

Chapter 12: Terrestrial Mandibulates

Phylum: Arthropoda

Subphylum: Uniramia

Class: Chilopoda

Class: Diplopoda

Class: Hexapoda (Insecta)

Class: **Chilopoda** (Gr. margin/lip/jaw foot) centipedes 3000 spp.

carnivores, fast moving- prey on insects, cockroaches, earthworms

prefer moist places, under logs, bark, stones

spiracles cannot close

cuticle unwaxed

head and trunk segments → dorsoventrally flattened

pair of jointed legs on each segment except
segment behind head & last two in the body

1st pair trunk appendage modified into pair of poison fangs **maxillipeds**

pair of long antennae

pair of mandibles (chewing)

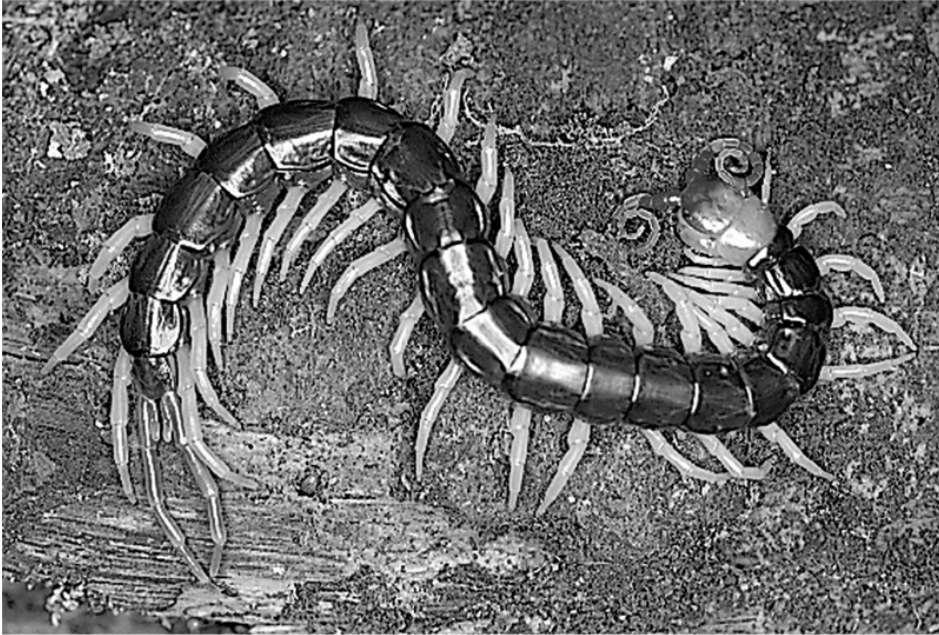
pair of first & 2nd maxillae

pair of eyes (groups of ocelli)

repugnatorial glands → ventral surfaces

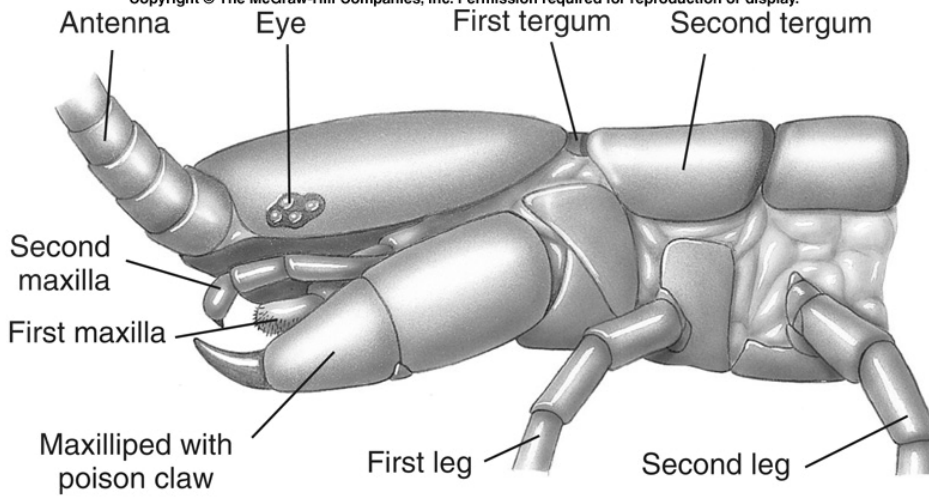
oviparous

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A

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B

Class: **Diplopoda** (Gr. double/two foot)

millipedes (thousand feet) 10,000 spp.

herbivores, deposit feeders, slow moving very few carnivores

integument impregnated with calcium salts/unwaxed cuticle

head with short antennae & simple eyes

body almost cylindrical

head and trunk segments

2 pairs of jointed legs on each segment except the
segment behind the head and last two in the body

pair of short antennae

pair of mandibles

pair of maxillae (no distinct second maxillae)

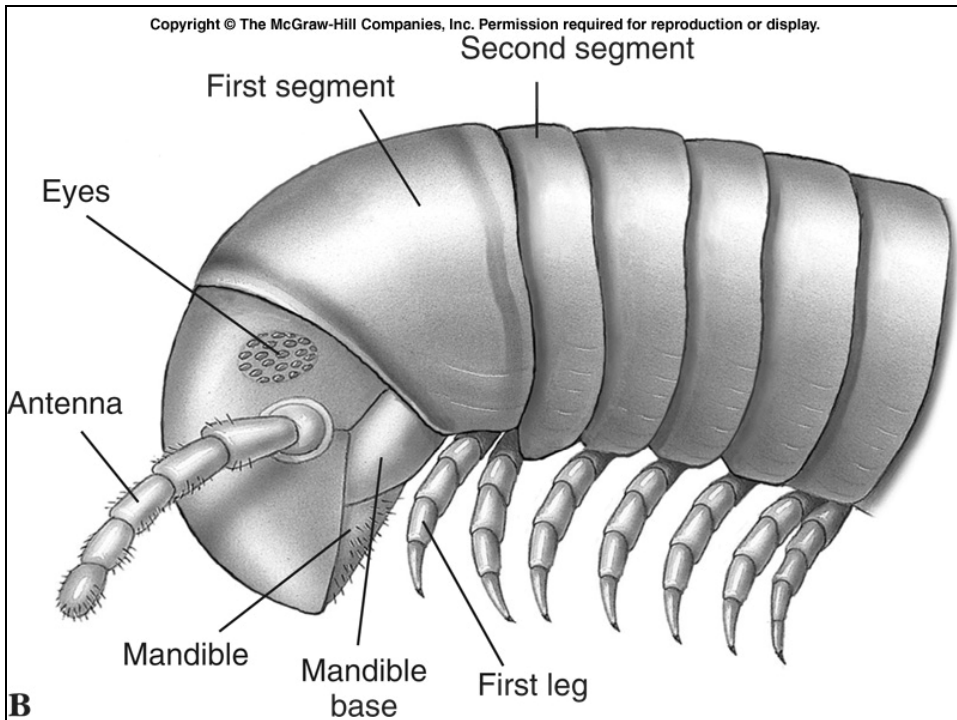
repugnatorial glands

oviparous

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A



Class: **Hexapoda** (Gr. six foot) **Insecta** (L. cut into)

@1,100,000 spp.

I. three tagmatas

head

thorax

abdomen

II. insects importance to human society

pests

destruction to plants/structures

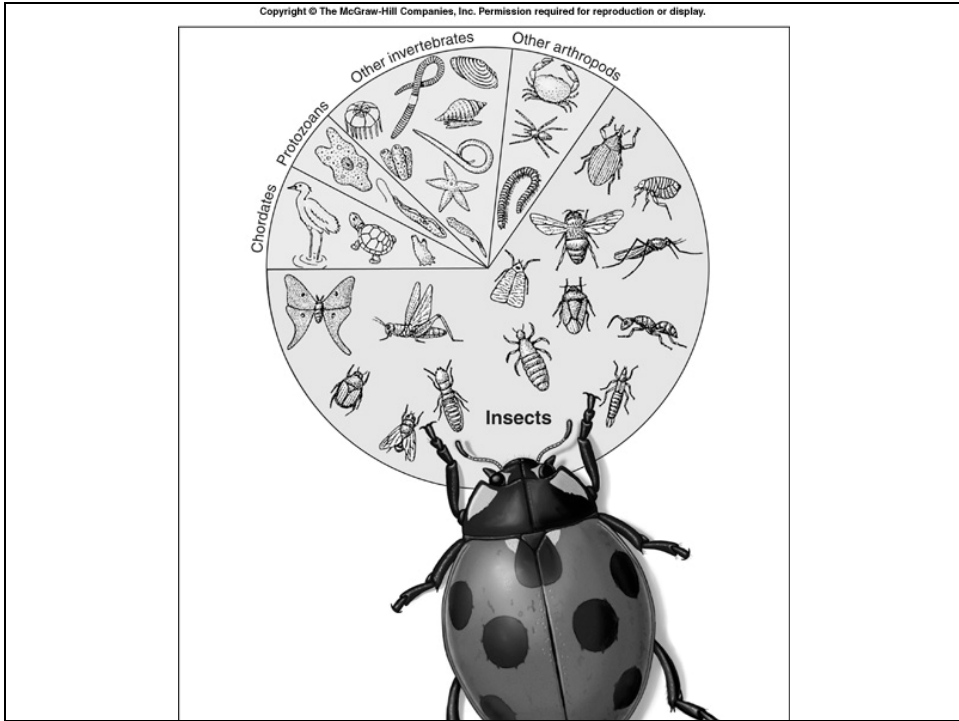
disease vectors

friends

pollinators co-evolution with plants

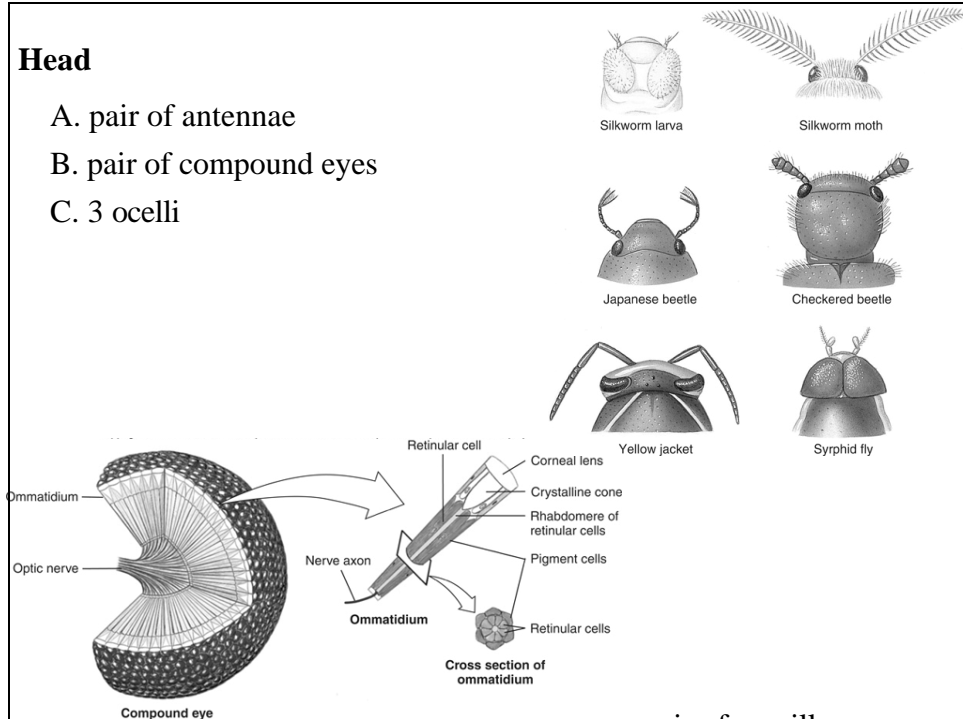
decomposers-leaf cutter ants/dung beetles

biological control-parasitoids



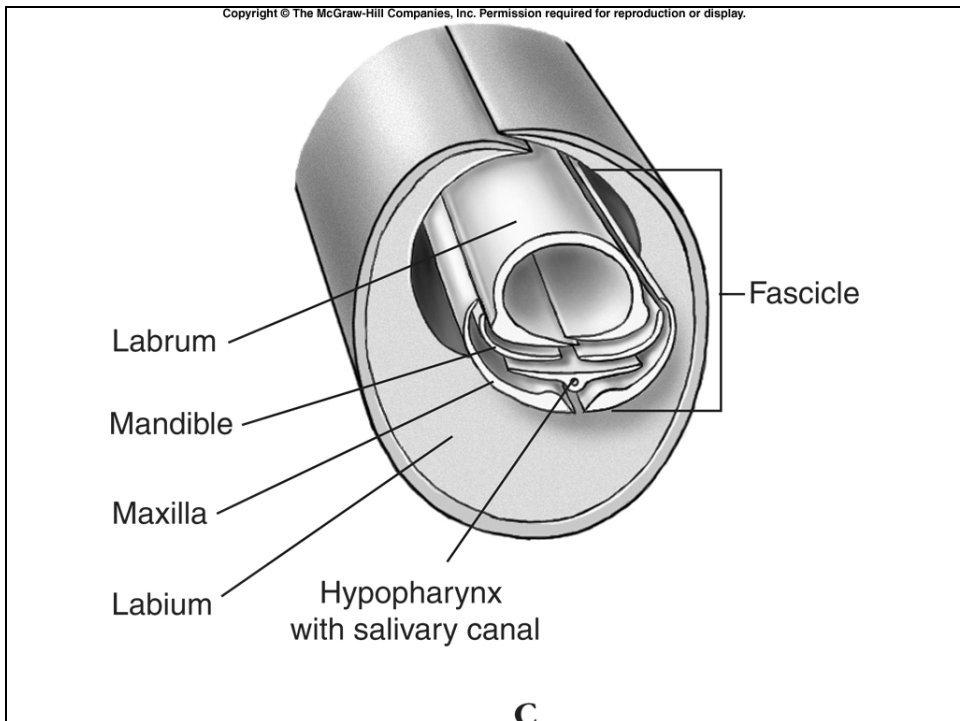
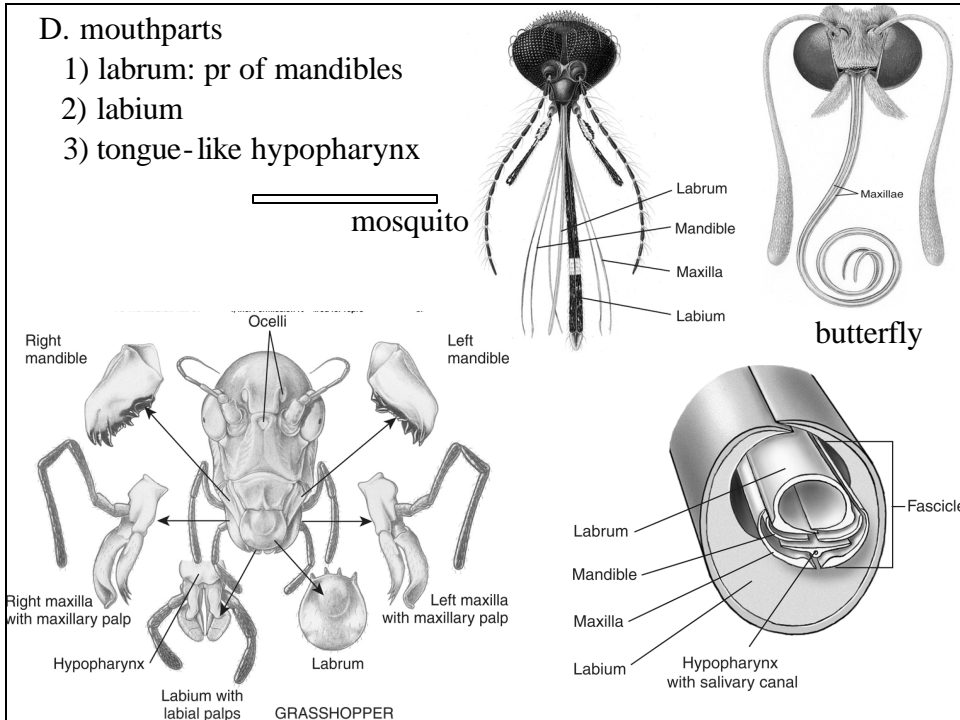
Head

- A. pair of antennae
- B. pair of compound eyes
- C. 3 ocelli

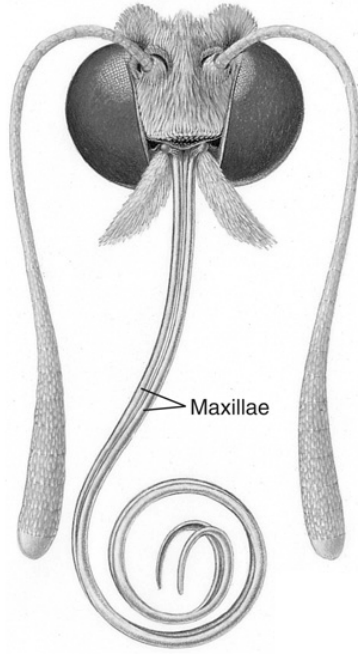


D. mouthparts

- 1) labrum: pr of mandibles
- 2) labium
- 3) tongue-like hypopharynx



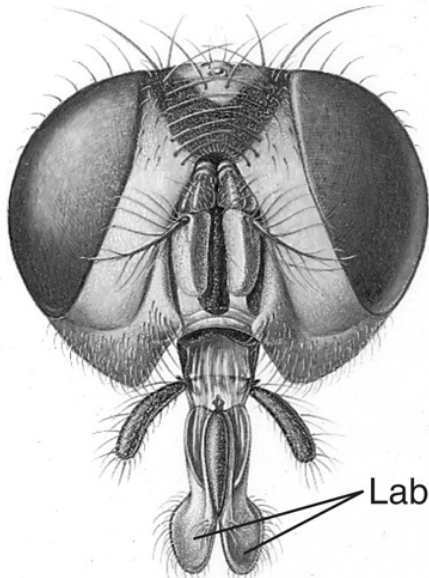
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Maxillae

D. BUTTERFLY

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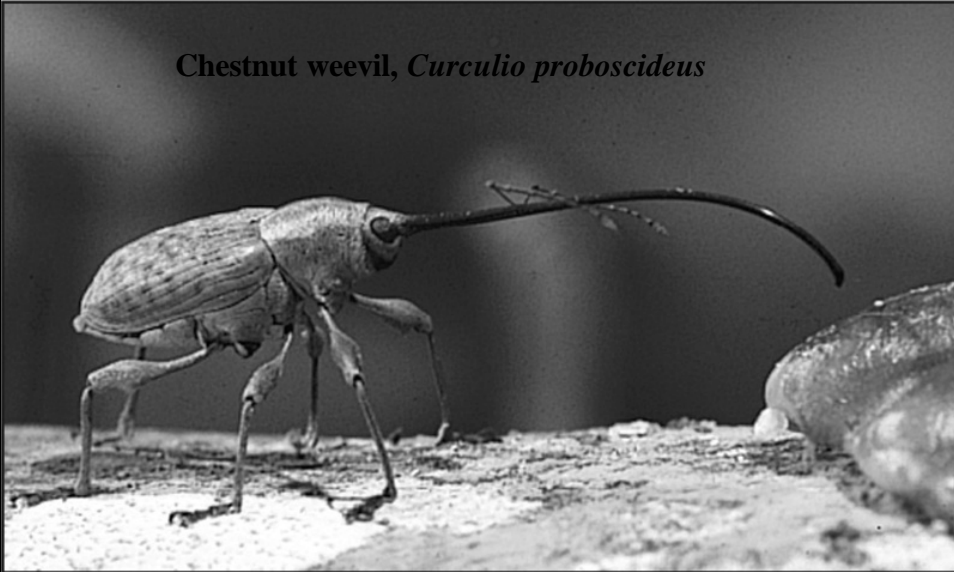


Labial lobes

E. HOUSE FLY

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Chestnut weevil, *Curculio proboscideus*



D

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A

Giant horned beetle

Thorax

prothorax

pair of legs (burrowing/grasping)

mesothorax

pair of legs

pair of wings

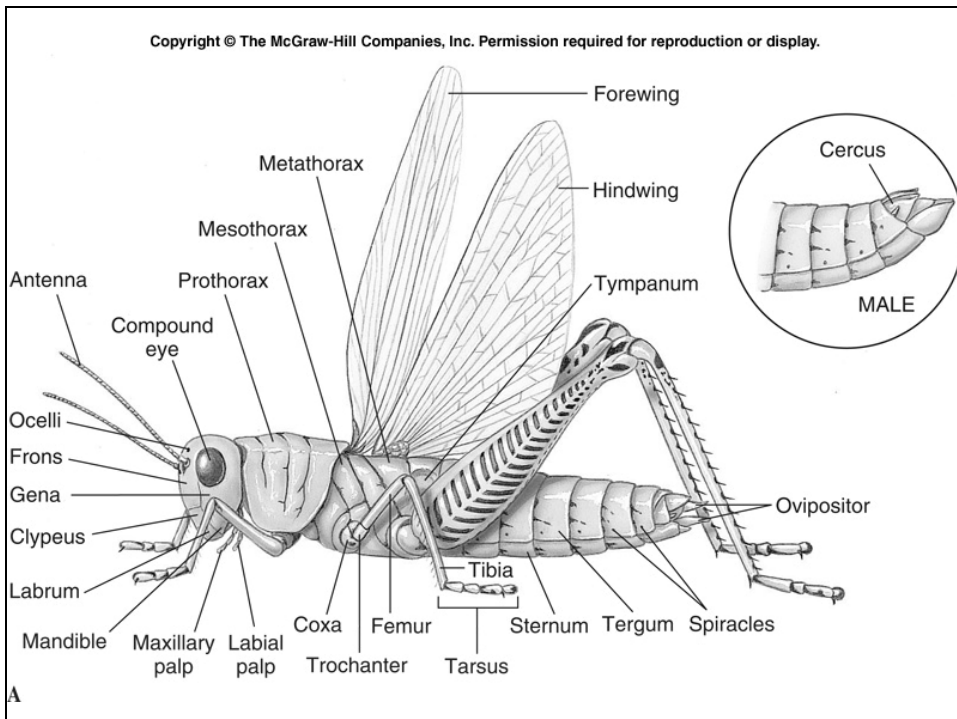
metathorax

pair of legs (jumping)

pair of wings

legs-terminal pads, claws, paddle-shaped

wings-cuticular extensions of epidermis

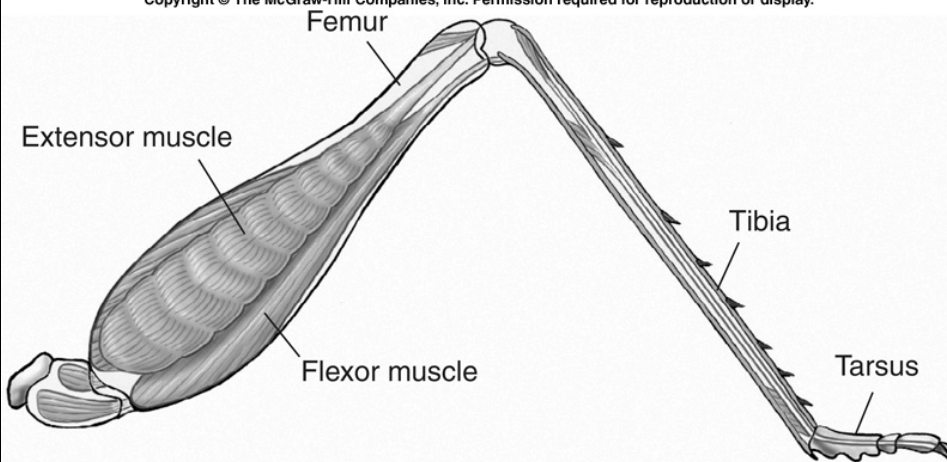


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A

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Femur

Extensor muscle

Flexor muscle

Tibia

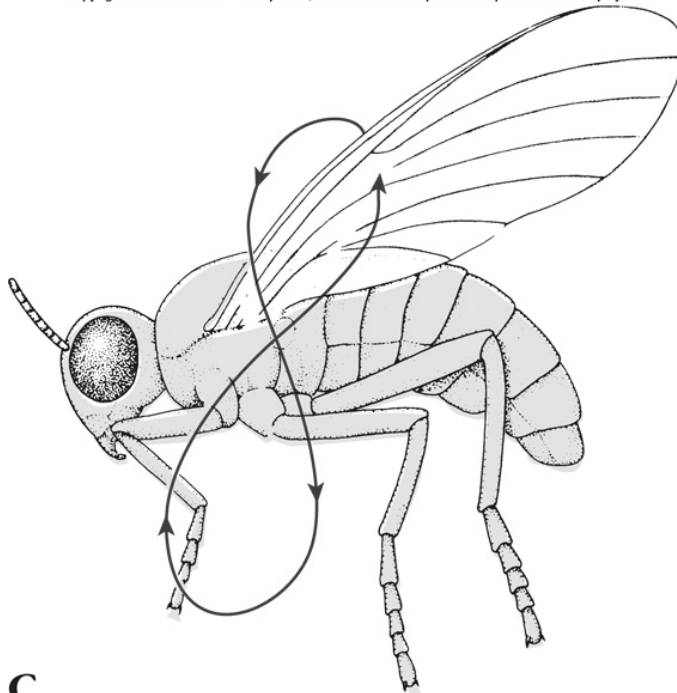
Tarsus

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Water strider, *Gerris* sp.

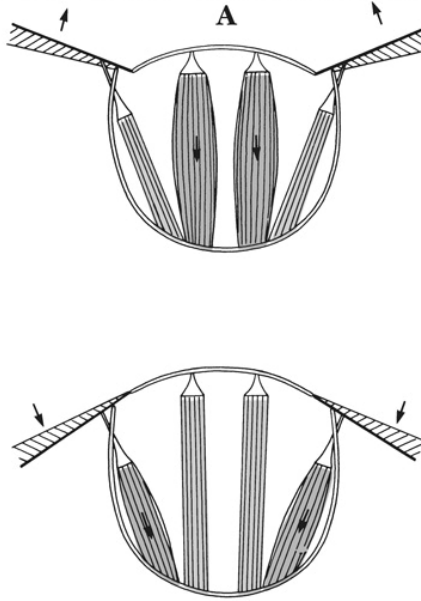


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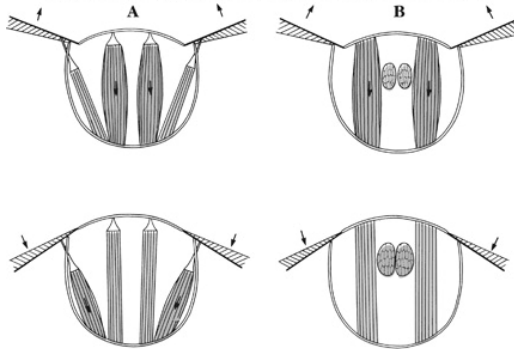
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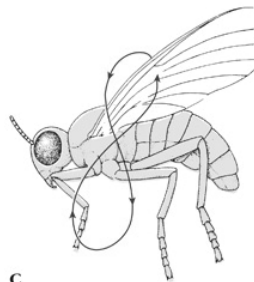
Direct and indirect flight muscles of locusts and dragonflies

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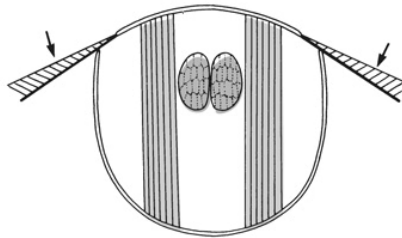
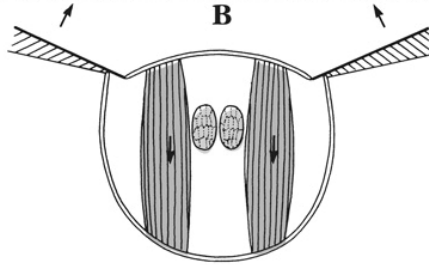


Direct and indirect flight muscles of locusts and dragonflies

Indirect flight muscles of flies and midges



C



Indirect flight muscles
of flies and midges

Abdomen

9-11 segments

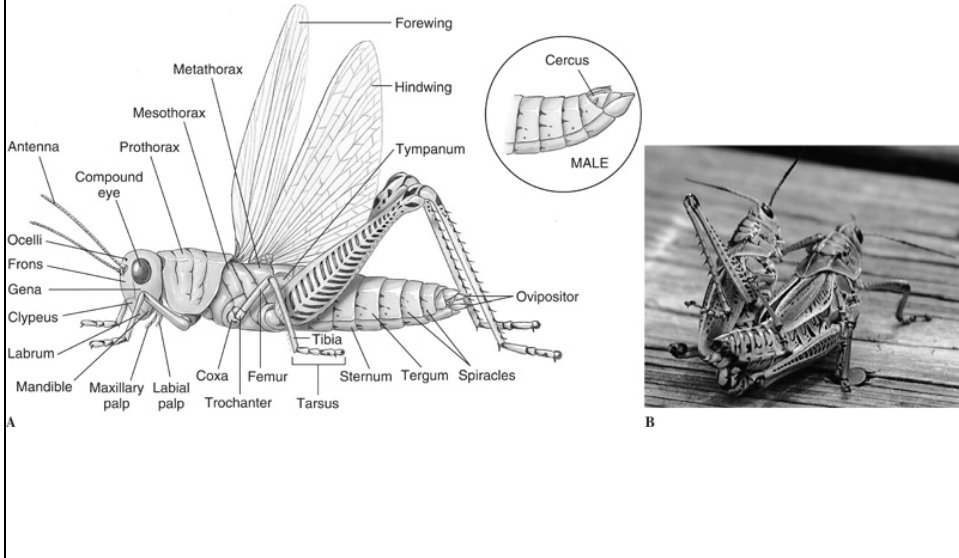
11th segment → pair of cerci

larval/nymphal forms → appendages

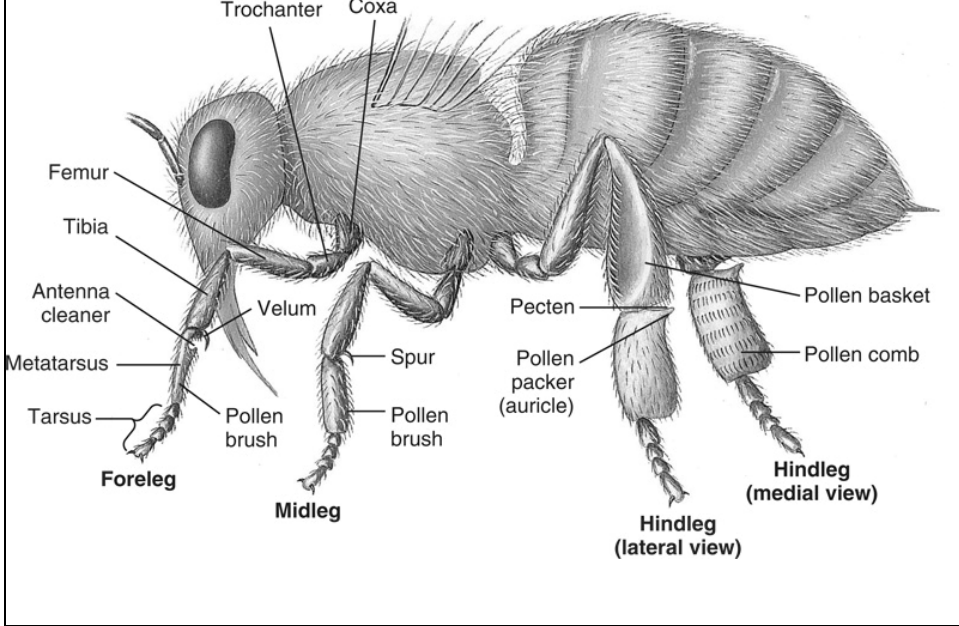
adults → lack appendages

end of abdomen → external genitalia

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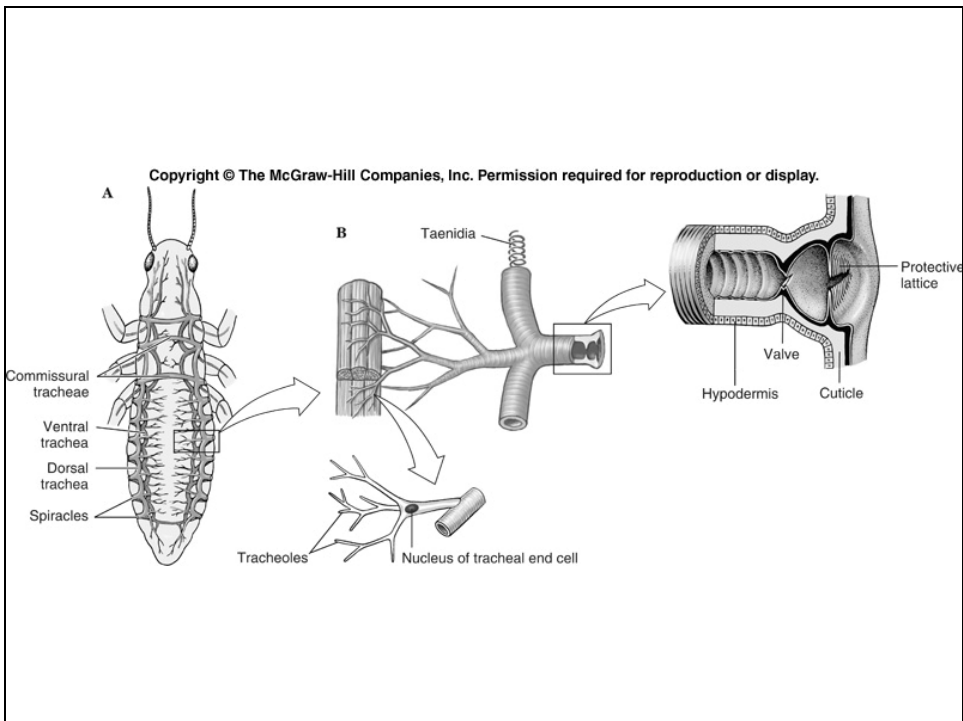
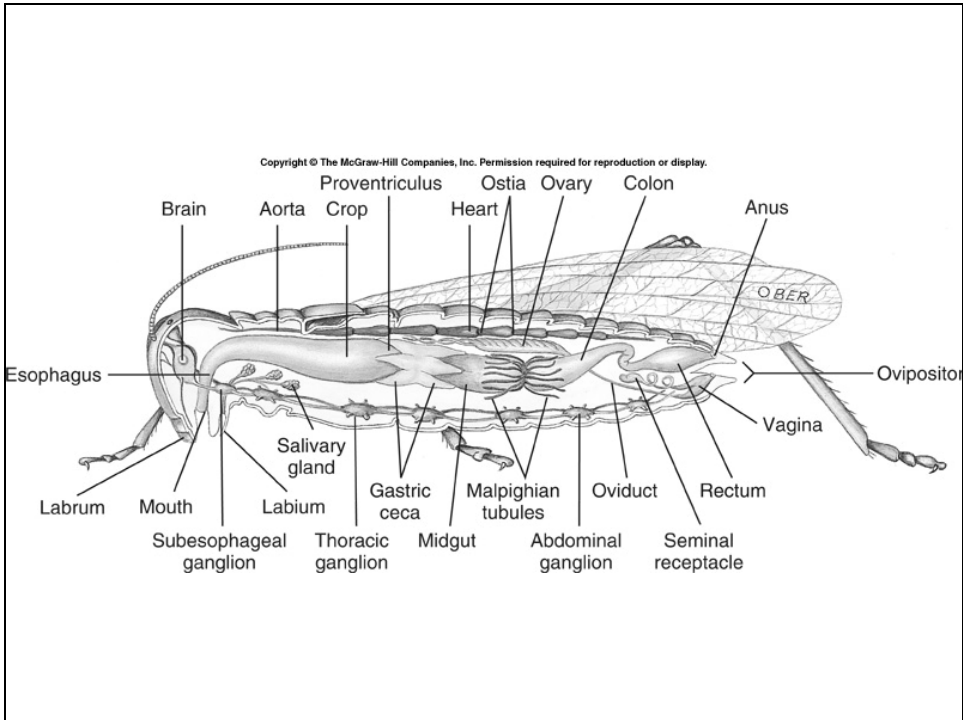
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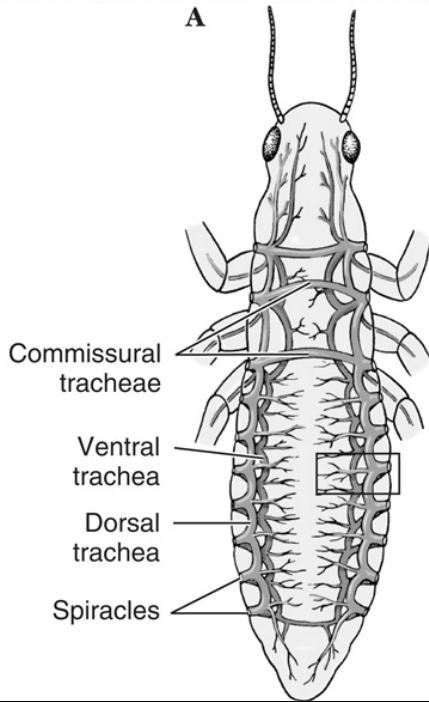
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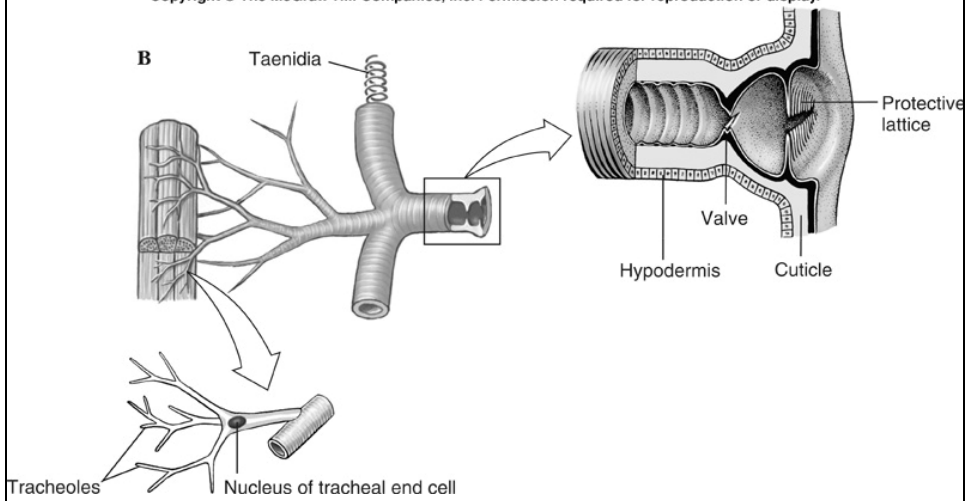


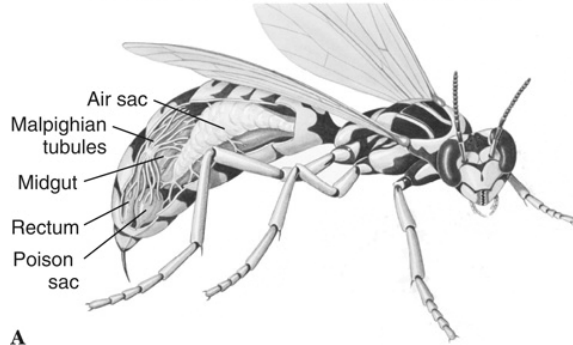


A

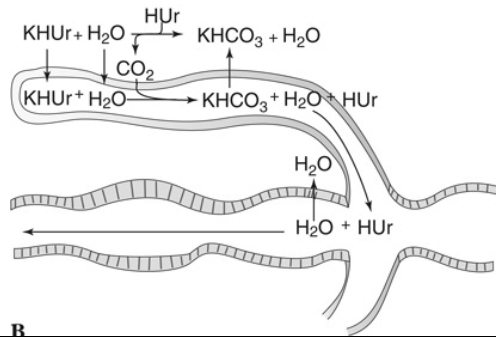


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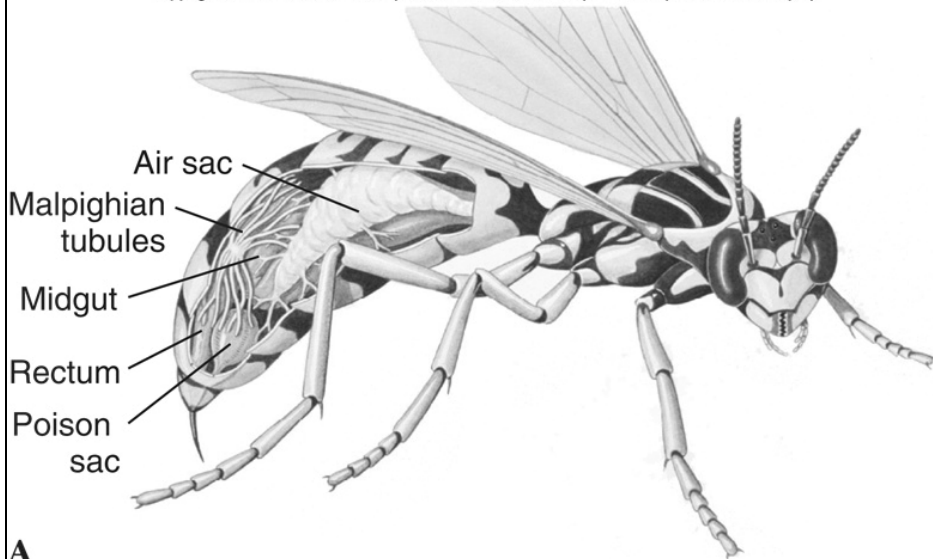




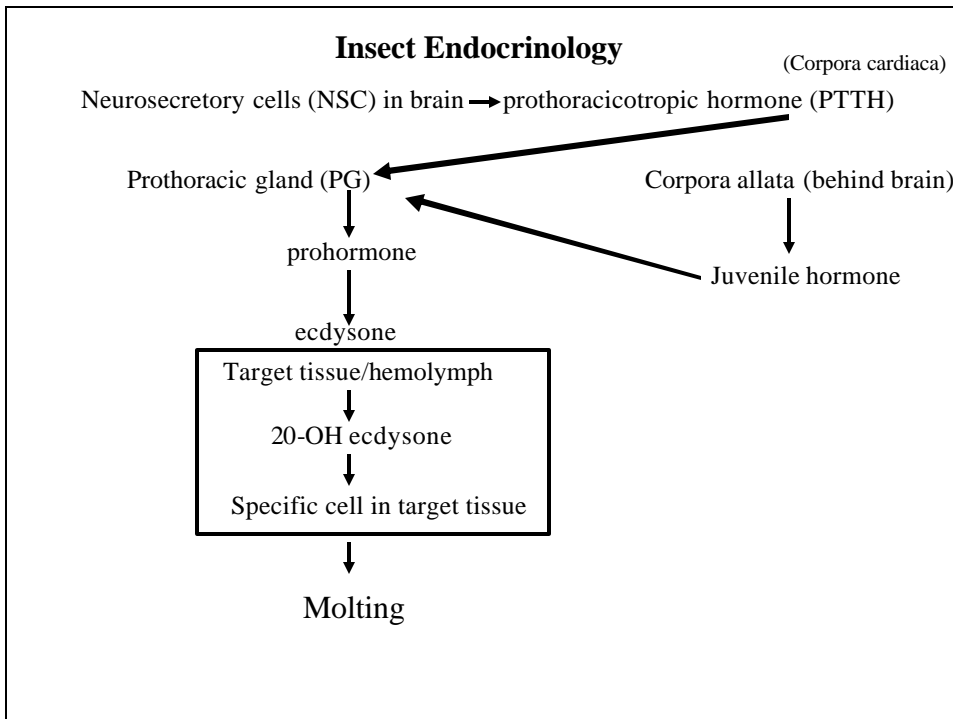
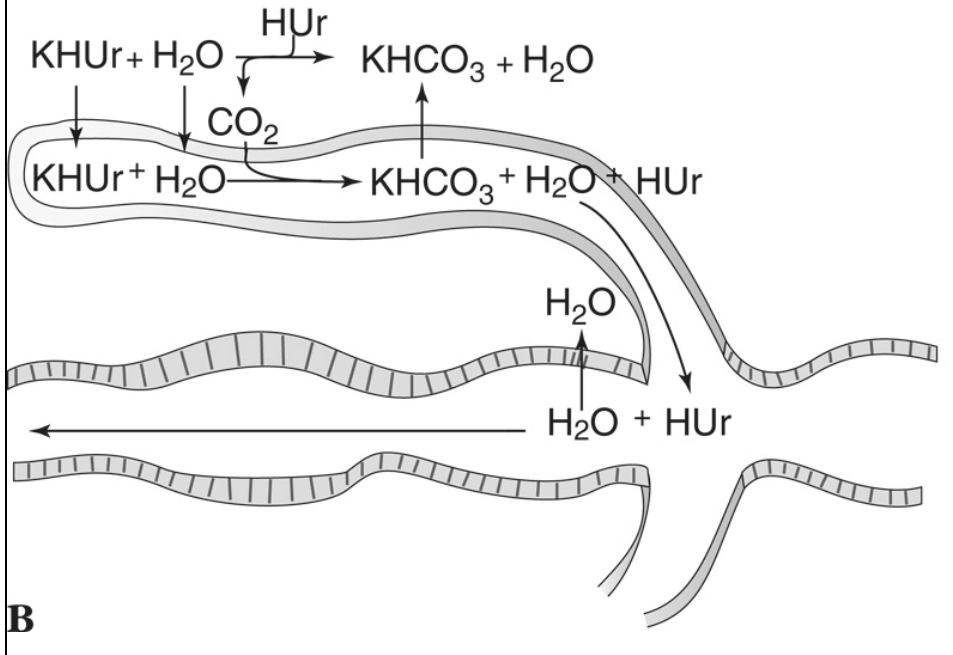
A



B

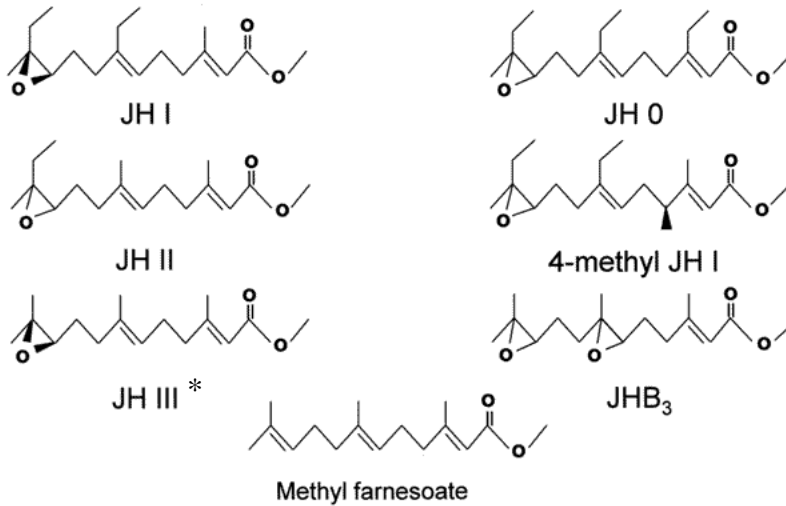


A



Juvenile Hormone

family of acyclic sesquiterpenoids



<http://entomology.wisc.edu/~goodman/wgresrch.html>

Responses to Environmental Conditions

Dormancy

= period of arrested metabolism in response to unfavorable environmental conditions

winter sleep:	bears
hibernation	Canadian ground squirrels
summer: estivation	<i>Oreohelix</i> (Utah land snail)
daily: torpor	hummingbirds

Diapause

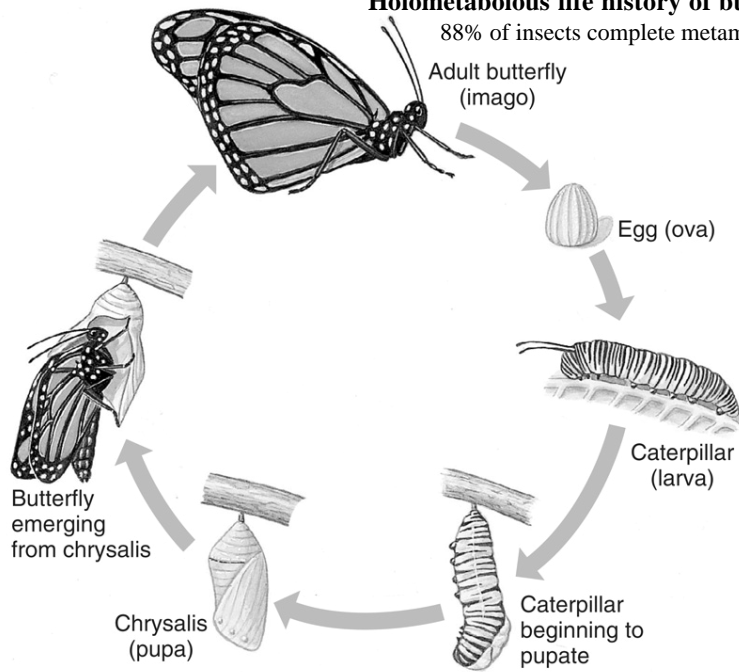
= prolonged arrested growth regardless of environmental conditions

- extreme adverse condition
- genetically determined
- initiated by particular cue(s) (e.g. photoperiod)
- ended by particular cue(s) (e.g. warmer temperature)

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Holometabolous life history of butterfly

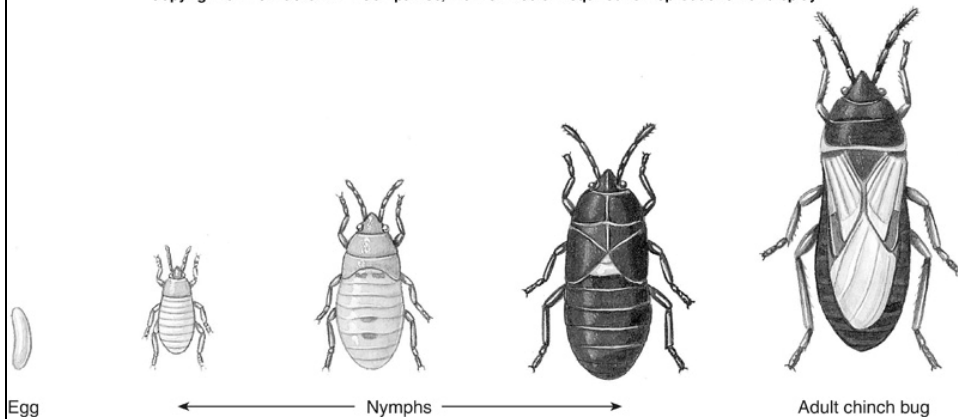
88% of insects complete metamorphosis



Life history of hemimetabolous insect

incomplete/gradual metamorphosis

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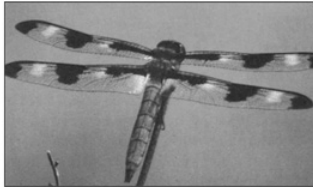
grasshoppers, cicadas, mantids, terrestrial bugs, mayflies, stoneflies, dragonflies, aquatic bugs with young (nymphs)

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A

Stonefly



B

Ten-spot dragonfly

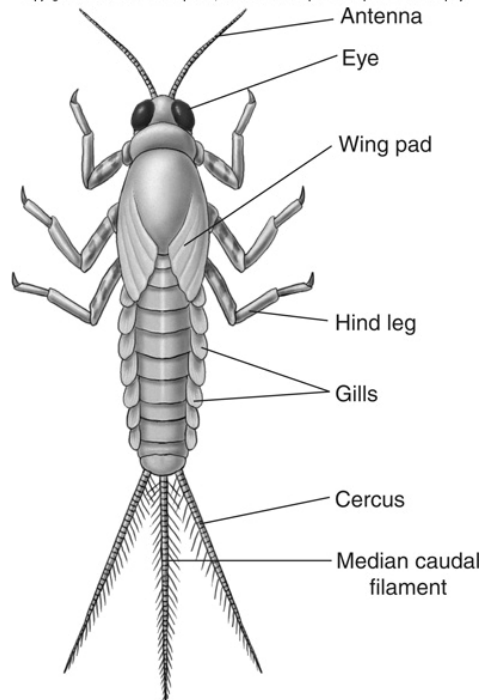


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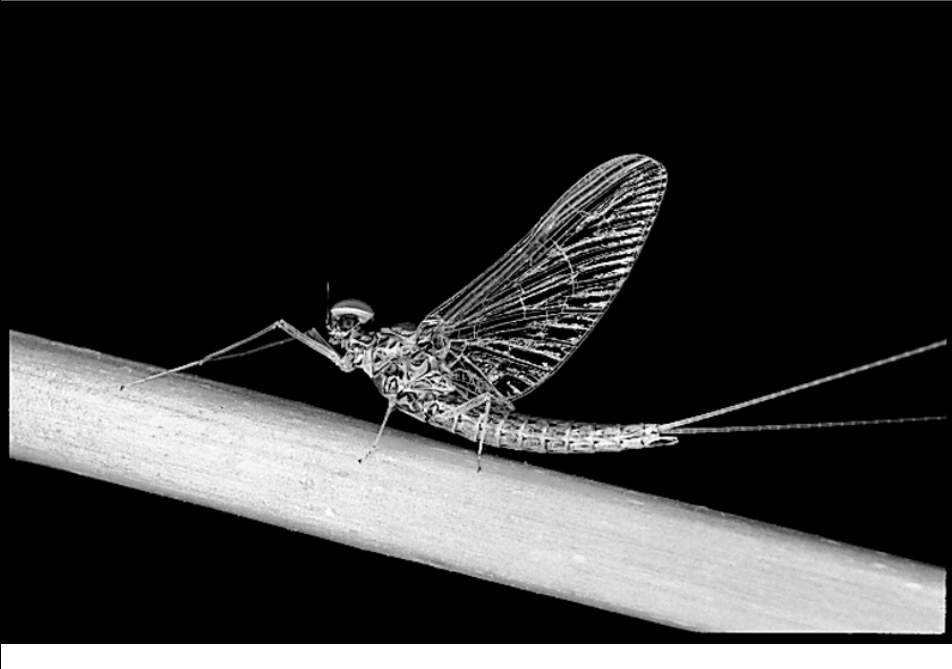
Dragonfly nymph

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Mayfly nymph



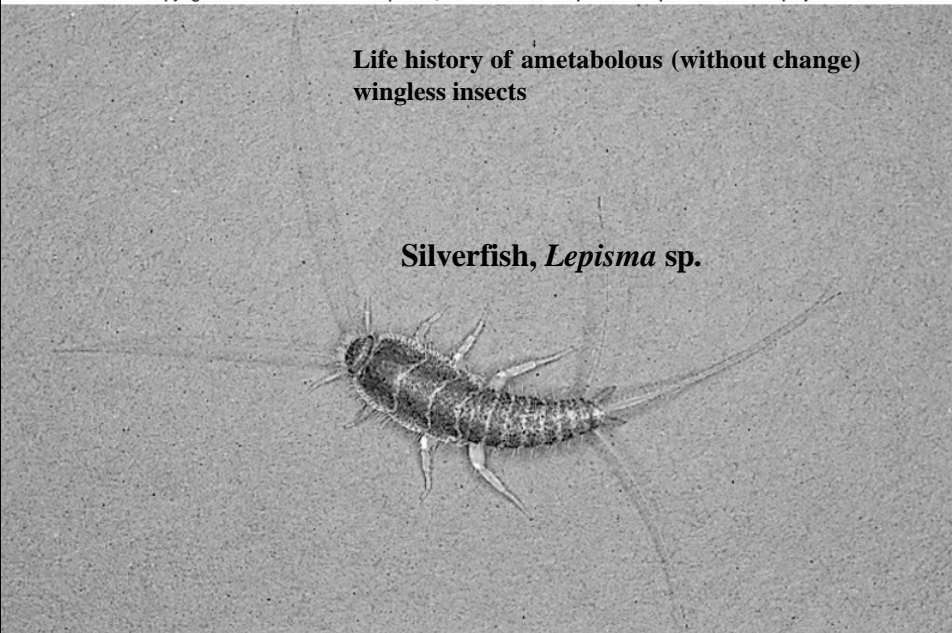
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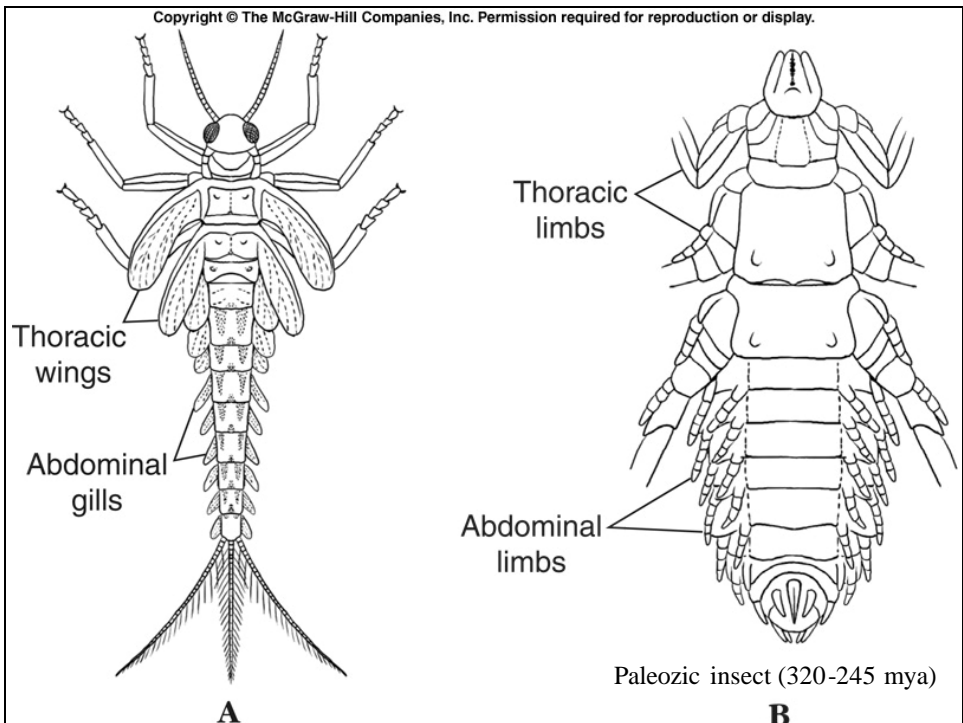
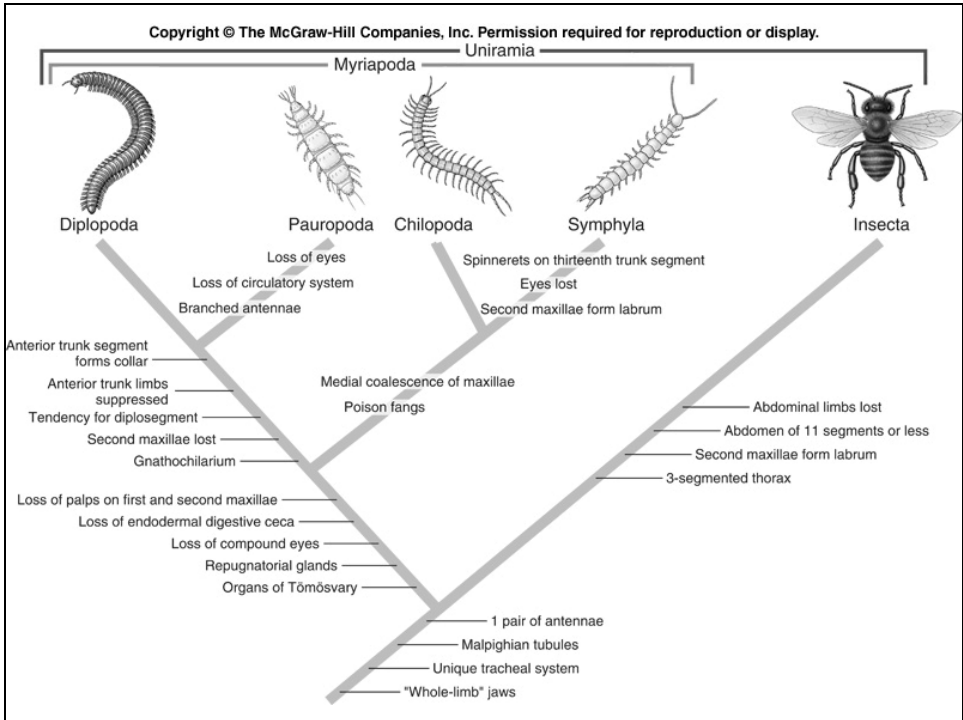


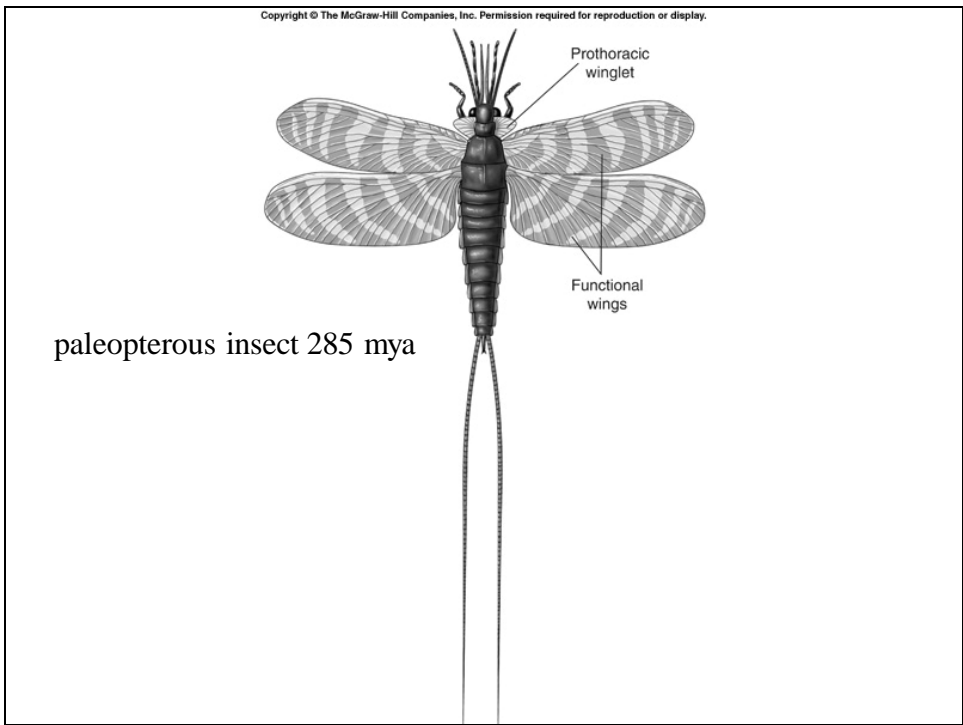
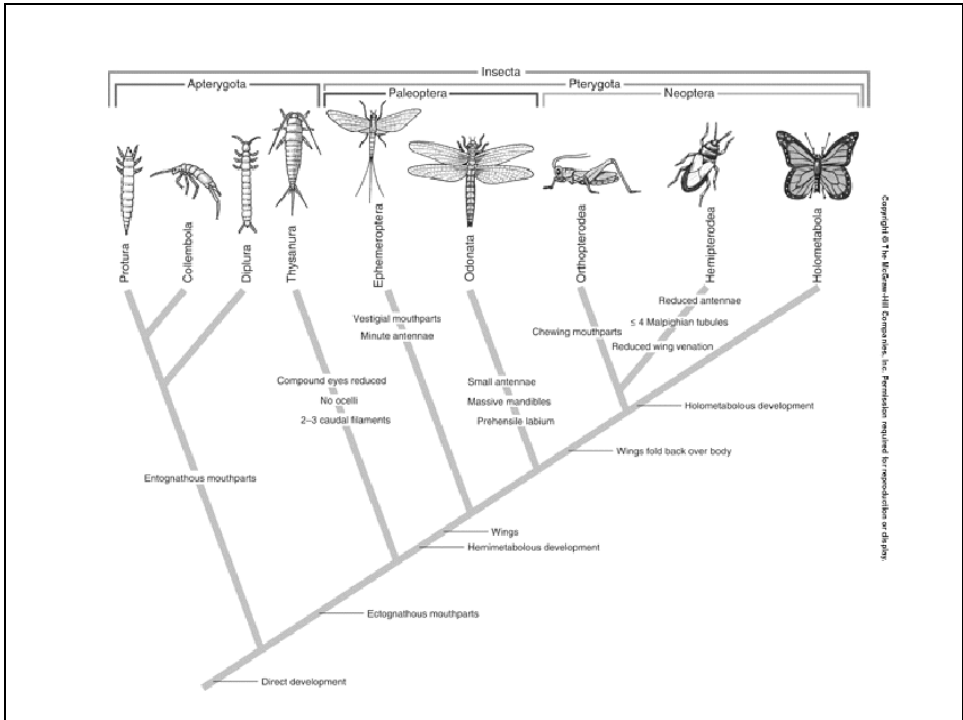
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**Life history of ametabolous (without change)
wingless insects**

Silverfish, *Lepisma* sp.

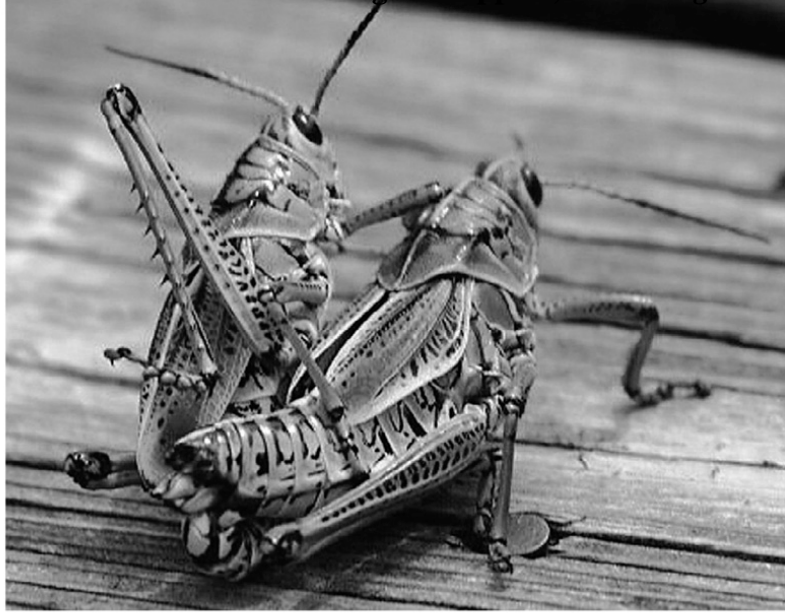






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Lubber grasshoppers, *Romalea guttata*



B

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Brazilian saturniid moth, *Rothschildia jacobaea*



B

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Indian swallowtail butterfly, *Papilio krishna*



A

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Viceroy butterfly, *Limenitis archippus*

B

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B

Walking stick

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Estigena pardalis (order: Lepidoptera) from Java



A

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Mexican tree hopper, *Sphongophorus* sp.

B

crypsis = camouflage in shape/coloration to escape predators

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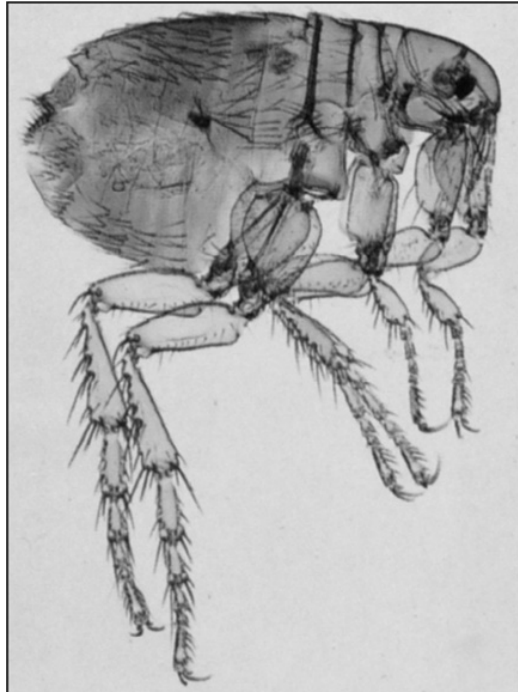
katydid *Dysonia* sp.

C

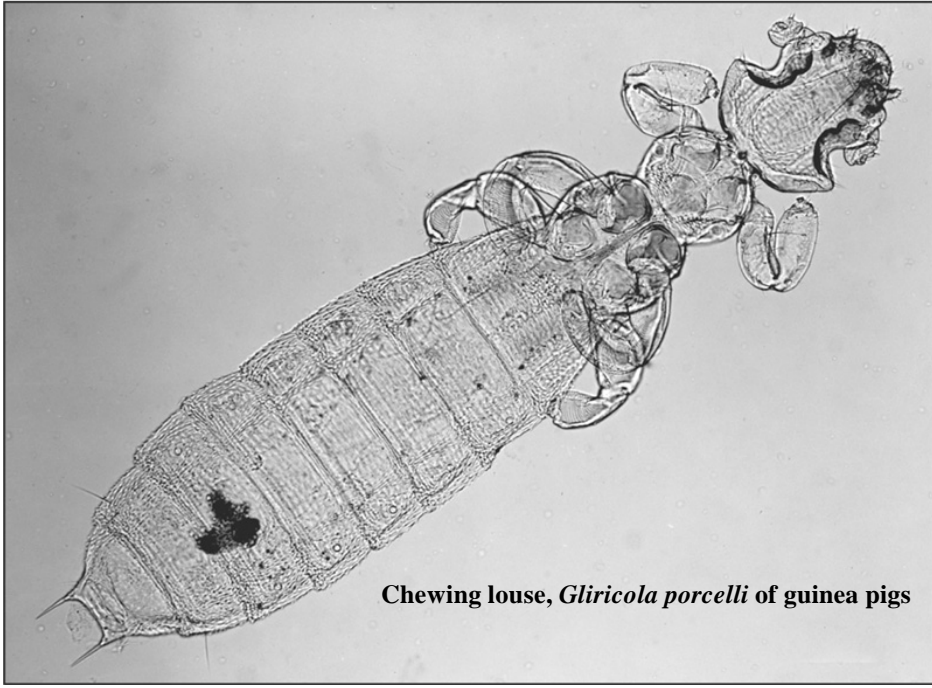
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Chewing louse, *Gliricola porcelli* of guinea pigs

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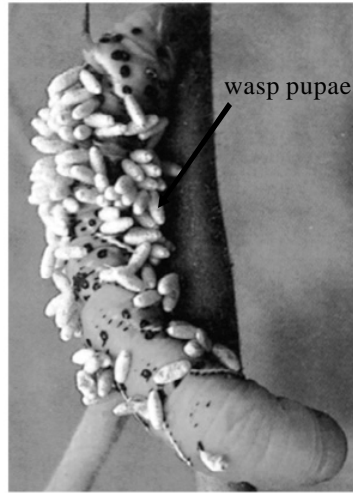
Human head/body louse, *Pediculus humanus*

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Tomato hornworm, *Manduca sexta*
→ sphinx moth

A



wasp pupae

B Hornworm parasitized
by tiny wasp, *Apanteles*

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Brazilian kind of grasshopper, *Omura congrua*

A

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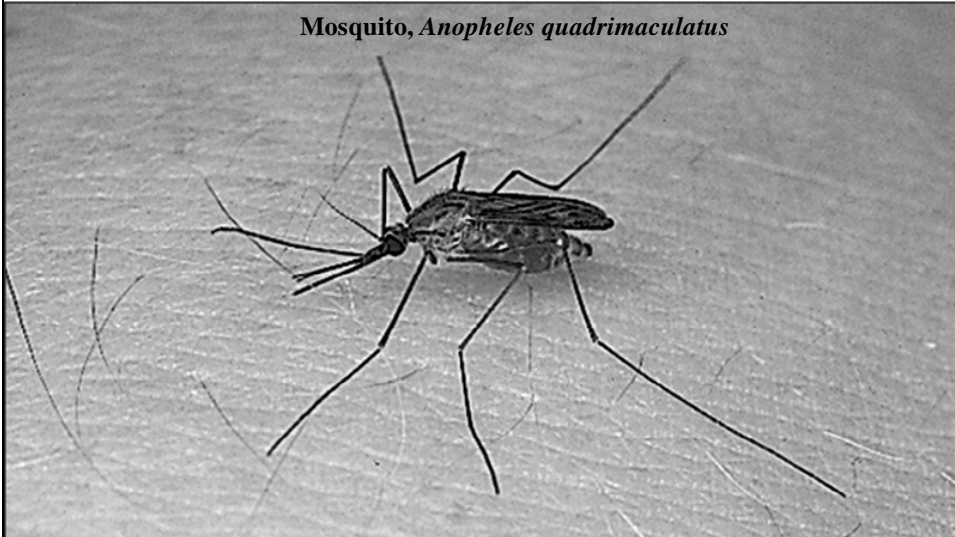
Bluet damselflies, *Enallagma* sp.



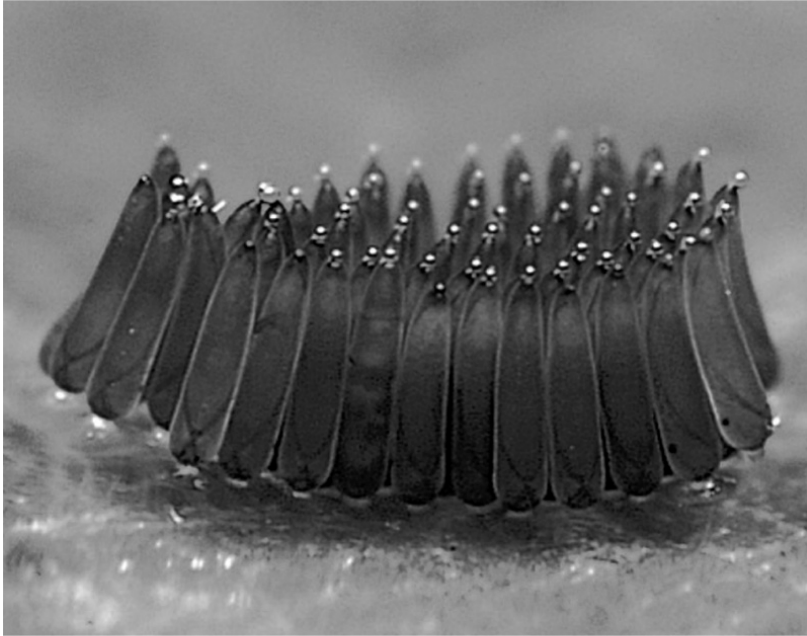
B

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Mosquito, *Anopheles quadrimaculatus*



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A

Aquatic mosquito eggs

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B aquatic larva of mosquito

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A Ecdysis in cicada



B Adult cicada

Mimicry = imitation of noxious species

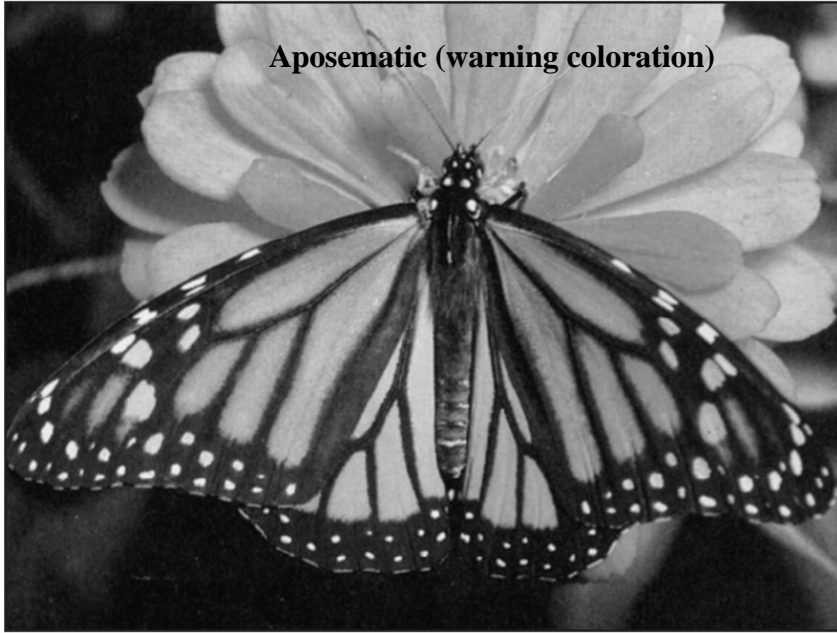
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A Monarch

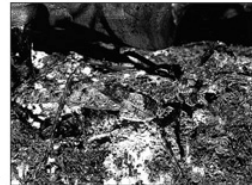


B Viceroy



A

Monarch butterfly



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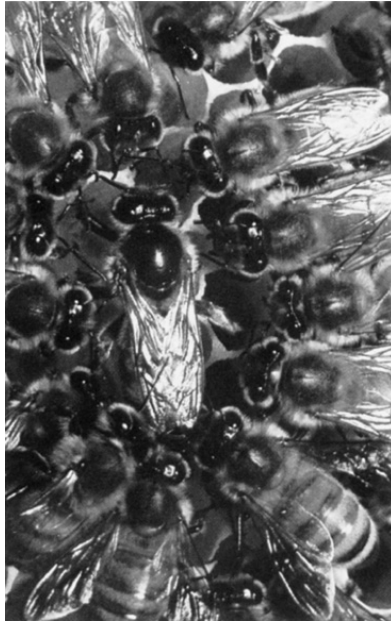
Dung beetle → ummmm good!!

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Female firefly eating a male firefly

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Parthenogenesis = virgin birth

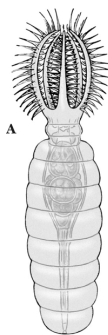
development of an individual from an unfertilized egg
no sperm contribution

aphids, ants, bees & wasps

e.g. ants, bees & wasps: ♂♂ (drones) parthenogenetically
♀♀ sexually sterile female workers & reproductive queens

certain flatworms, rotifers, roundworms

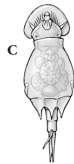
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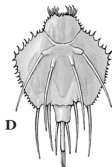
Stephanoceros fimbriatus



Asplanchna priodonta

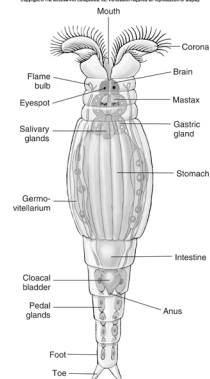


Squatinella rostrum

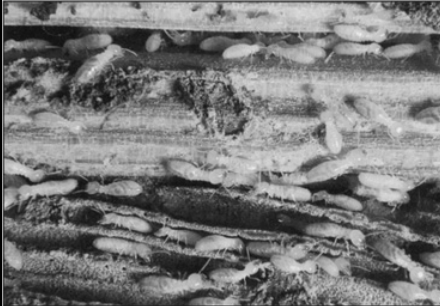
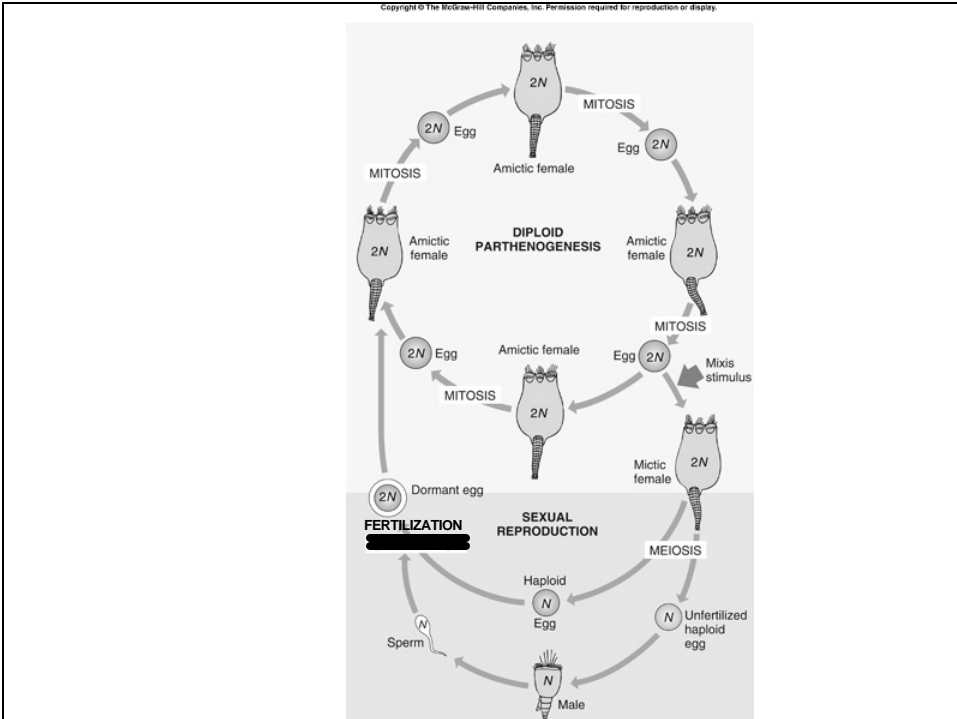


Macrochaetus longipes

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Rotifer, *Philodina*

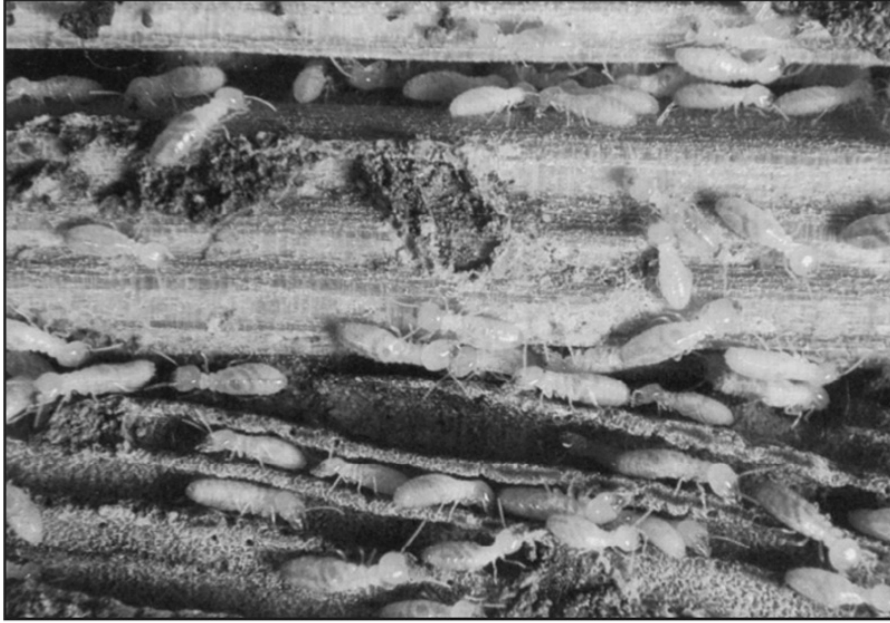


A Sterile wingless termite workers



B Queen termite with workers and soldiers

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A

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B

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A



B

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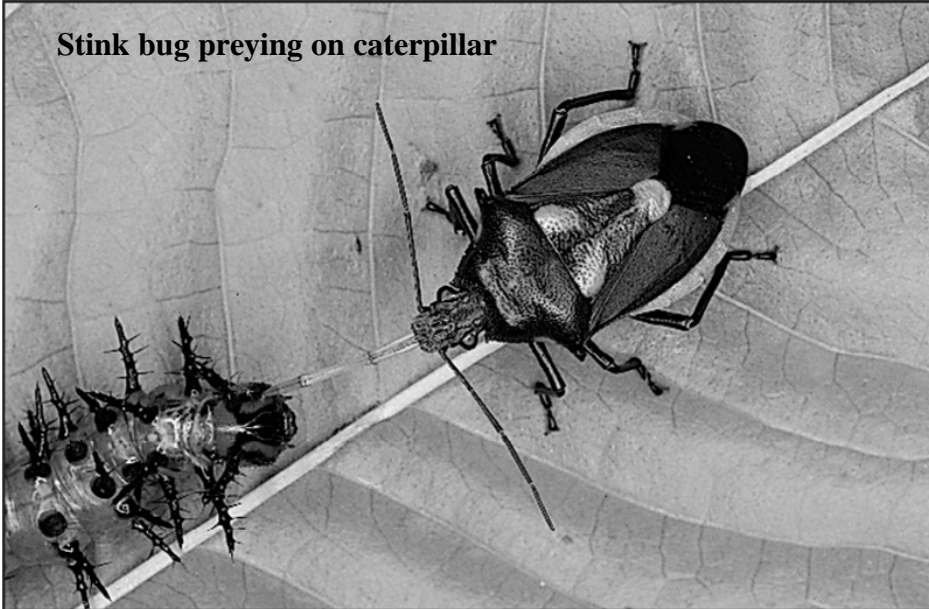


A



B

Stink bug preying on caterpillar



A

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Ladybird beetle (ladybug) eat mites, aphids, scale insects & thrips



B Aposematic coloration = warning coloration to advertise noxious qualities

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Parasitic wasp, *Larra bicolor* attacking mole cricket & laying eggs



C

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A

Japanese beetle



B

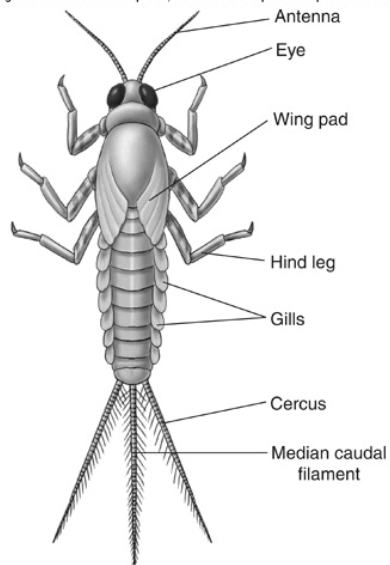
Longtailed mealybug



C

Corn ear worms

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Oak treehoppers, *Platycotis vittata*



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Adult ant lion



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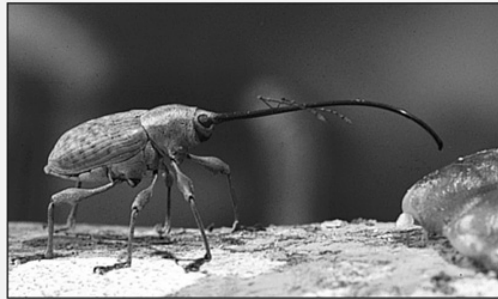
A



C



B



D

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Paper wasps attending their pupae & larvae



C