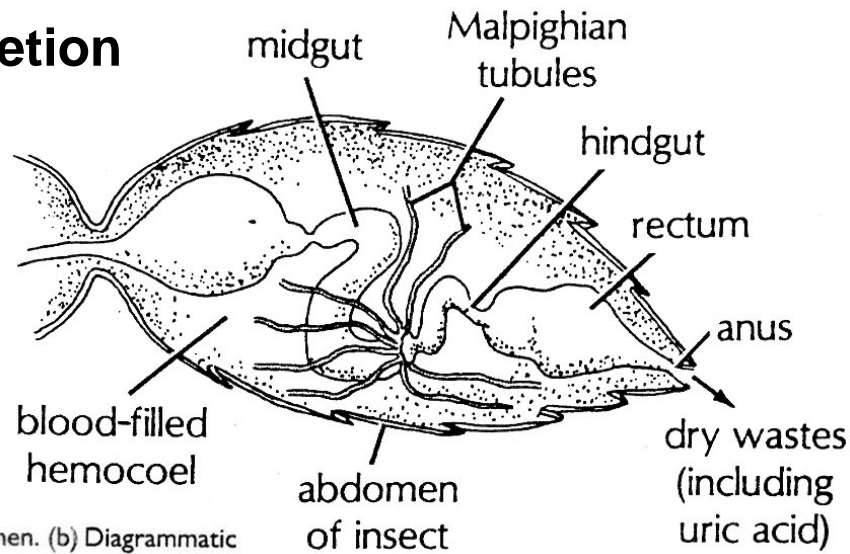


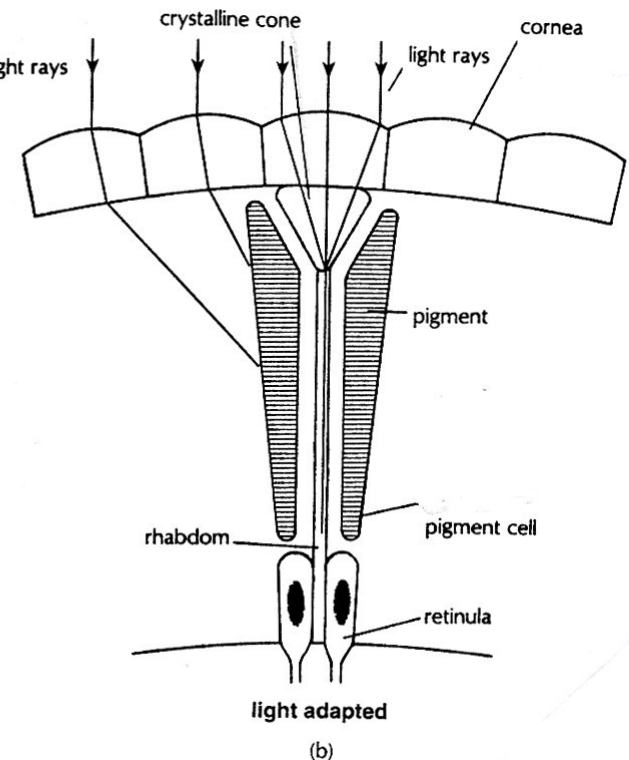
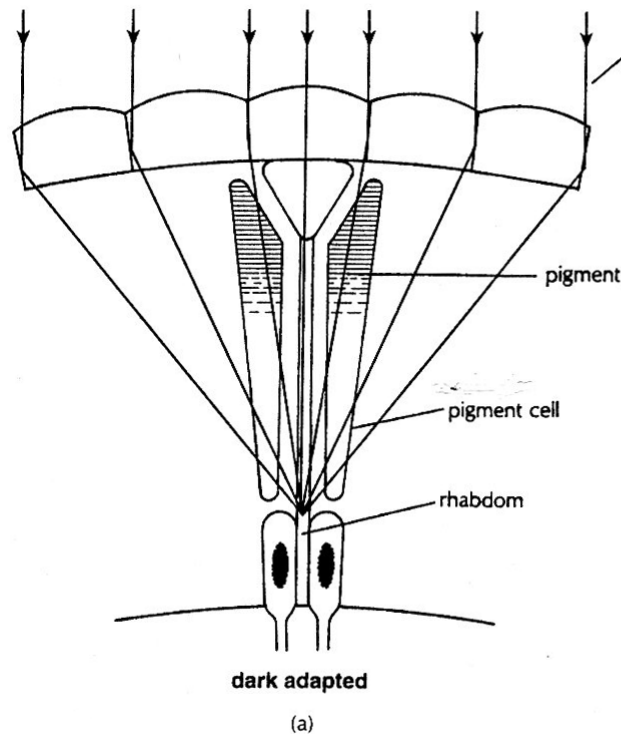
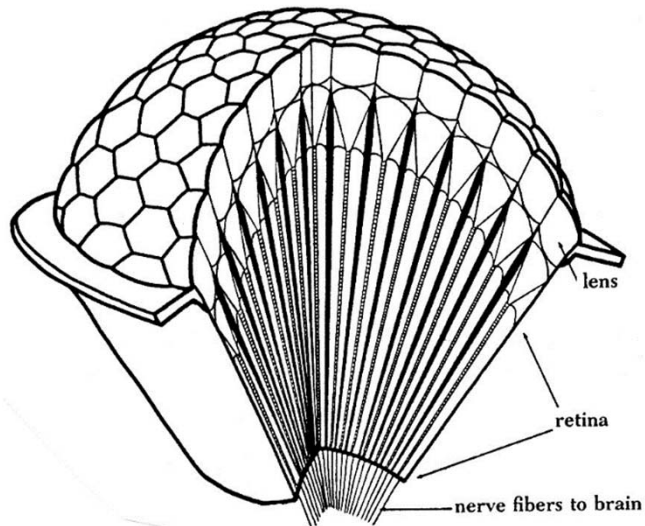
Figure 13
Arthropod gas exchange structures. A, One type of crustacean gill (surface view and cross section). B, Tracheal system in a beetle. C, An arachnid book lung (cutaway view).

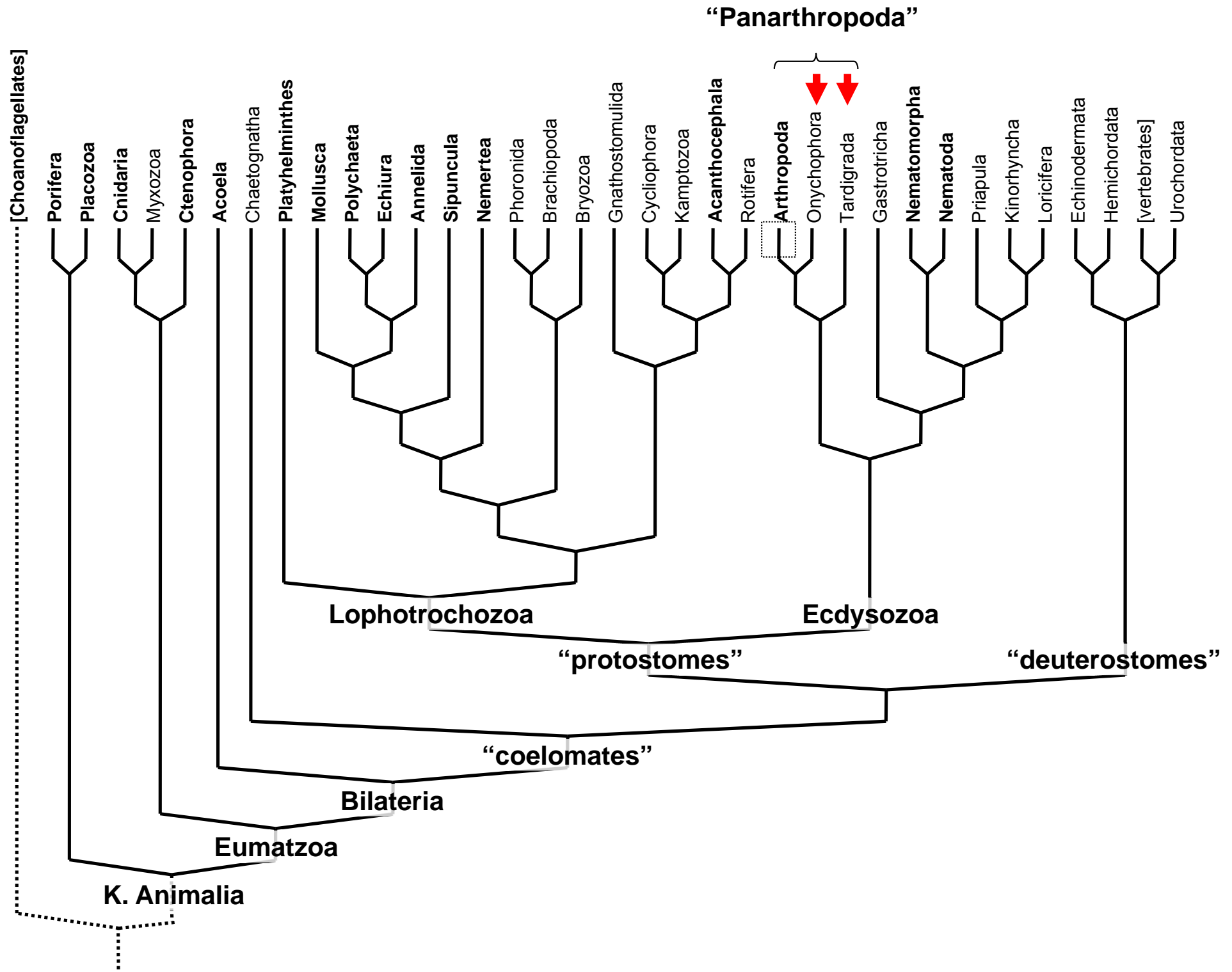
Life on land: excretion



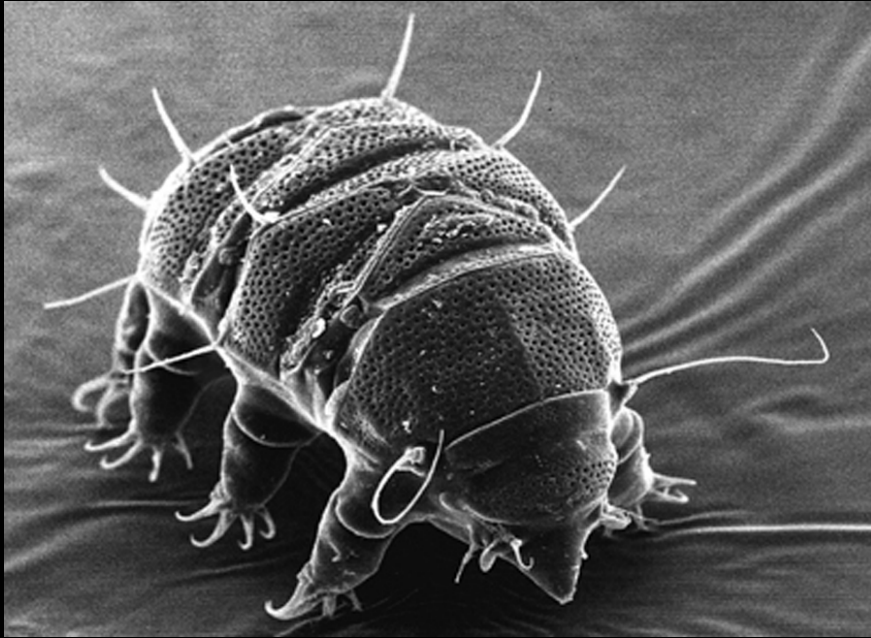
(a) Malpighian tubules in the insect abdomen. (b) Diagrammatic illustration of the relationship between the Malpighian tubules and the posterior portion of the digestive tract. Fluid moves from the hemocoel into the tubules, where it joins wastes moving toward the anus. The arrows indicate the extensive reclamation of water that occurs in the hindgut and rectum.

Life on land: vision (compound superposition eyes)





Two closely-related phyla: Tardigrada and Onychophora



lobopods!

