

**Tracheata**

# Ph. Arthropoda

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

**Trilobitomorpha** (extinct)

**Chelicerata**

**Crustacea**

## What are the challenges of moving from water to land?

Problem	Solution
desiccation	waxy cuticle
_____	_____
_____	_____
_____	_____
_____	_____
_____	_____
_____	_____
_____	_____
_____	_____

**Class Arachnida**

**Class Merostomata**

**Subph. Chelicerata**

**Class Pycnogonida**

### Subph. Chelicerata (approx. 75,000 species)

**Cl. Arachnida**

**Book lung**

**Spinneret**

**Abdominal artery**

**Midgut**

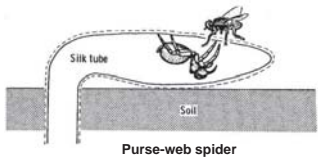
**Pericardial sinus**

**Heart**

**Ostium**

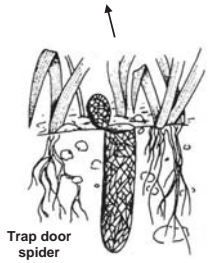
**Aorta**





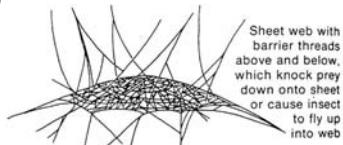
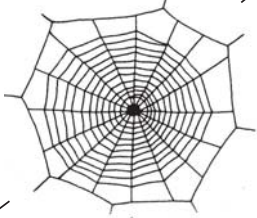
Purse-web spider

### Life on land: feeding Evolution of spider web design

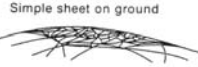


Trap door spider

Orb web (viscid spiral)



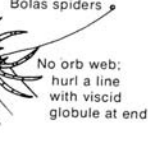
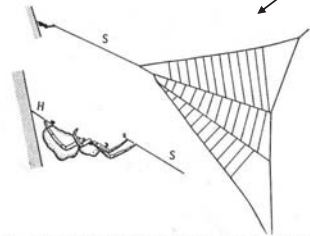
Sheet web with barrier threads above and below, which knock prey down onto sheet or cause insect to fly up into web



Simple sheet on ground



Irregular mesh webs, no tube or retreat



Bolas spiders  
No orb web; hurl a line with viscid globule at end

Fig. 100. The spring trap of *Hypisotes*. 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

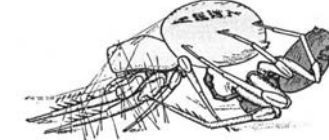
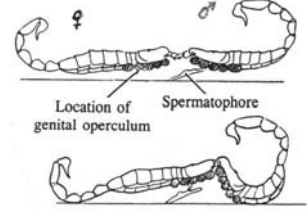
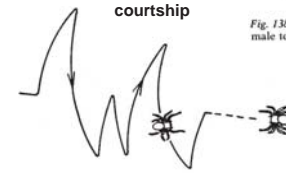


Fig. 138. Copulation of the crab spider *Xysticus*. The male "ties" the female to the ground and then crawls under her abdomen to start mating.

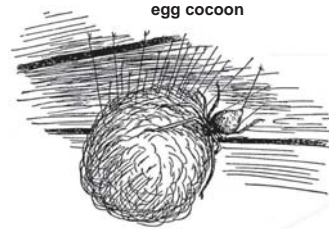
indirect insemination



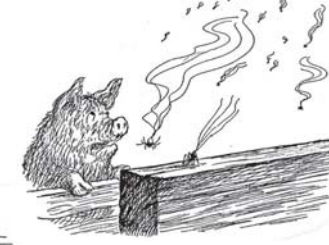
Location of Spermatophore genital operculum



courtship

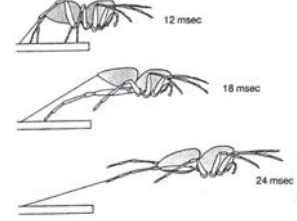


egg cocoon



spiderlings ballooning!

drag line

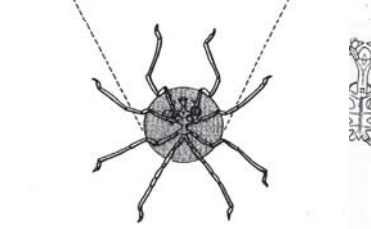
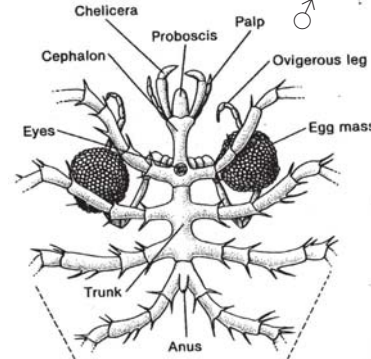


### Life on land: reproduction

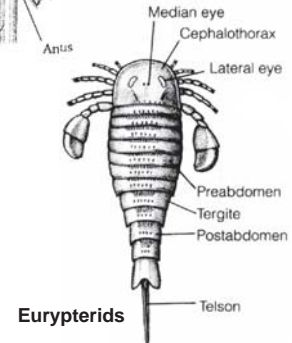
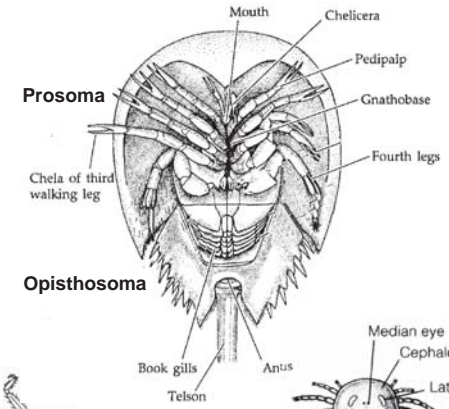


### Subph. Chelicerata

#### Cl. Pycnogonida



#### Cl. Merostomata



Eurypterids

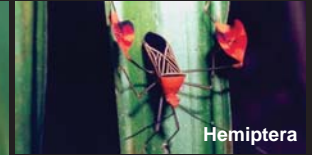
***Colossendeis australis***  
Antarctic pycnogonid



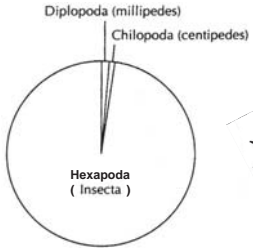
Cl. Myriapoda

**Subph. Tracheata**

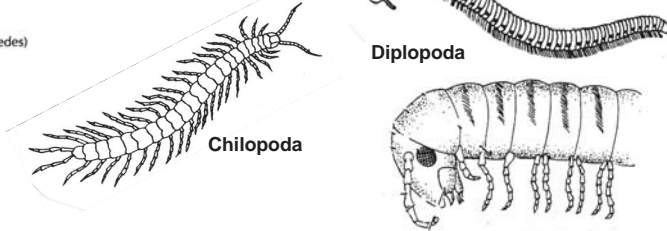
Cl. Hexapoda



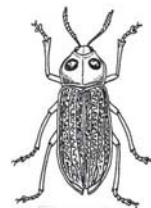
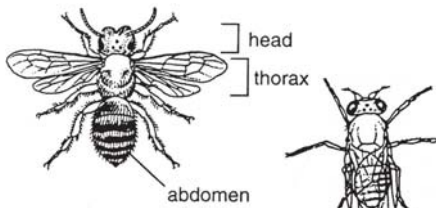
**Subph. Tracheata (= Uniramia)**  
(approx. 750,000 species)



Cl. Myriapoda



Cl. Hexapoda (= Insecta)



Bees, wasps, ants  
(O. Hymenoptera)  
130,000!

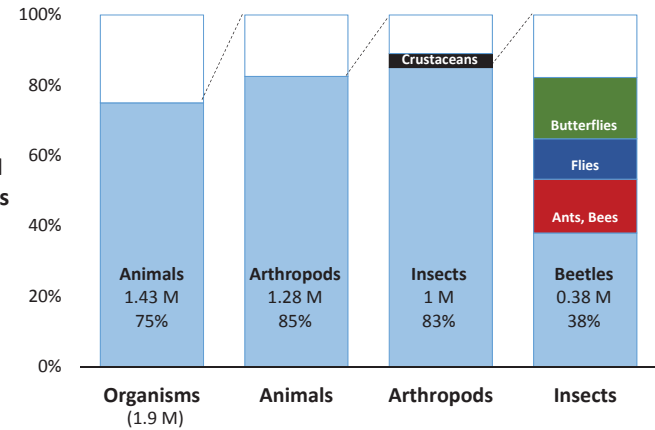
Flies  
(O. Diptera)  
150,000!

Butterflies and moths  
(O. Lepidoptera)  
160,000!

Beetles  
(O. Coleoptera)  
360,000!

**Arthropods are mind-blowingly species rich**

% of named and described species  
(Chapman, 2009)



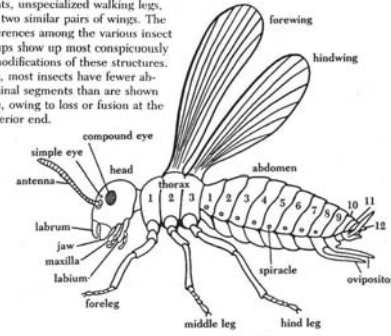


"God must have had an inordinate fondness for beetles" – J.B.S. Haldane

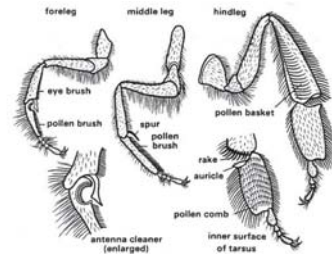


**O. Coleoptera** 40% of arthropods  
25% of all named organisms

Diagram of a generalized insect, with antennae that are single 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.



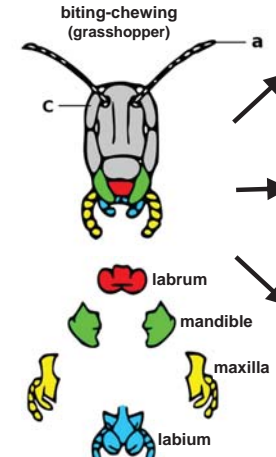
**legs**



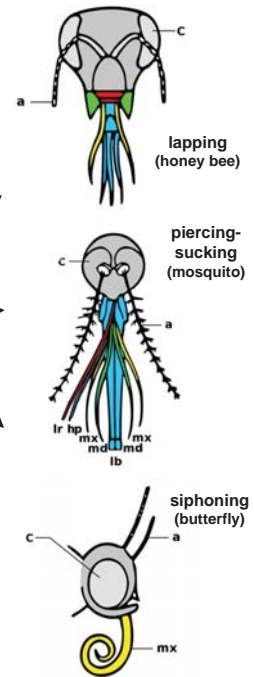
The legs of a honey bee are modified for collecting pollen. Each pair is different from the others, so that, together, they constitute a complete set of tools for manipulating the pollen upon which the bee feeds.

**Life on land: feeding specialization of appendages**

**mouthparts**

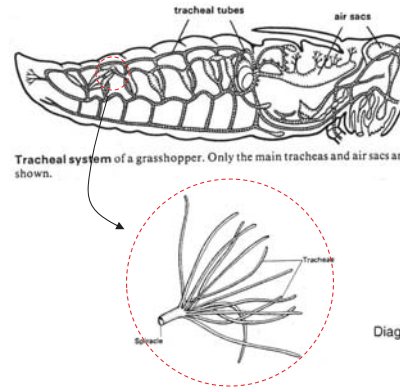


Credit: Xavier Vázquez



**Life on land: locomotion and dispersal**

> 99.5% of all insects are in Subcl. Pterygota



**comparison of subphyla**

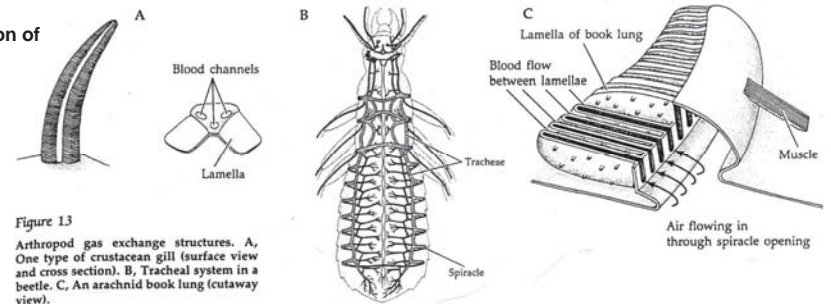


Figure 13  
Arthropod gas exchange structures. A, One type of crustacean gill (surface view and cross section). B, Tracheal system in a beetle. C, An arachnid book lung (cutaway view).

**Life on land: respiration insect spiracle-tracheal system**

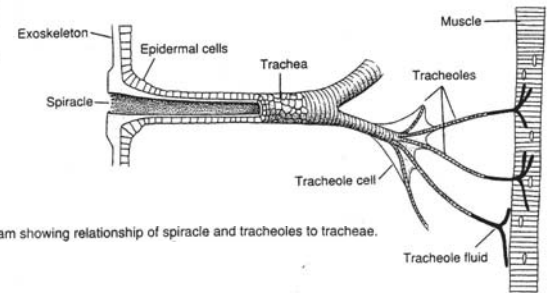
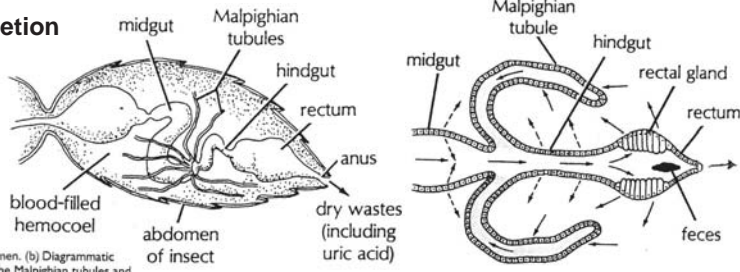


Diagram showing relationship of spiracle and tracheoles to tracheae.

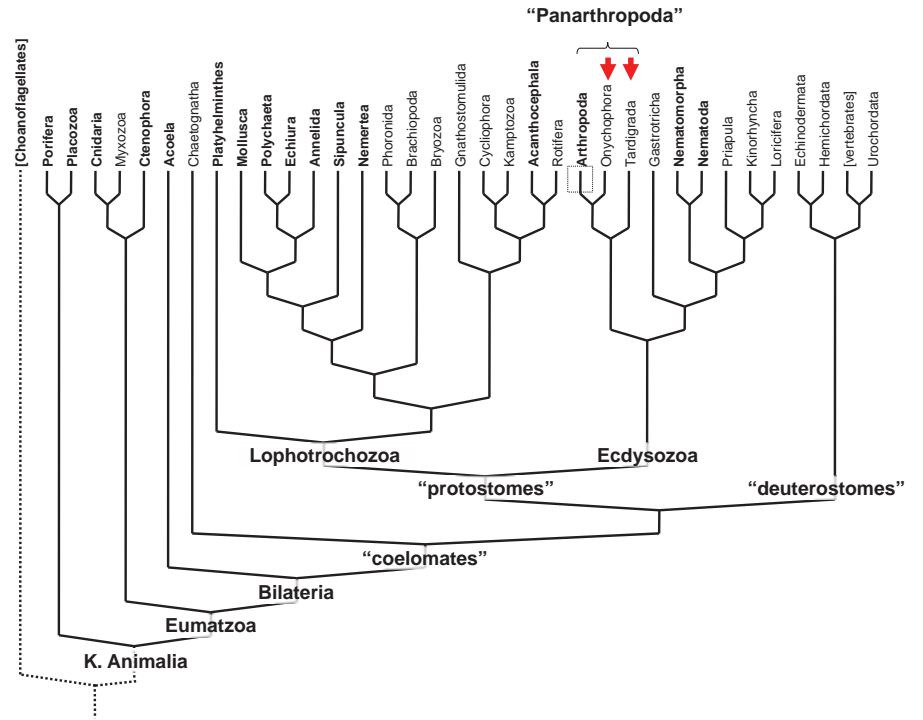
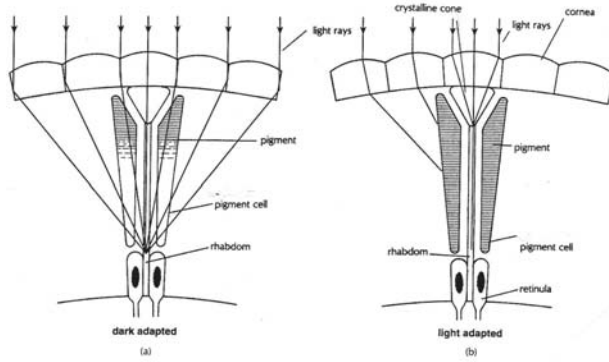
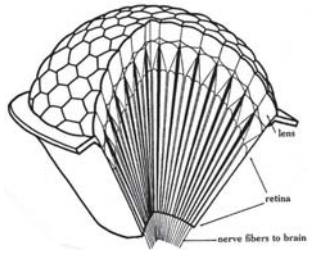
Air flowing in through spiracle opening

**Life on land: excretion**

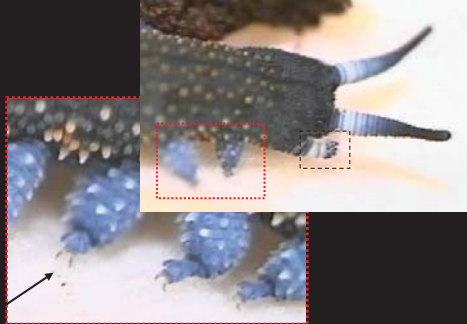
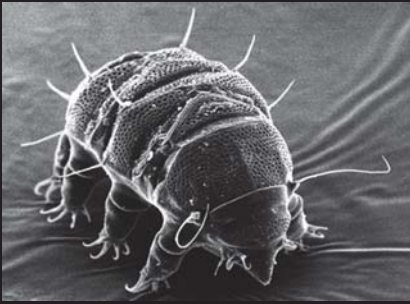


(a) Malpighian tubules in the insect abdomen. (b) Diagrammatic illustration of the relationship between the Malpighian tubules and the posterior portion of the digestive tract. Fluid moves from the hemocoel into the tubules, where it joins wastes moving toward the anus. The arrows indicate the extensive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