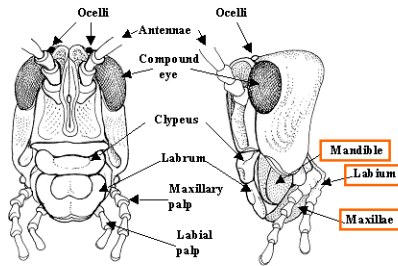
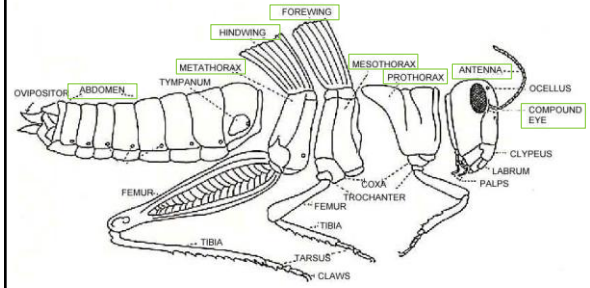


Generalized Insect Head with Chewing Type Mouthparts



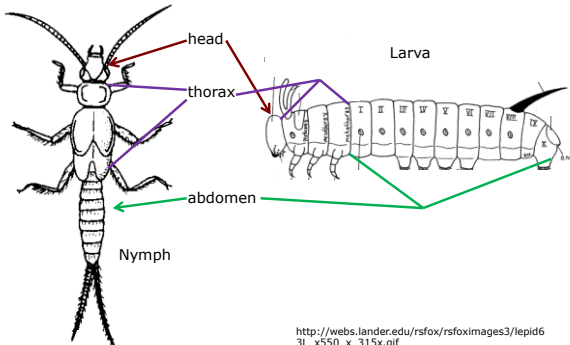
<http://www.ndsu.nodak.edu/entomology/topics/heads.htm>

Insect Body Parts and Tagmata



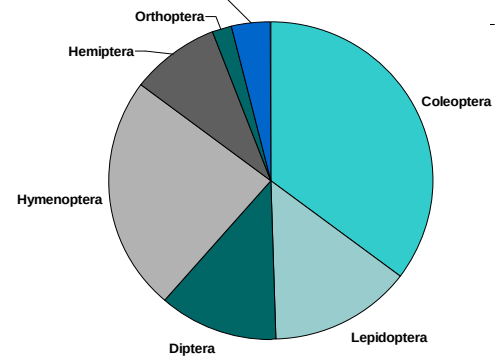
<http://cas.bellarmine.edu/tietjen/Laboratories/FlowerCommunities/inst2.jpg>

nymphal and larval tagmata



http://webs.lander.edu/rsfox/rsfoximages3/lepid63l_x550_x_315x.gif

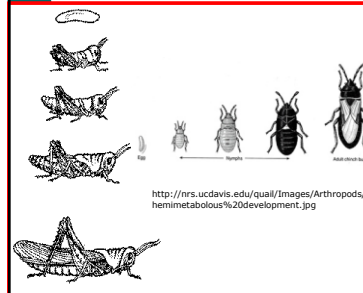
Hexapod Diversity



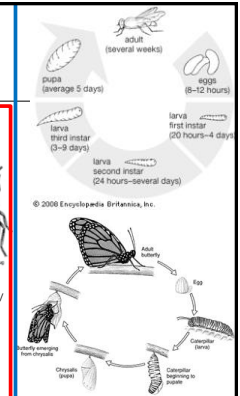
Superclass Hexapoda

Class	Infraclass	Div./Subdiv.	Order	Name
Entognatha			Protura	Proturans
			Collembola	Springtails
			Diplura	Diplurans
Insecta	"Apterygota"		Archaeognatha	Bristletails
			Thysanura	Silverfish
	Pterygota	"Paleoptera"/ Ephemeroptera	Ephemeroptera	Mayflies
		"Paleoptera"/ Odonata	Odonata	Dragonflies
		Neoptera	24	
		/ Polyneoptera	10 Orthopteroid - Plecopteroid Orders	
		/ Paraneoptera	3 Hemipteroid Orders	
		/ Endopterygota	11 Orders with Holometabolous Development	

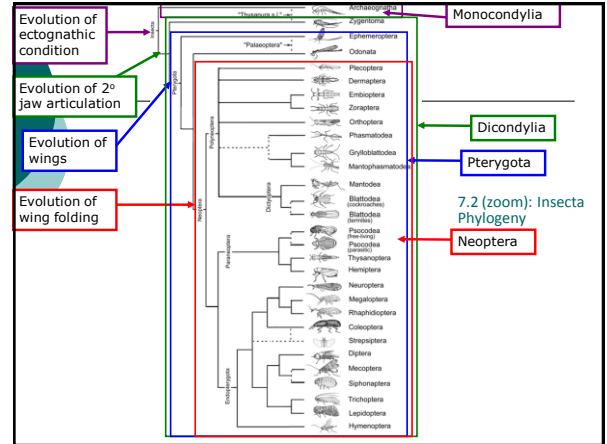
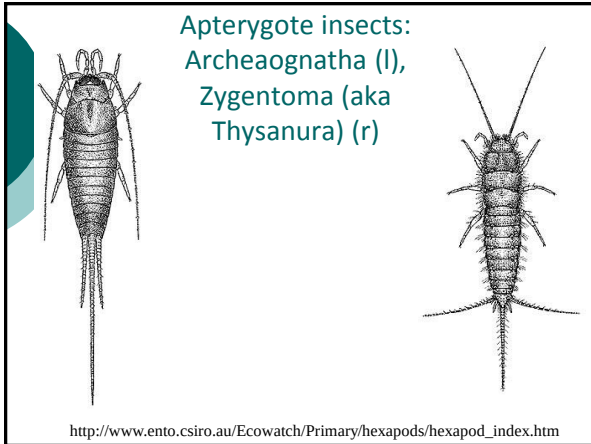
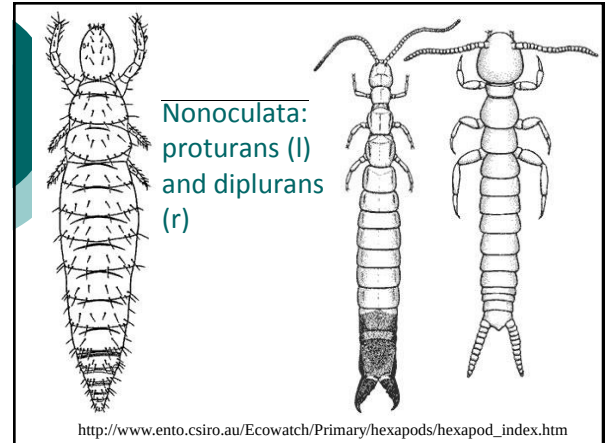
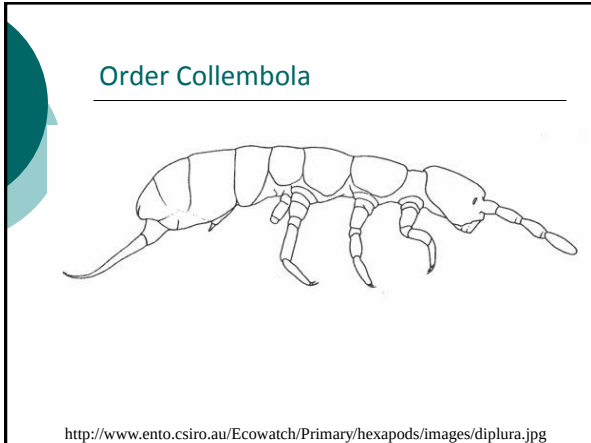
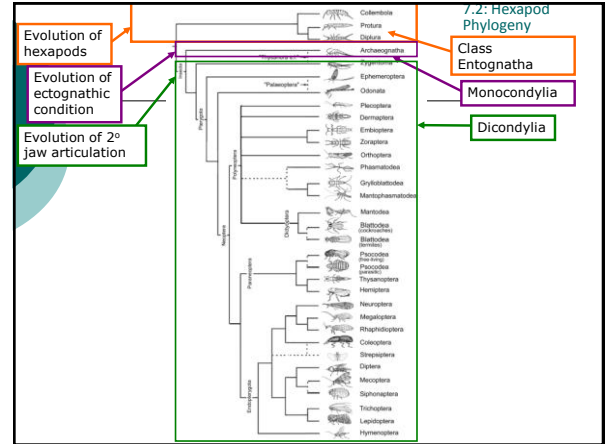
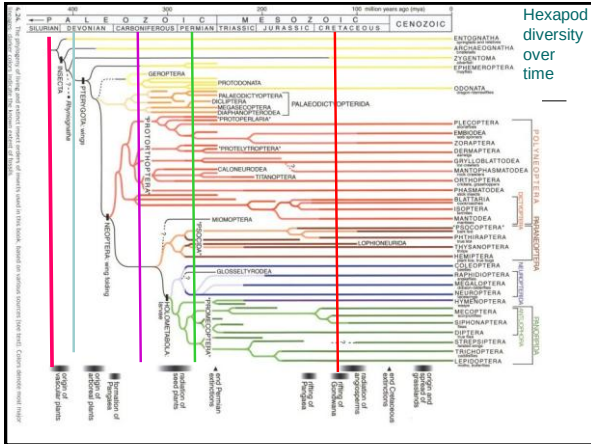
Insect development patterns: hemi- and holometabolous



<http://www.owu.edu/~darwin/BISc151/Protostomes/incomplete.GIF>

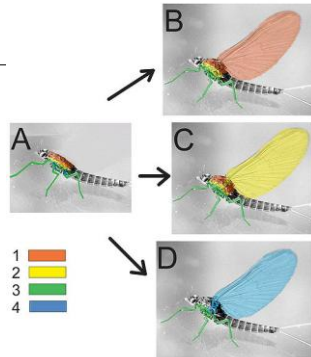


<http://nrs.ucdavis.edu/quali/Images/Arthropods/holometabolous%20development.jpg>



Wings: a derived evolutionary trait

- What are the two major hypotheses regarding the evolution of wings?
- What evidence is there for either?

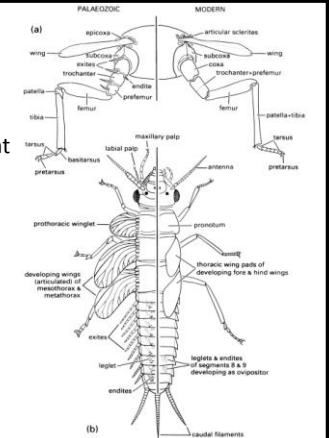


http://upload.wikimedia.org/wikipedia/commons/7/76/Evolution_of_wing_of_insect.jpg

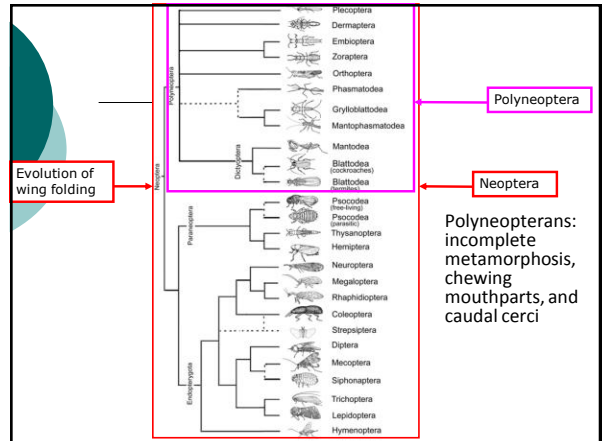
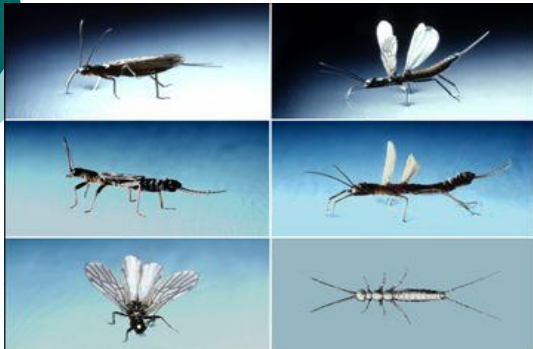
Figure 8.4

Appendages of hypothetical primitive Palaeozoic (left of each diagram) and modern (right of each diagram) pterygotes:

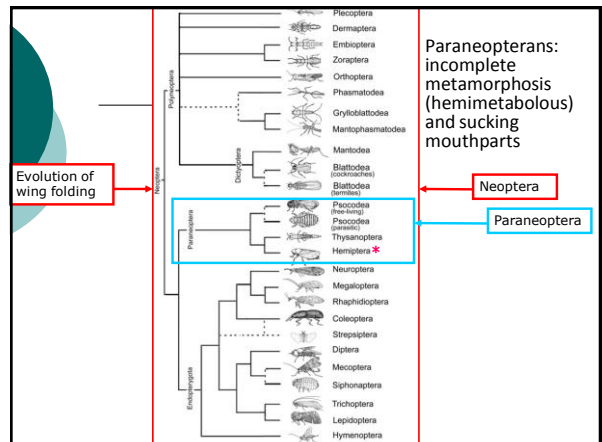
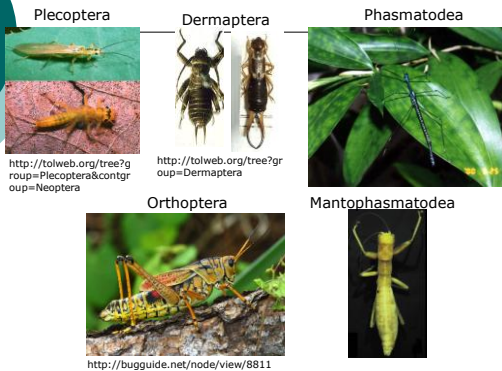
- (a) thoracic segment showing generalized condition of appendages
- (b) dorsal view of nymphal morphology.



Allocaupnia vivipara



Polyneopterans: incomplete metamorphosis, chewing mouthparts, and caudal cerci



Paraneopterans: incomplete metamorphosis (hemimetabolous) and sucking mouthparts

Clade

Psocodea

- Psocoptera: booklice
- Phthiraptera: lice



<http://www.ville-ge.ch/musinfo/mino/image1/arto-psoc.jpg>



<http://www.cals.ncsu.edu/course/ent425/spotID/phthiraptera.html>

Clade

Hemiptera

- Heteroptera: true bugs
- Homoptera: cicadas, aphids

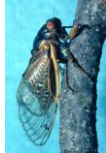
Thysanoptera: thrips



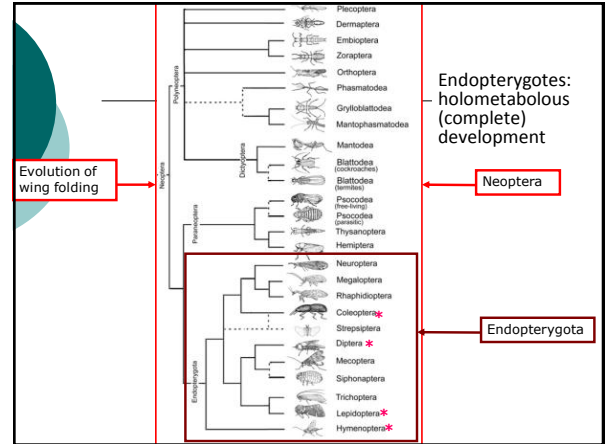
http://zoex.bakel.ru/pictures/hemipteroidea/Haplothrips_tritici.jpg



<http://www.lesinsectesduquebec.com/insecta/20-hemiptera/hemiptera.JPG>



<http://www.ent.lastate.edu/imagel/homoptera/cicada/cicada.html>



Evolution of holometaboly

- What are the steps involved?
- What do these figures show?

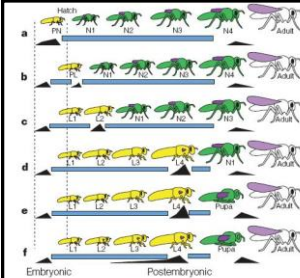


Figure 5 Possible steps in the transition from a hemimetabolous to a holometabolous life history and their relationship to timing of adult (A) production (blue bar) and to growth directed towards the imaginal form (black triangles). The pronymphal (PN), protovivipar (PV) and larval (L) instars are in yellow, and the nymphal (N) and pupal stages are in green; wing buds, wing imaginal discs, and wings are in purple. See text for explanation.

http://1.bp.blogspot.com/_VA6LePZ6KNY/SXBHAMjgIN/AAAAAAAAABWU/GgJKZx0BpHU/s1600-h/Holometabola+evolution.JPG

Endopterygotes: holometabolous (complete) development

Clade

- Neuropterida
 - Megaloptera: dobsonflies
 - Neuroptera: lacewings
 - Raphidioptera: snakeflies
- Coleoptera: beetles

Clade

- Diptera: true flies
- Mecoptera: scorpionflies
- Siphonaptera: fleas

Clade

- Lepidoptera: butterflies
- Trichoptera: caddisflies

Clade: Hymenoptera: ants, bees, wasps

Coleoptera (beetles)



Megaloptera (dobsonflies)



<http://www.ru.ac.za/academic/departments/zoento/Martin/corydalidae2.jpg>



Neuroptera (lacewings)



<http://www.discoverlife.org/nh/tv/Insecta/Neuroptera/images/neur-2700.jpg>



<http://www.ruf.rice.edu/~ecology/insects/Neuroptera%20Ascalaphidae%20Ululodes%20sp.%20nymph%20205%20AB%20NF%206.29.01%20n6.jpg>

Raphidioptera (snakeflies)



<http://www.cartage.org.lb/en/themes/Balances/Zoology/Insects/InsectOrders/Endopterygota/Raphidioptera/Raphidioptera.jpg>

Diptera: true flies



<http://bugguide.net/images/raw/SQBRRLQRIQRU0Z090FQFKDR90FRQJRMZQRJQFRE00QRQBRZQQX0H0P000JQTRSQBRQRES0R.jpg>



http://www.health.qld.gov.au/dengue/images/aedes_aegypti_1_c.jpg

Mecoptera: scorpionflies & Siphonaptera: fleas



<http://bugguide.net/images/raw/BRLQBRQRNRHQARHQRRHQVR3K0CQKQWRUK9RM09RG00QE0Q07QFRK3QJLQIQ0CQ0CQ0V0K3K1R000Q.jpg>

Lepidoptera: butterflies & moths
Trichoptera: caddisflies



<http://bugguide.net/node/view/38123>



<http://bugguide.net/node/view/6729>



<http://tolweb.org/tree?group=Trichoptera&contgroup=Endopterygota>



<http://www.graficimages.com/2112%20Caterpillar%20.JPG>

Hymenoptera: sawflies, ants, bees, wasps



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<http://bugguide.net>