

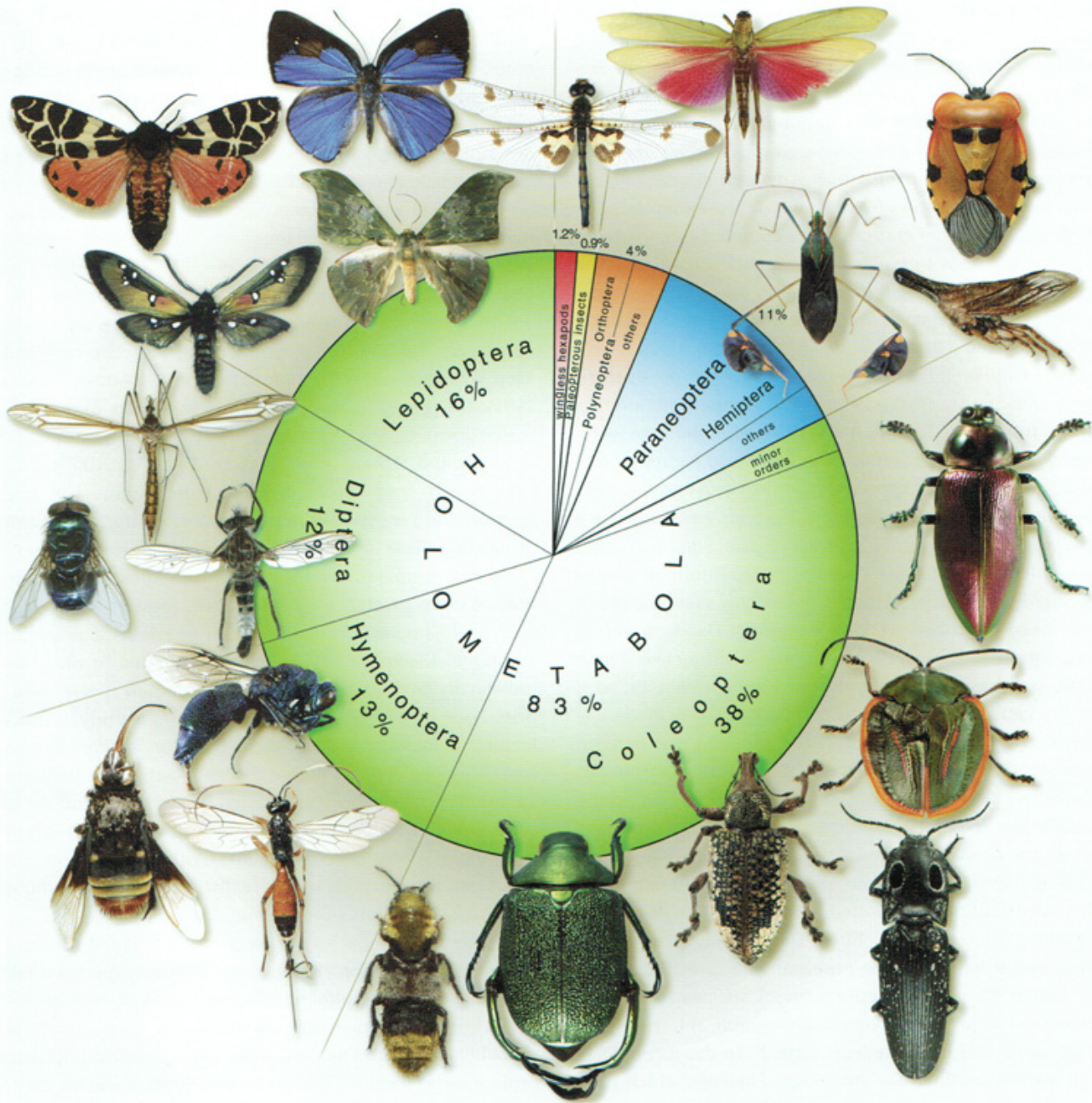
What's eating you?

A natural history of insect herbivores



Peter Oboyski - Essig Museum of Entomology

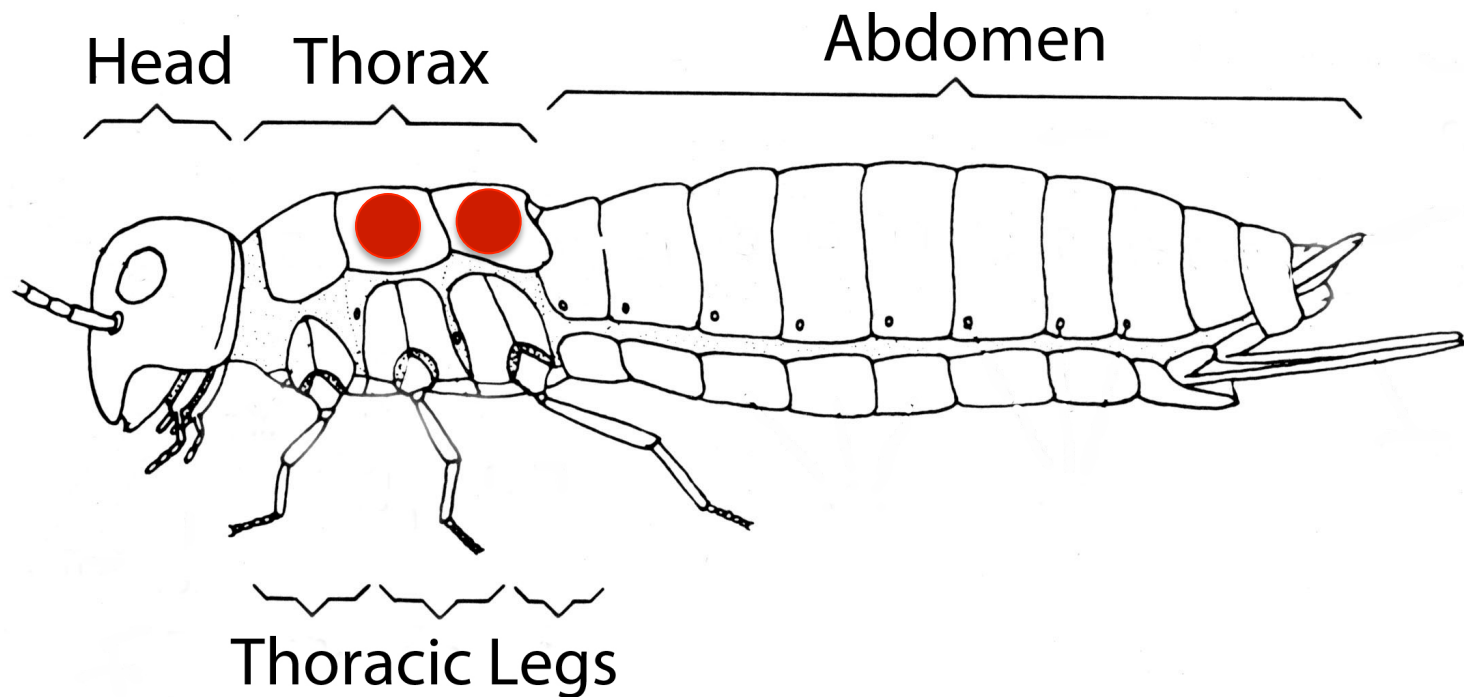




What is an insect?

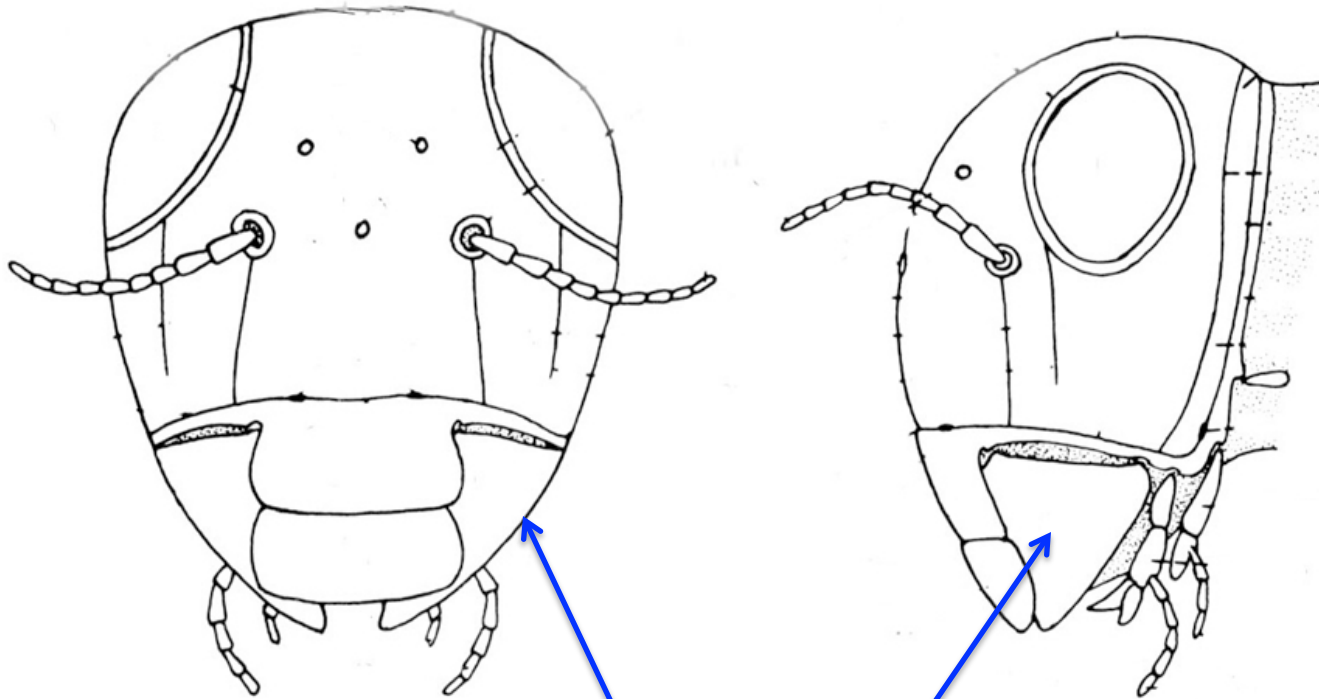
- Animalia
 - Multicellular (usually arranged in tissues and organs)
 - Heterotrophic (rely on other organisms for food)
- Arthropoda
 - Jointed appendages
 - Exoskeleton
- Insecta
 - Three body regions (head, thorax, abdomen)
 - Three pairs of thoracic legs

The Insect Body



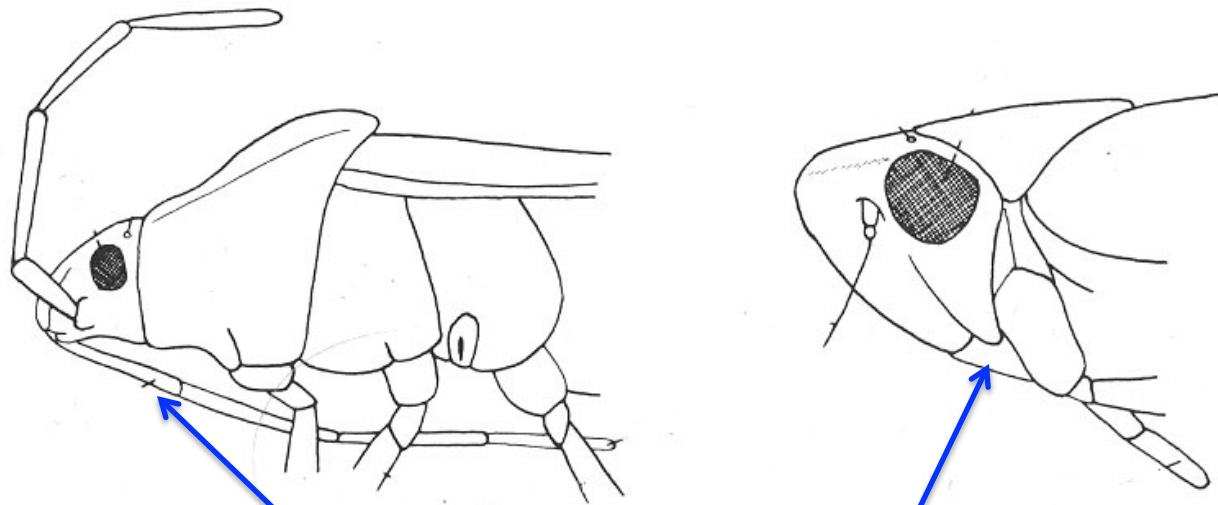
● Points of wing attachment (when present)

Chewing Mouthparts



mandibles

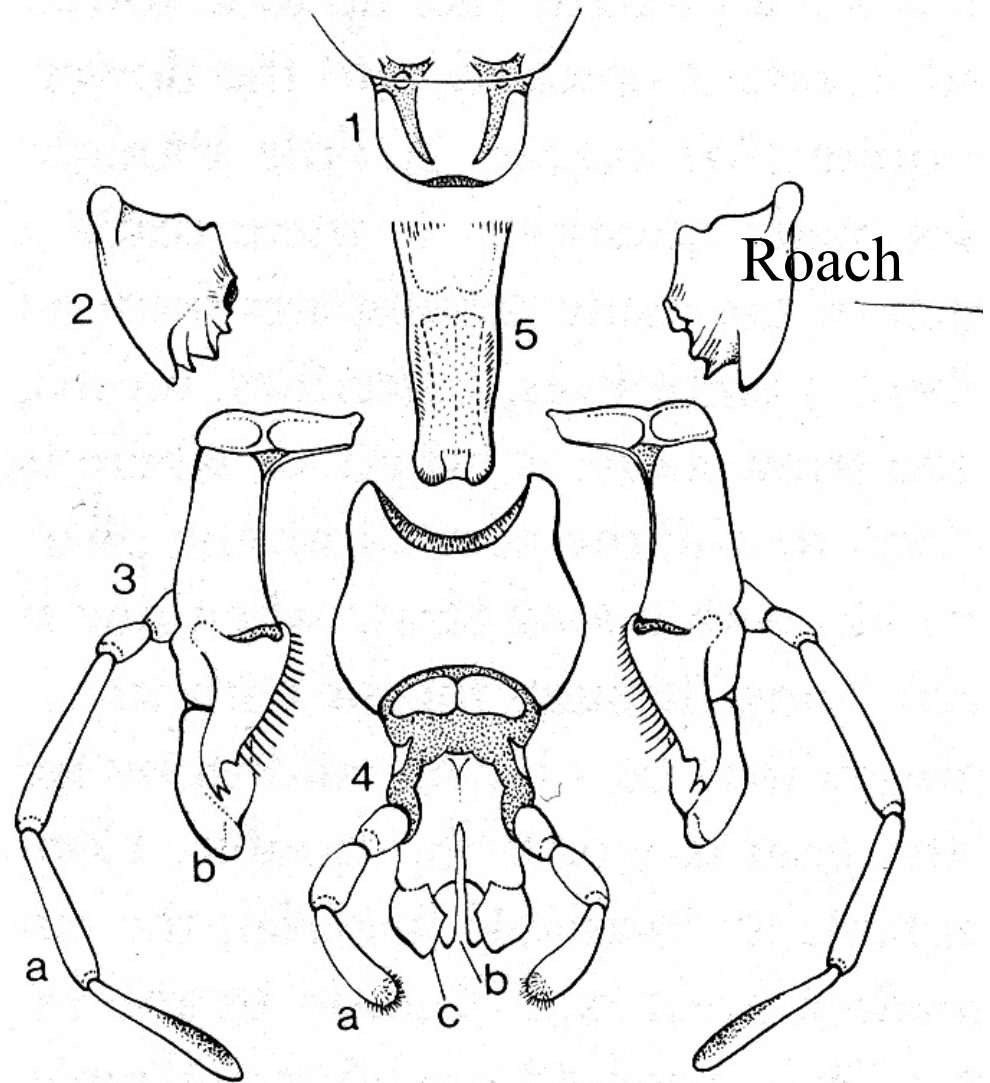
Sucking Mouthparts



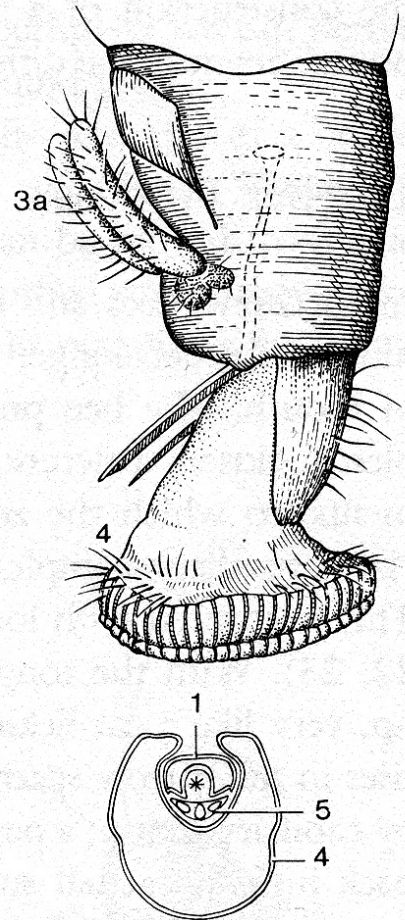
Straw-like Proboscis

MOUTHPARTS

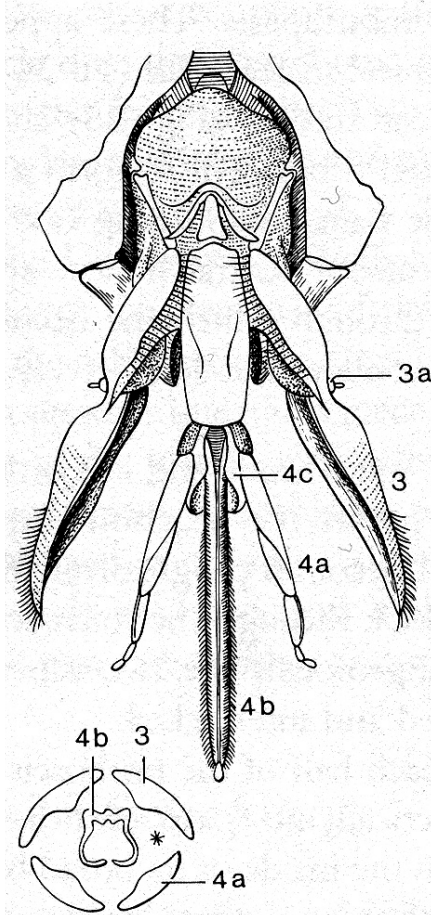
1. Labrum
2. Mandible
3. Maxilla
 - a. Palp
 - b. Galea
4. Labium
 - a. Palp
 - b. Glossa
 - c. Paraglossa
5. Hypopharynx



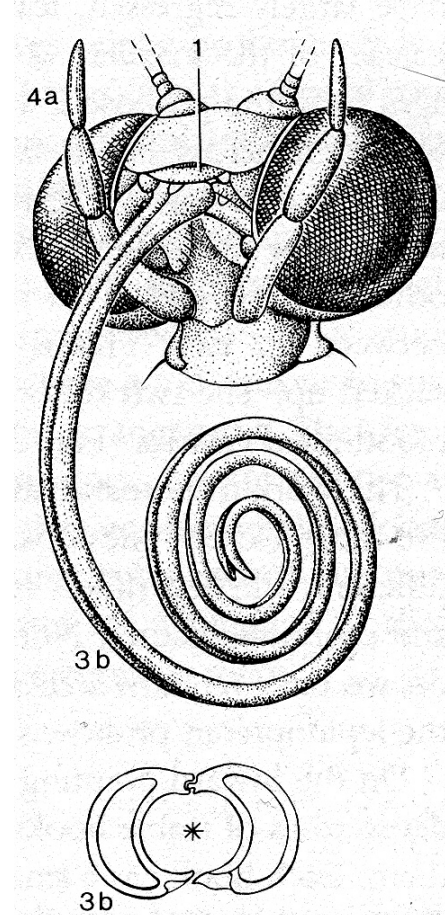
Three ways to build sucking mouthparts using different parts



Fly



Bee



Moth

1) Labrum

3) Maxilla

3b) Galea

4a) Palp

4c) Paraglossa

2) Mandible

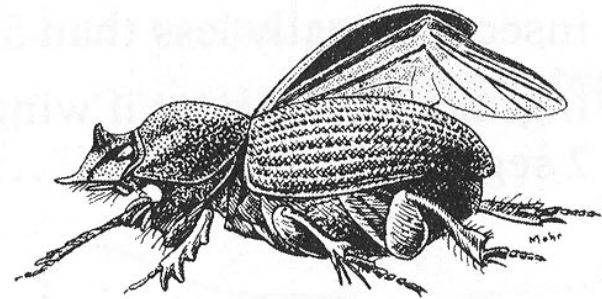
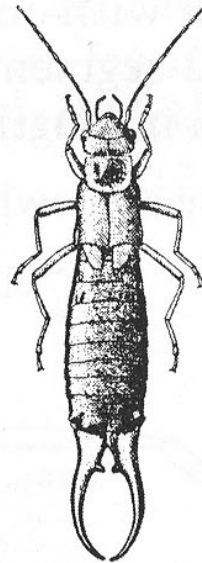
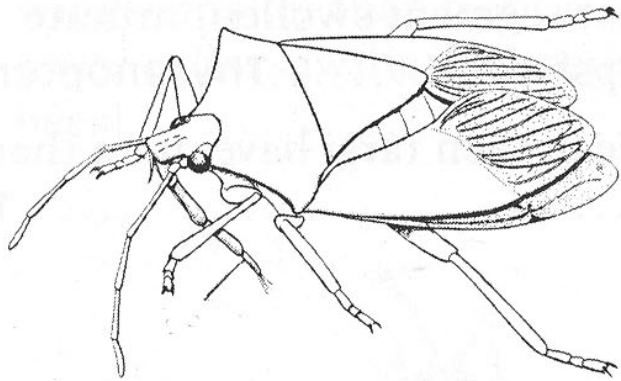
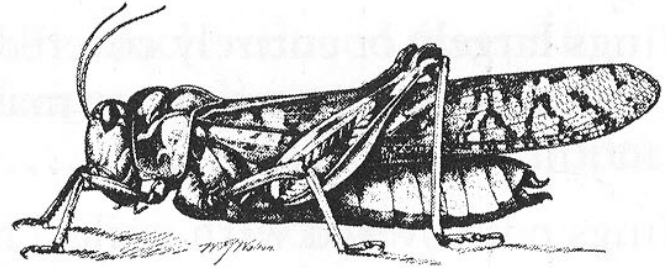
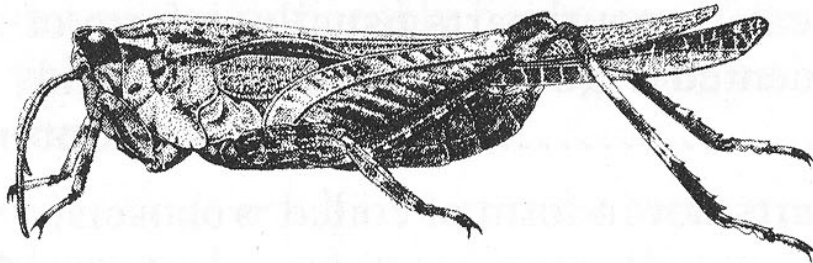
3a) Palp

4) Labium

4b) Glossa

5) Hypopharynx

Legs, wings, and other appendages



Under the microscope

- What to look for on each insect:
 - Three body regions
 - Type of mouth parts
 - Type of legs
 - Number and type of wings

Thorax

three segments – pro, meso, meta

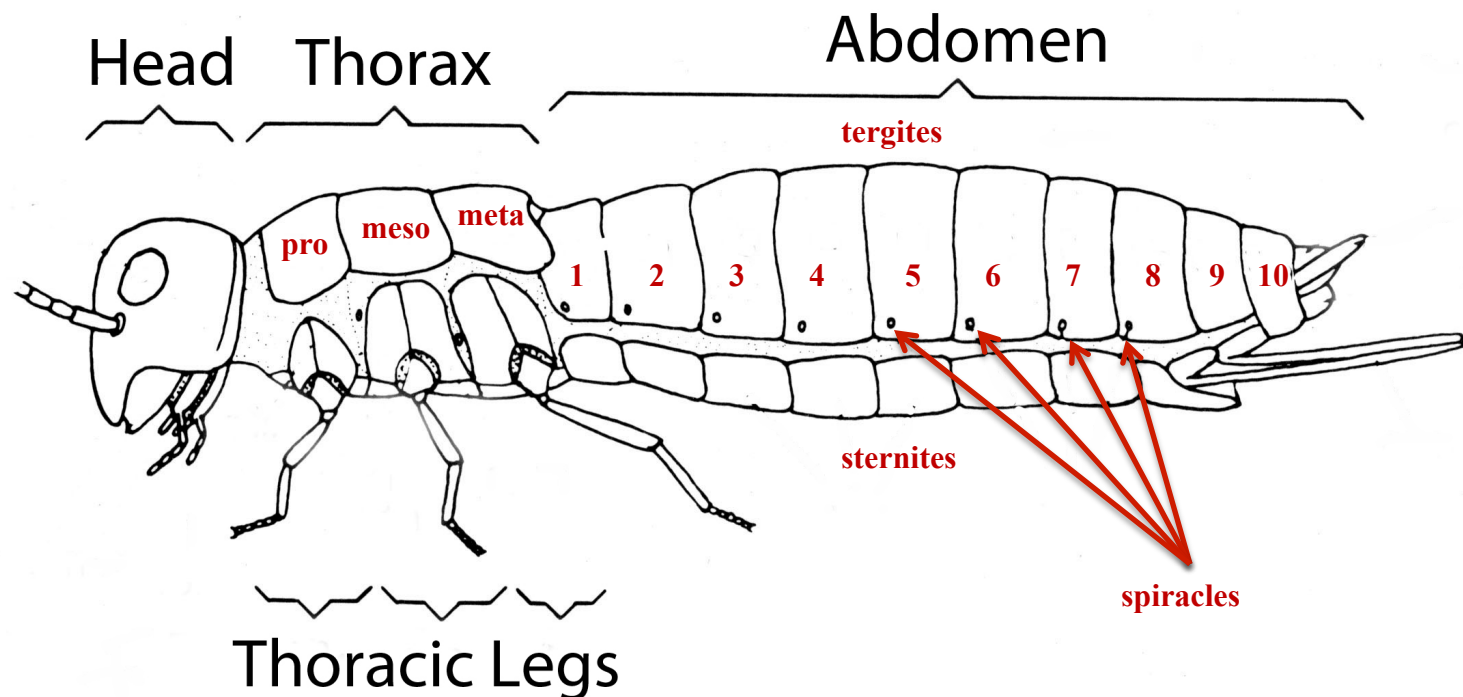
top (or dorsal) – nota (pronotum, mesonotum, metanotum)

Abdomen

six to ten segments

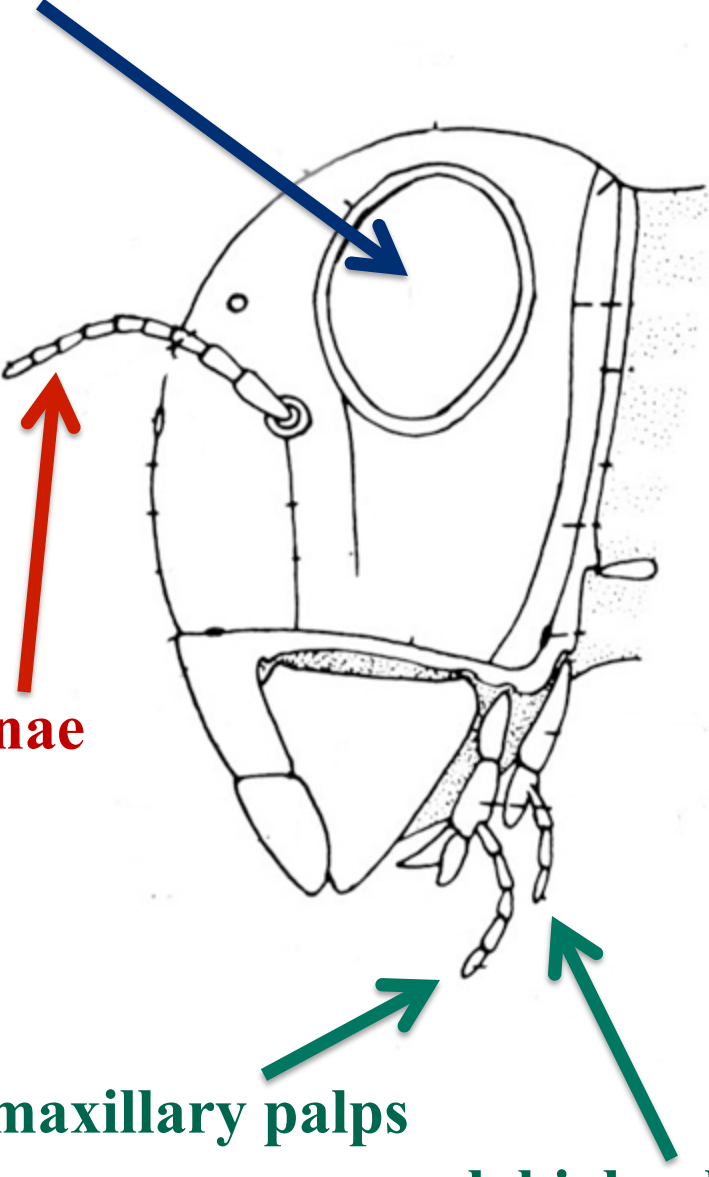
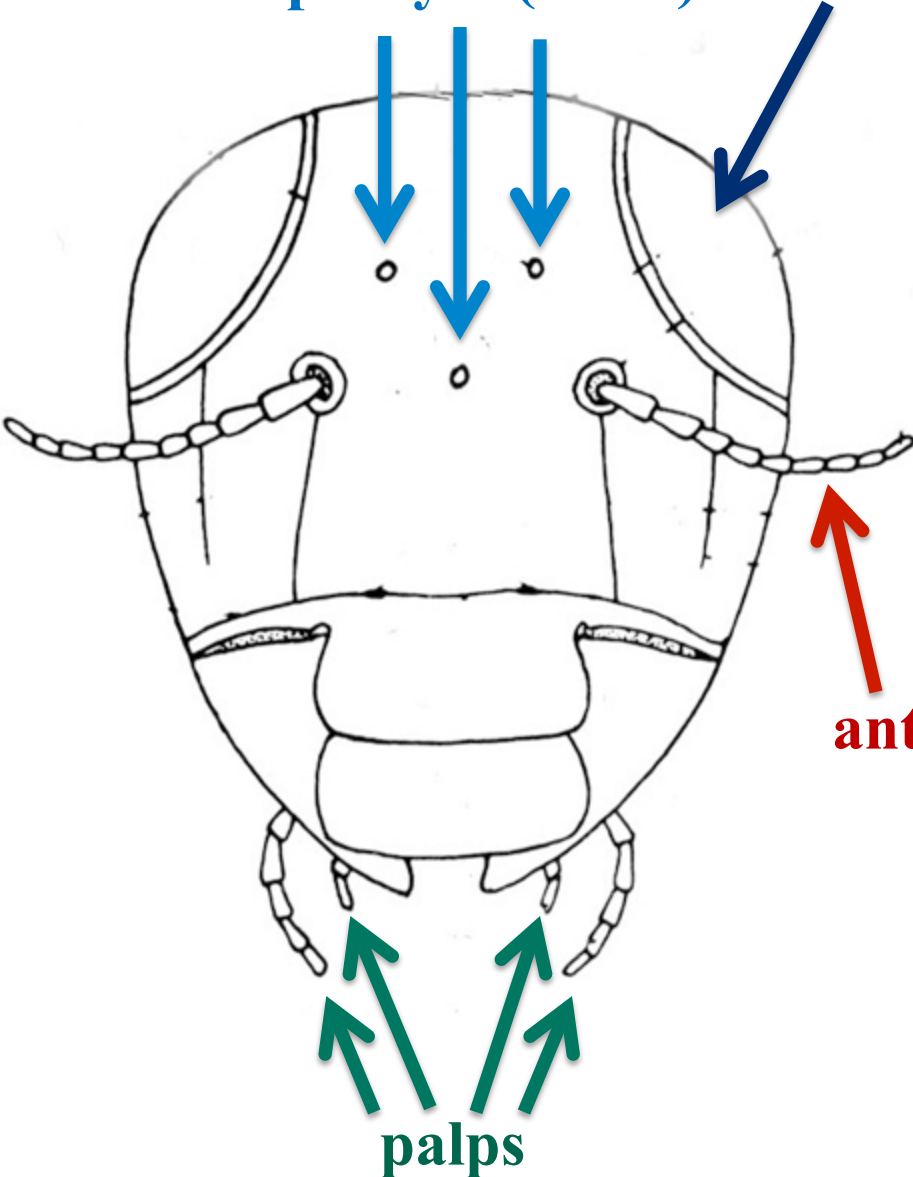
top = tergites, bottom – sternites

Spiracles = holes attached to tracheal tubes that deliver oxygen



simple eyes (ocelli)

compound eyes



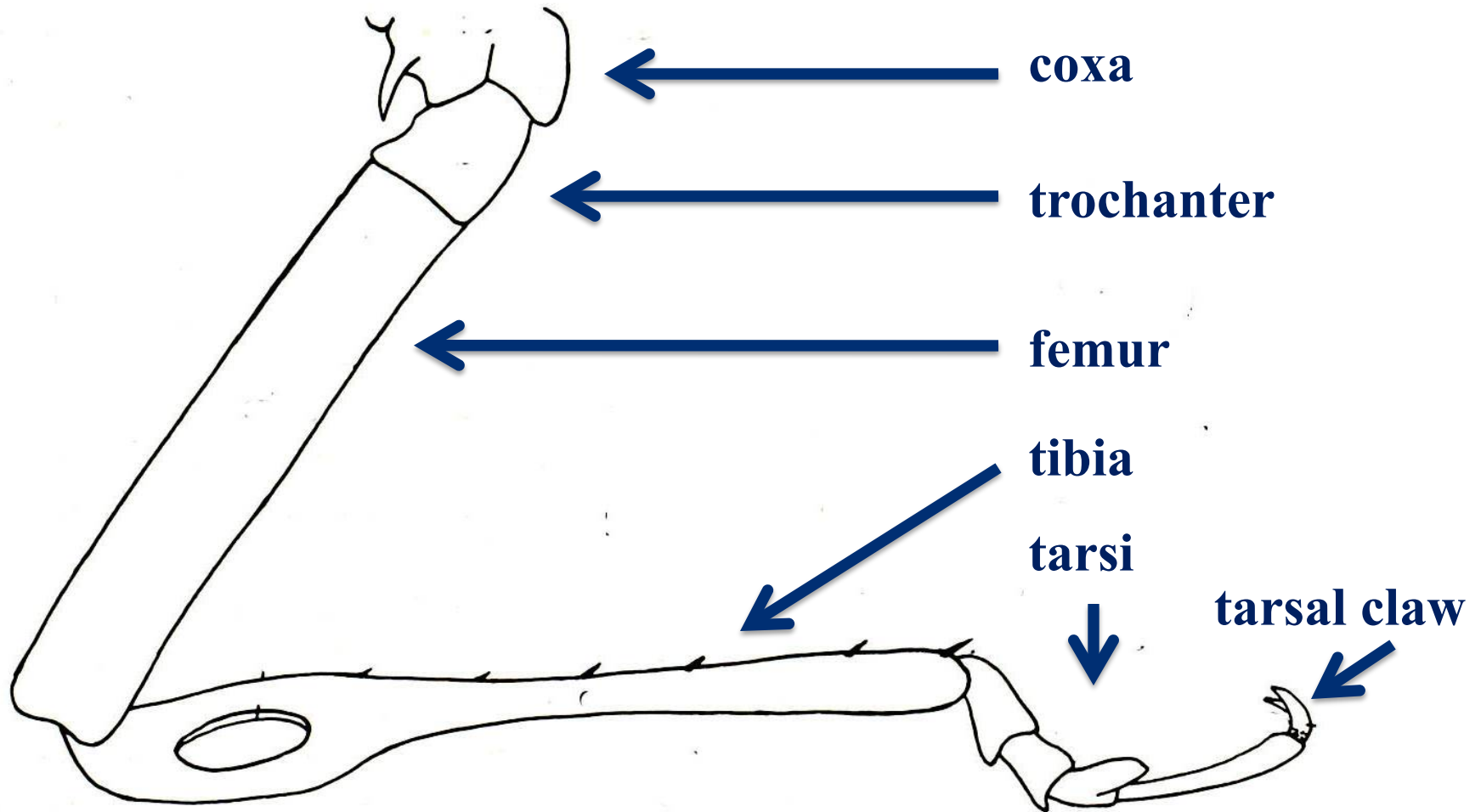
antennae

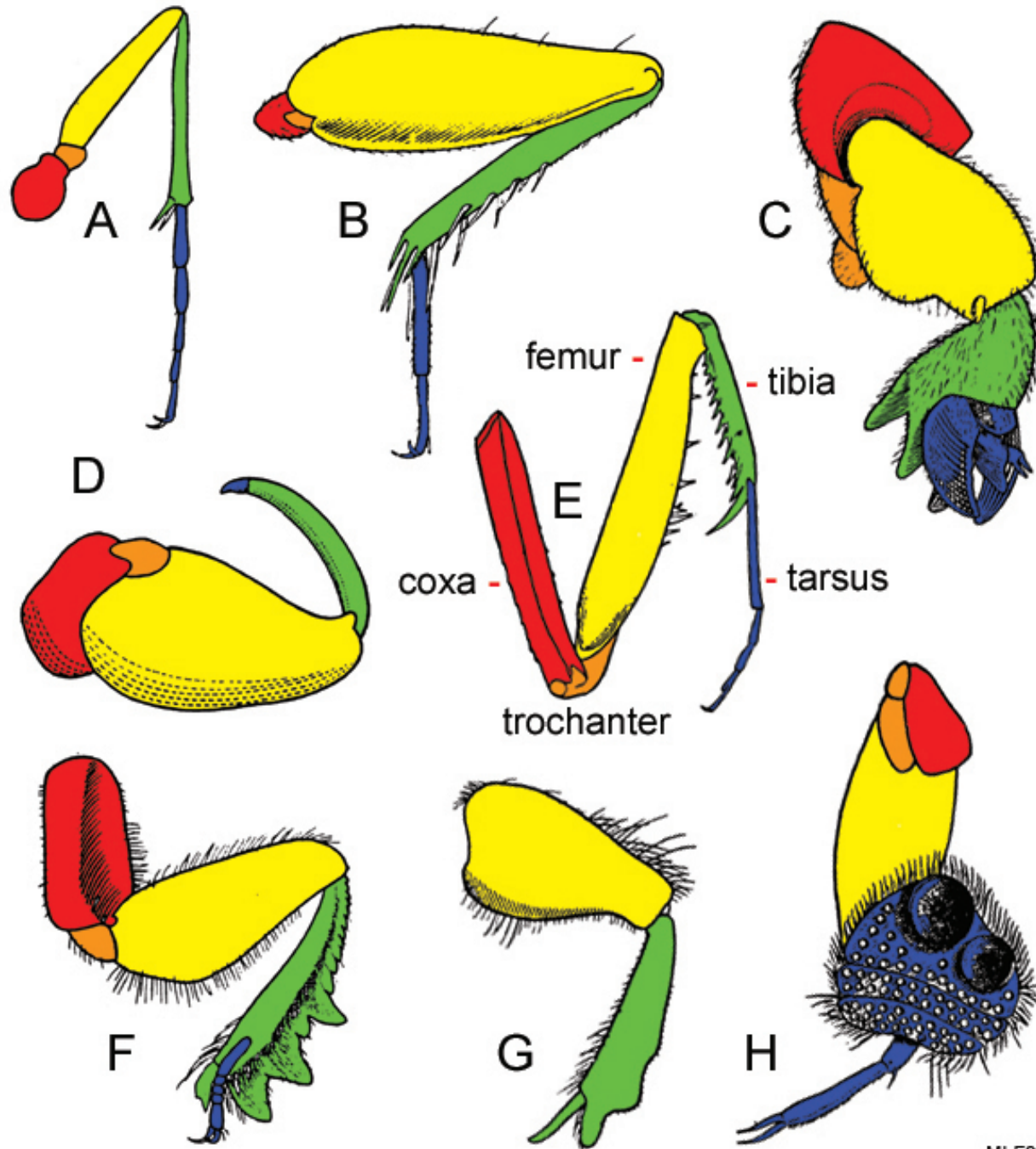
maxillary palps

labial palps

palps

The Insect Leg





The Limits of Insects



Smallest: Fairyflies

Live inside the eggs
of other insects



Largest:

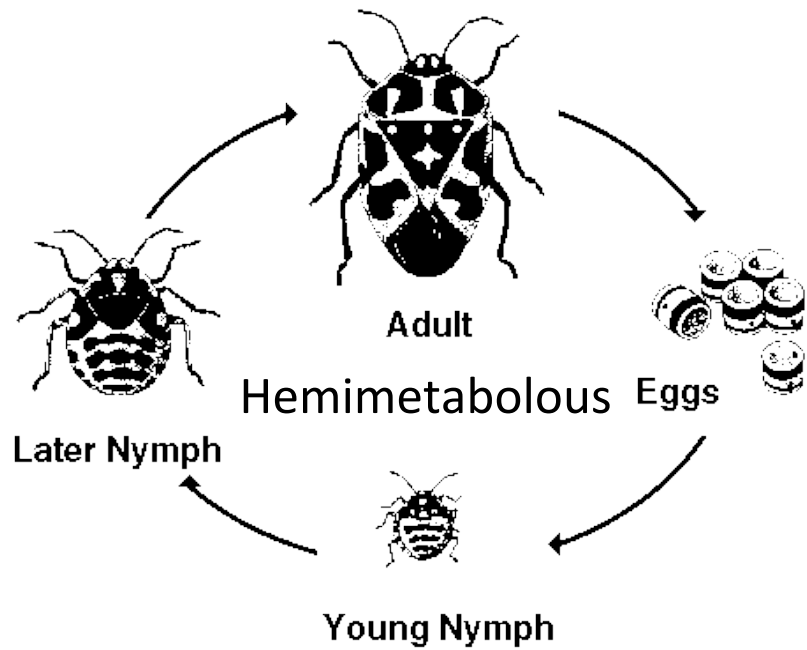
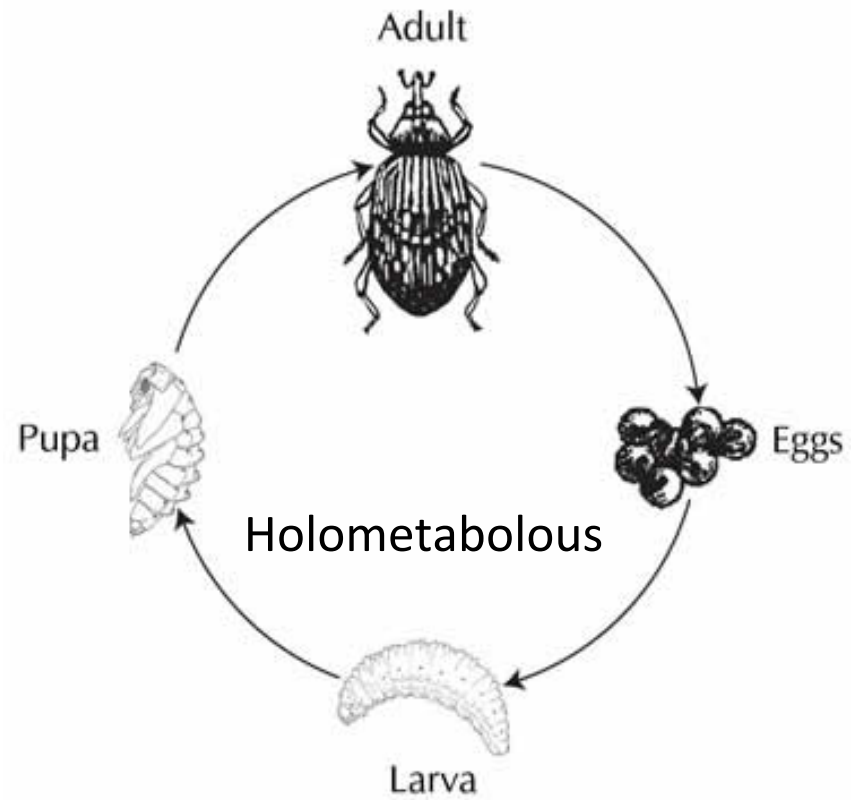
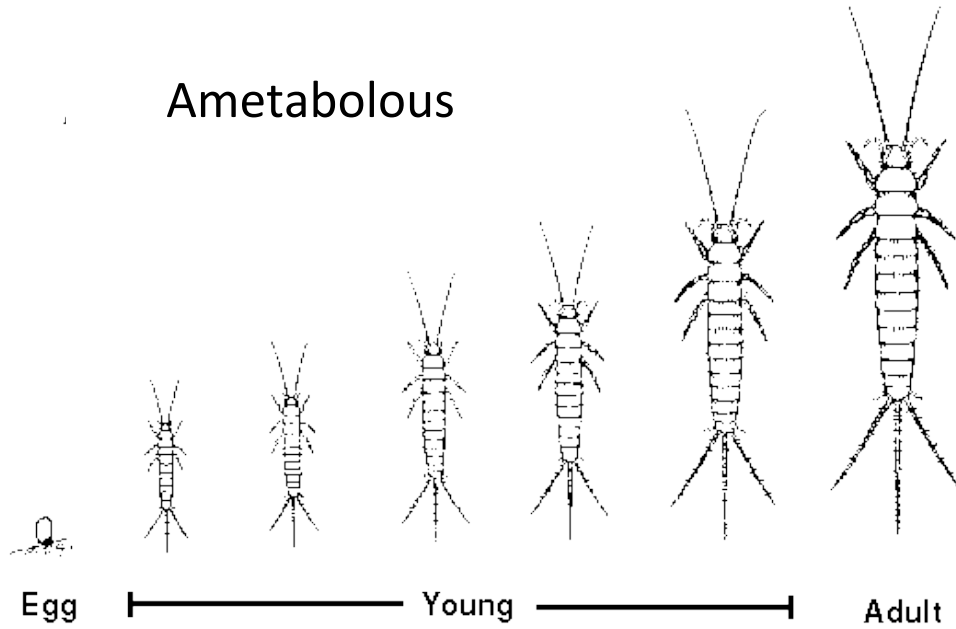
Atlas moth (above) – 10 inch wingspan

Goliath Beetle (left) – up to 1.8 ounces



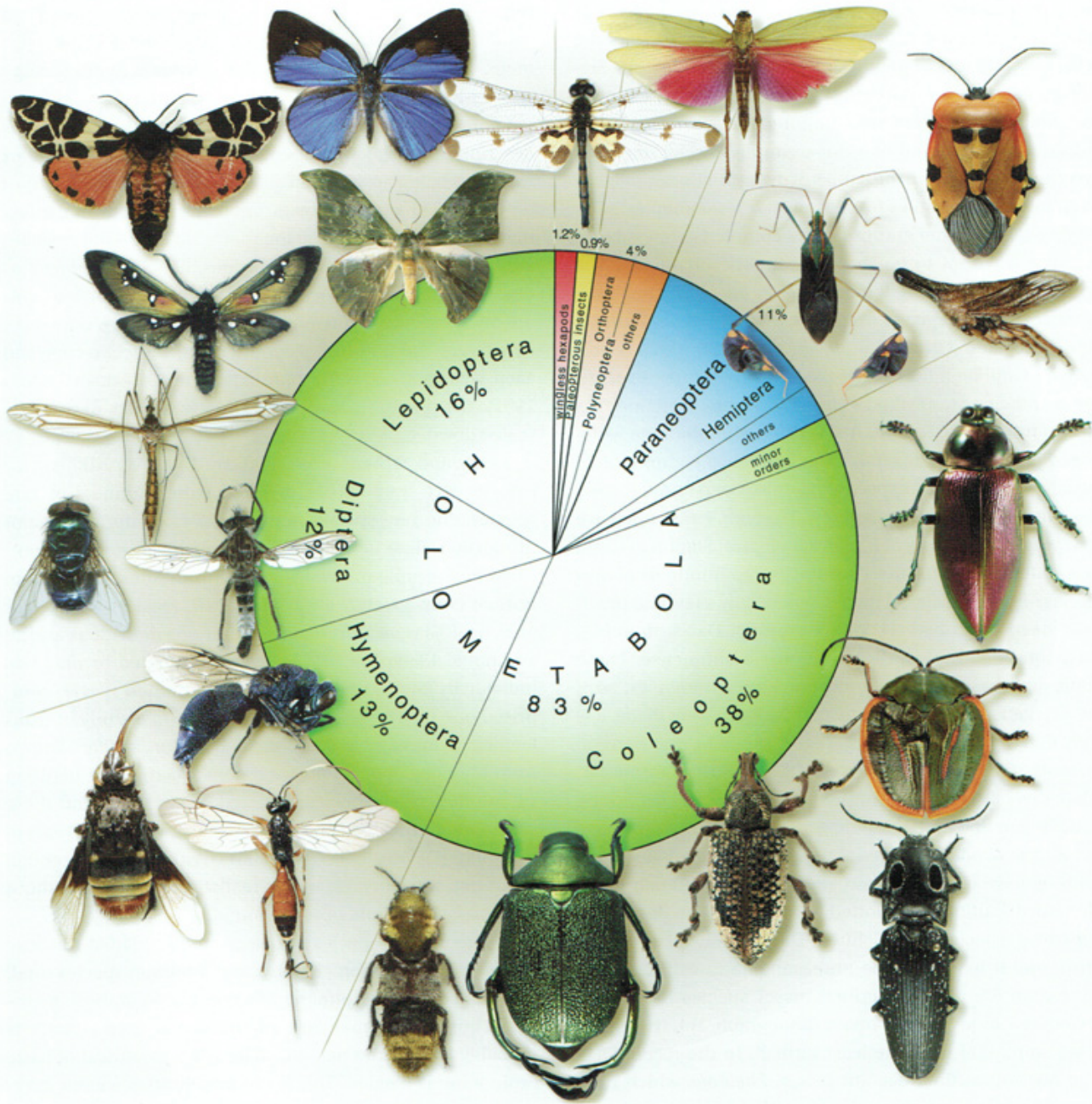
Life Cycles

Ametabolous



Life Cycles

- Ametabolous
 - Springtails, Silverfish, Jumping Bristletails
- Hemimetabolous
 - Crickets, Earwigs, Mantids, True Bugs
- Holometabolous
 - Beetles, Butterflies & Moths, Bees & Wasps, Flies



What do insects do?
(for us)
(against us)

Pollination



Plant pest control



Insect pest control



Decomposition



Food for other animals



Provide honey, wax, and silk



Vectoring diseases



Eating agricultural plants




Destroying forests





Infesting stored products



 University of Nebraska
Department of Entomology



Functional Groups

It is often easier to talk about groups in terms of how they function in the environment (predator, herbivore, etc.). But keep in mind these are somewhat artificial distinctions. What they all have in common is they eat something.

Herbivores



Decomposers

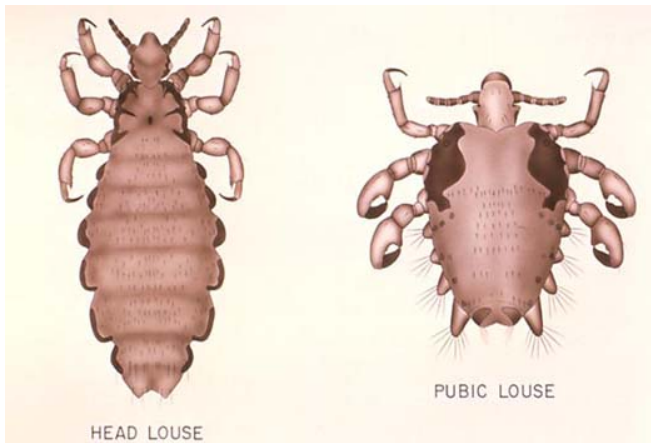


Pollinators



- Parasites – feed on host without killing
- Parasitoid – feed in or on host, eventually killing
- Predators – killing and eating outright

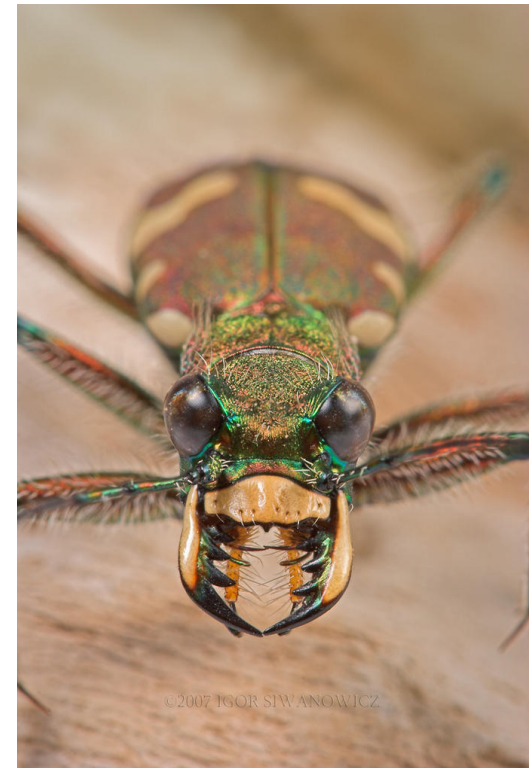
Parasites



Parasitoids

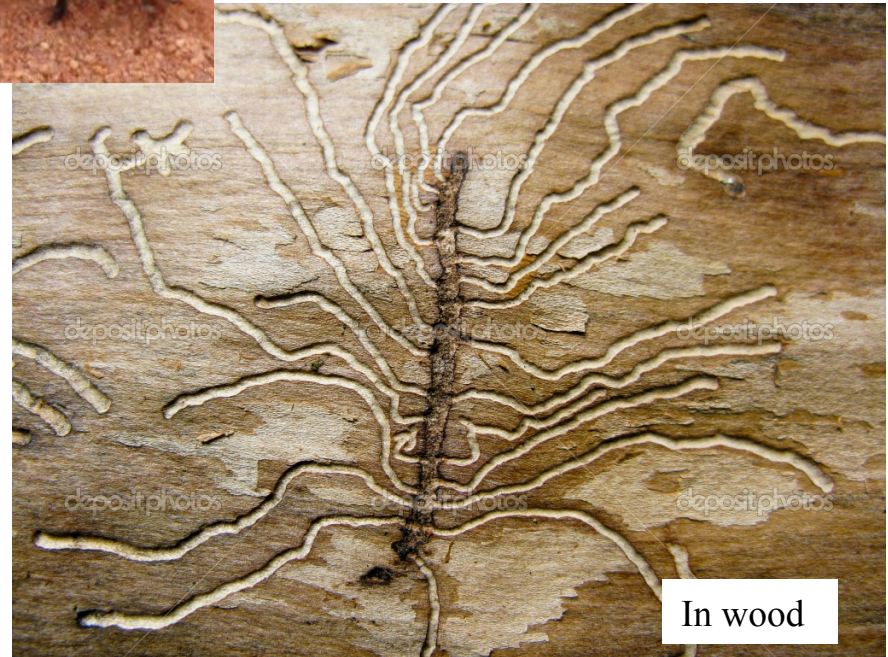
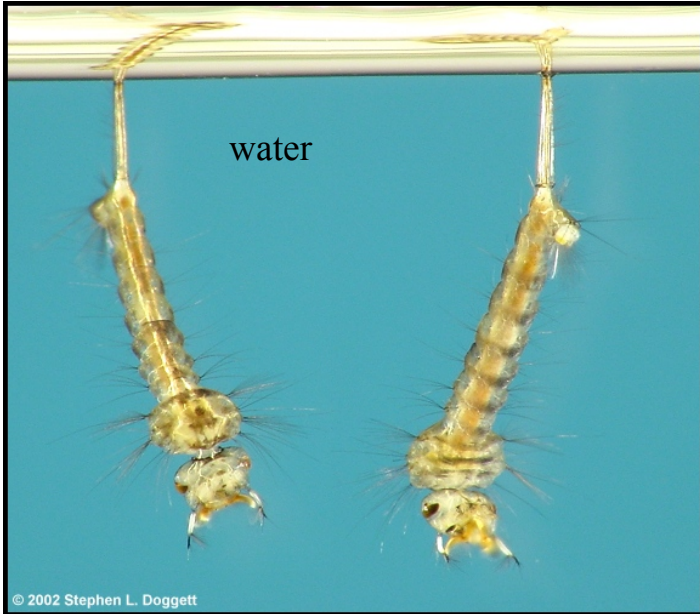


Predators



Where do insects live?

Habitats



What's eating you?



Herbivory



Function groups and signs of feeding

Pollinators



Leaf chewing



Caterpillars (Lepidoptera)



Leaf beetles (Chrysomelidae)



UGA900504



UGA5255035



Weevils

(Curculionidae)



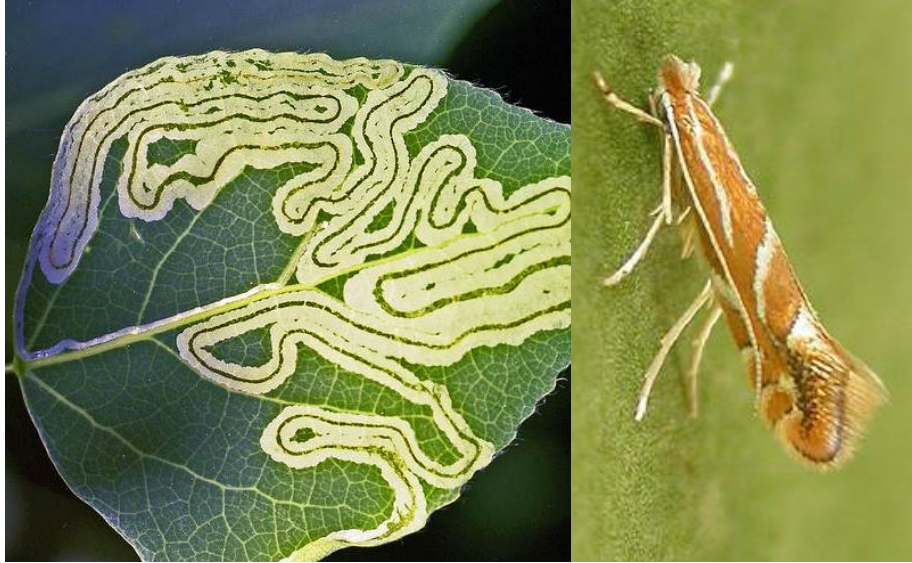
Black vine weevil damage



Leaf rollers (several families of caterpillars)



Leaf mining



Gracillariid moths



Nepticulid moth



Leaf mining flies (Agromyzidae)



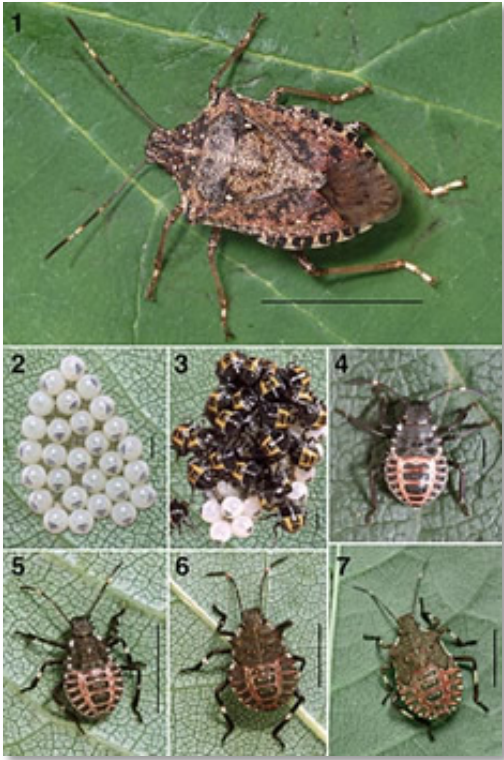
Sap sucking



→ brown marmorated stink bug

← glasswing sharpshooter

↓ oleander aphid



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Tending by ants

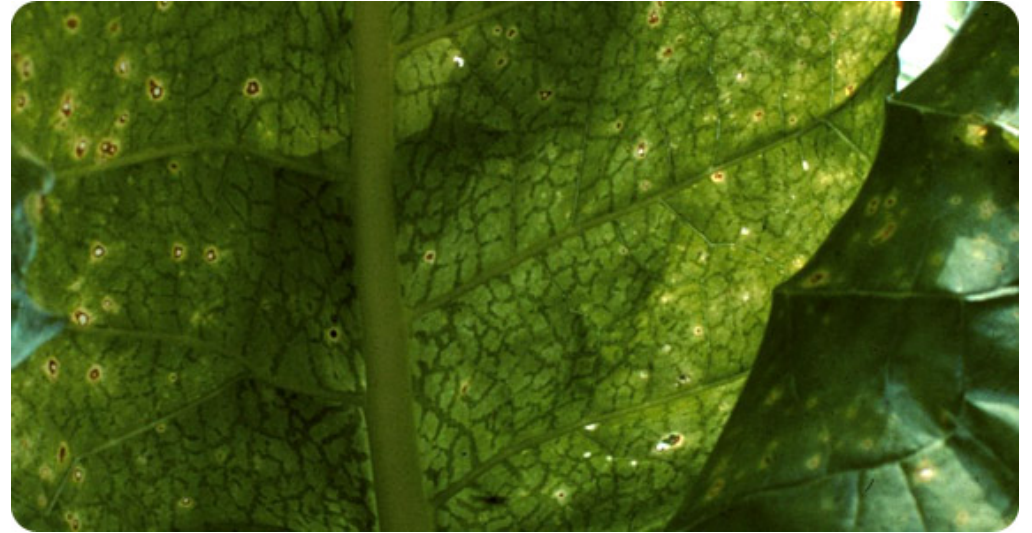




Damage caused by sap suckers



Pierce's disease from sharpshooter



speckling & chlorosis



brown marmorated stink bug damage





Sooty mold



Deformities caused by feeding



Galls



What causes a gall?

- Fungi (example: rust fungi)
- Bacteria & Viruses
- Parasitic plants (example: mistletoe)
- Insects & other arthropods
 - Nematodes
 - Mites (Eriophyidae)
 - Jumping plant lice (Psylloidea)
 - Scales (Coccoidea)
 - Aphids (Aphididae)
 - Moths (Gelechiidae)
 - Flies (Cecidomyiidae)
 - Wasps (Cynipidae)



Nematode galls on celery roots



Mites galls on maple leaves



Psyllid gall on hackberry leaves



Aphid galls on poplar petioles

Cynipid wasp galls



Seed boring





Stem boring



Weevils

(Curculionidae)



A. Nkakwa Attey

Squash vine borer



Under bark / In wood



Emerald ash borer





Wood boring moths
(family Cossidae)

Wood boring wasps (“sawflies”)
(family Siricidae)



Field Trip

&

Museum Visit

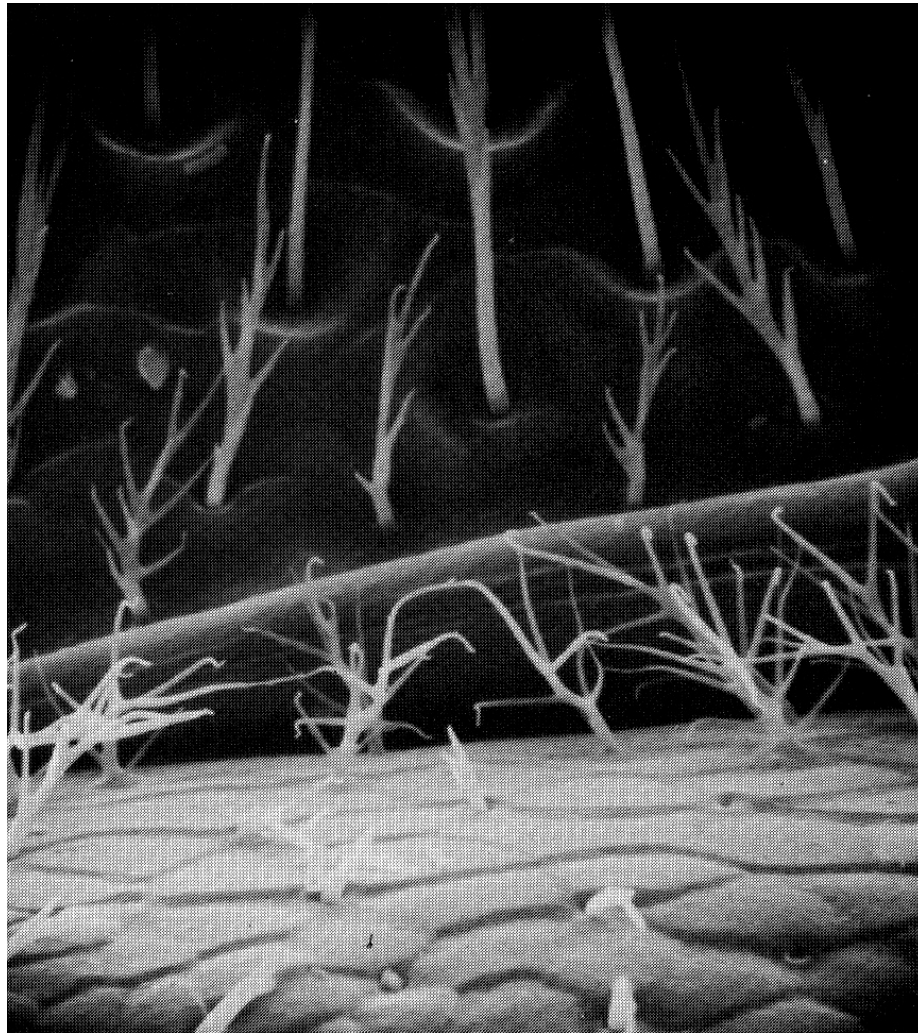
Pollination





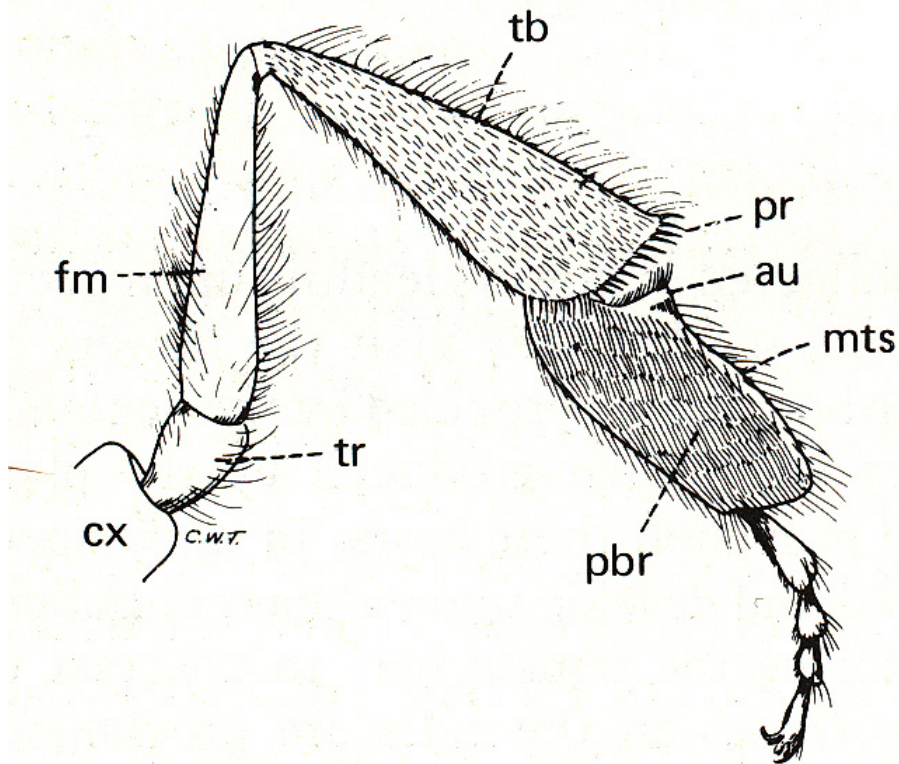
Morphological adaptations

- Branched hairs (Hymenoptera: Apoidea)



Morphological adaptations

- Modified legs (Hymenoptera: Apoidea)
 - Brush, Comb (rake), Corbicula (pollen basket)



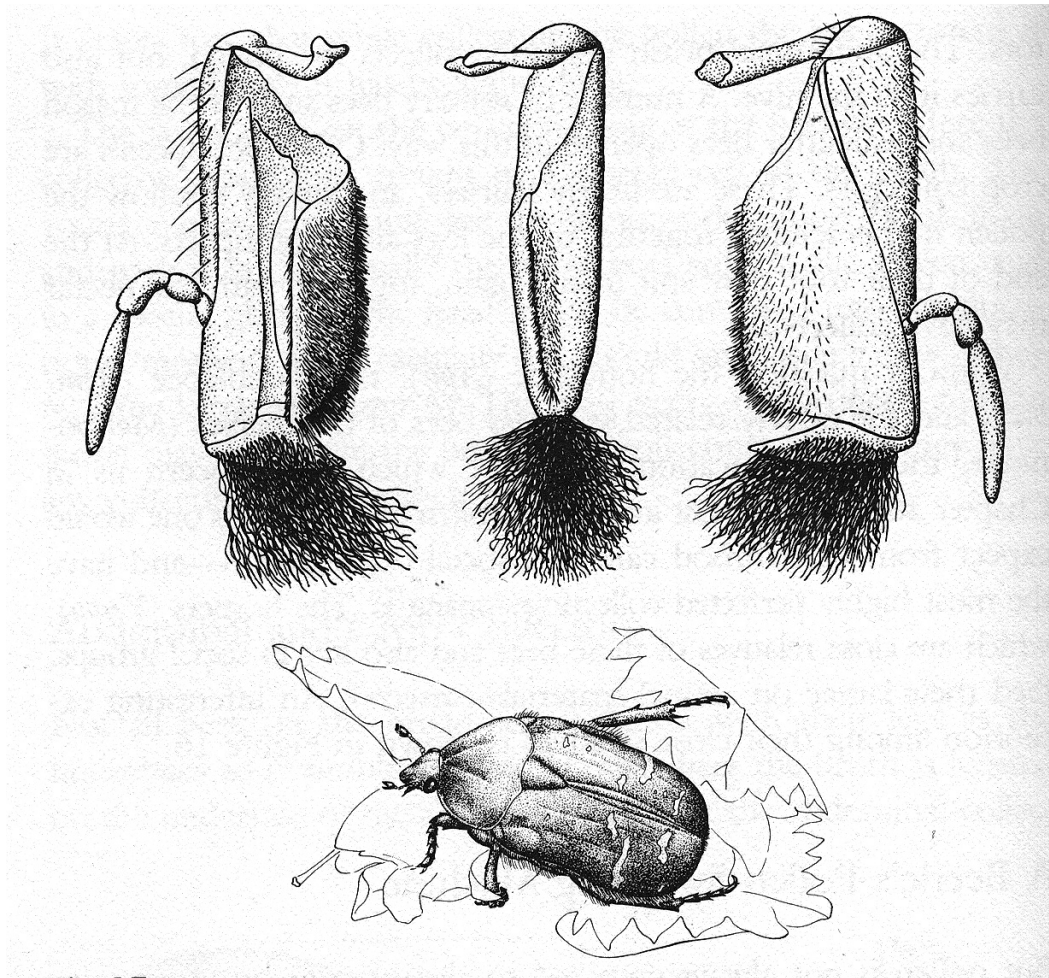
Morphological adaptations

- Scopa (small, dense tuft of hairs)
 - Hymenoptera: Apoidea,
 - Coleoptera: Cerambycidae, Scarabaeidae

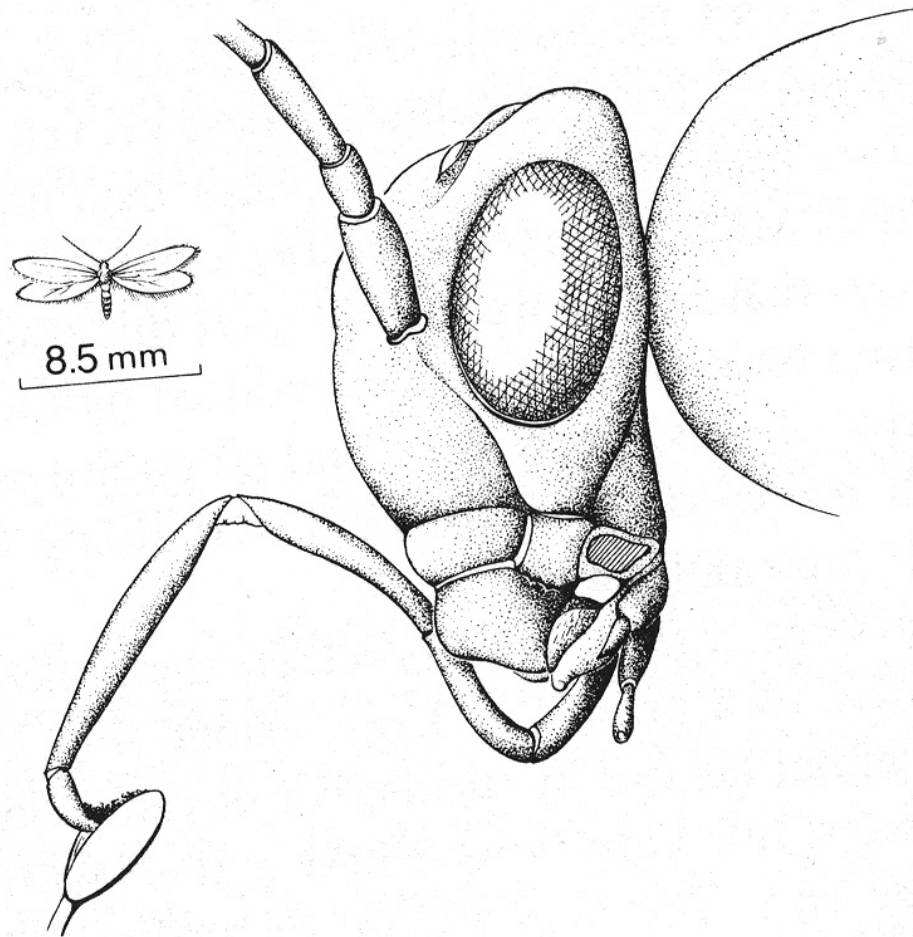


Morphological adaptations

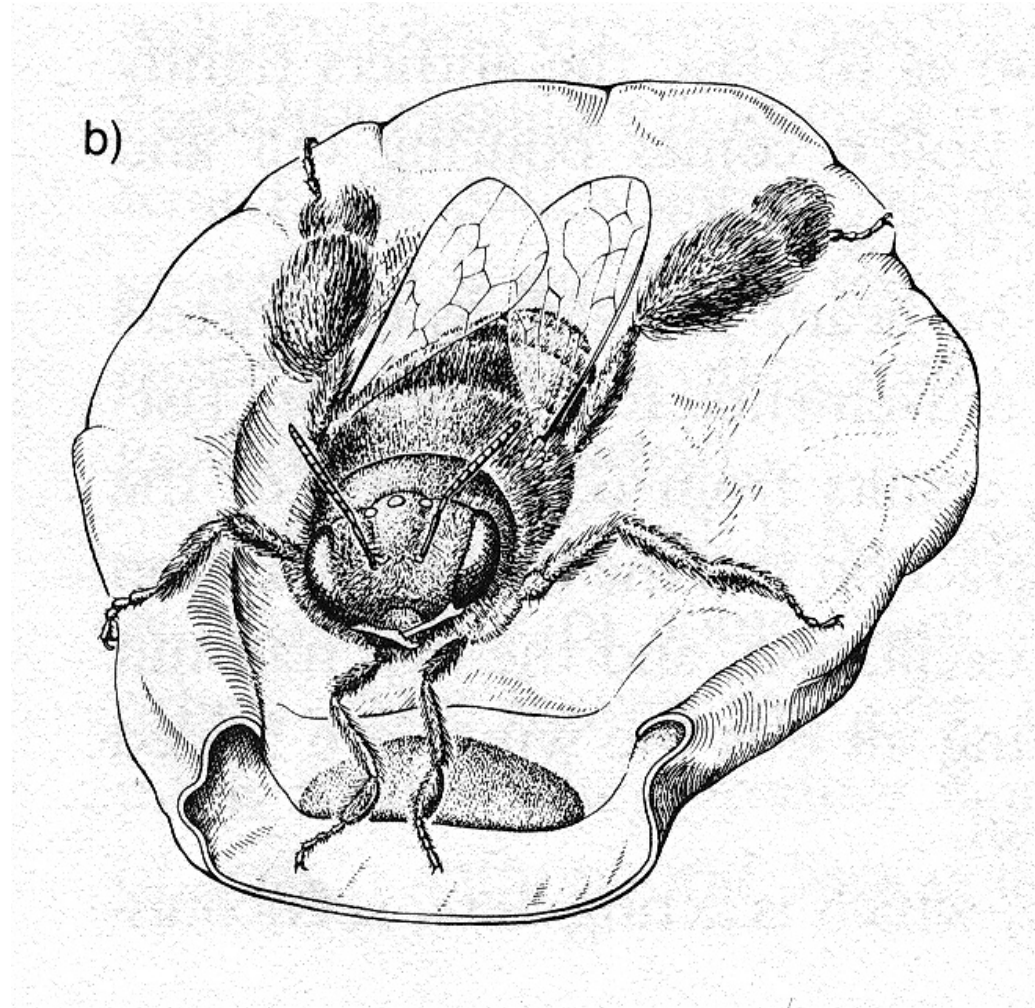
- “Pollen brooms”
 - Rose chafer, *Cetonia aurata* (Coleoptera: Scarabaeidae)



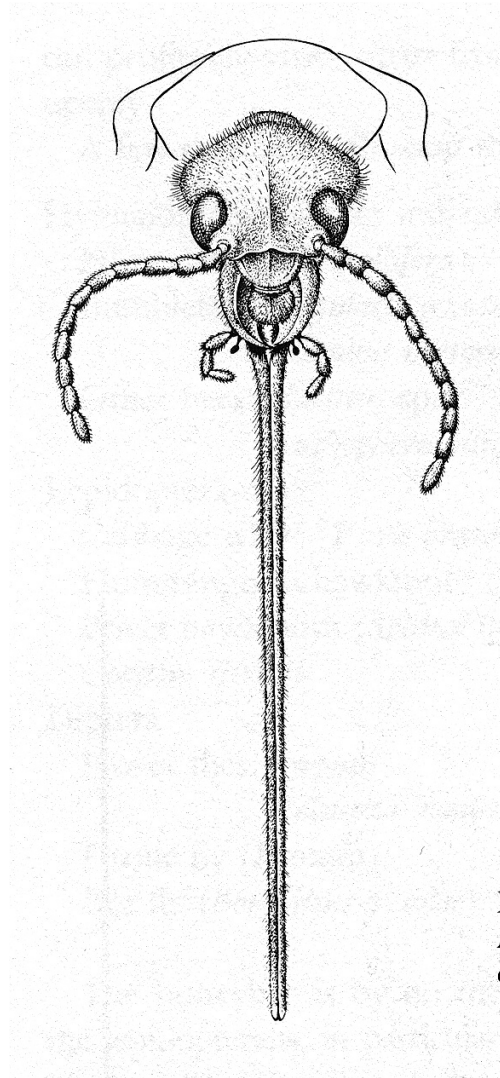
Morphological adaptations



Morphological adaptations

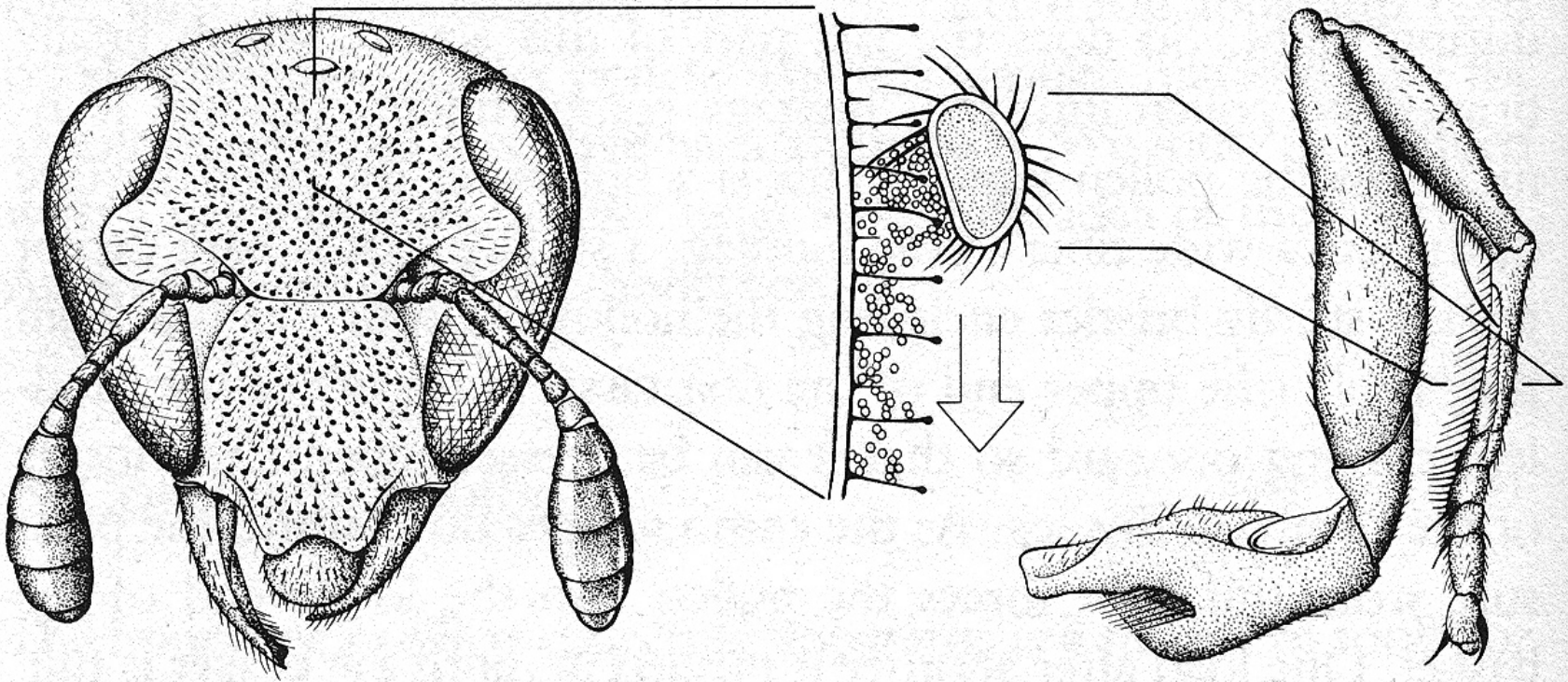


Morphological Adaptations



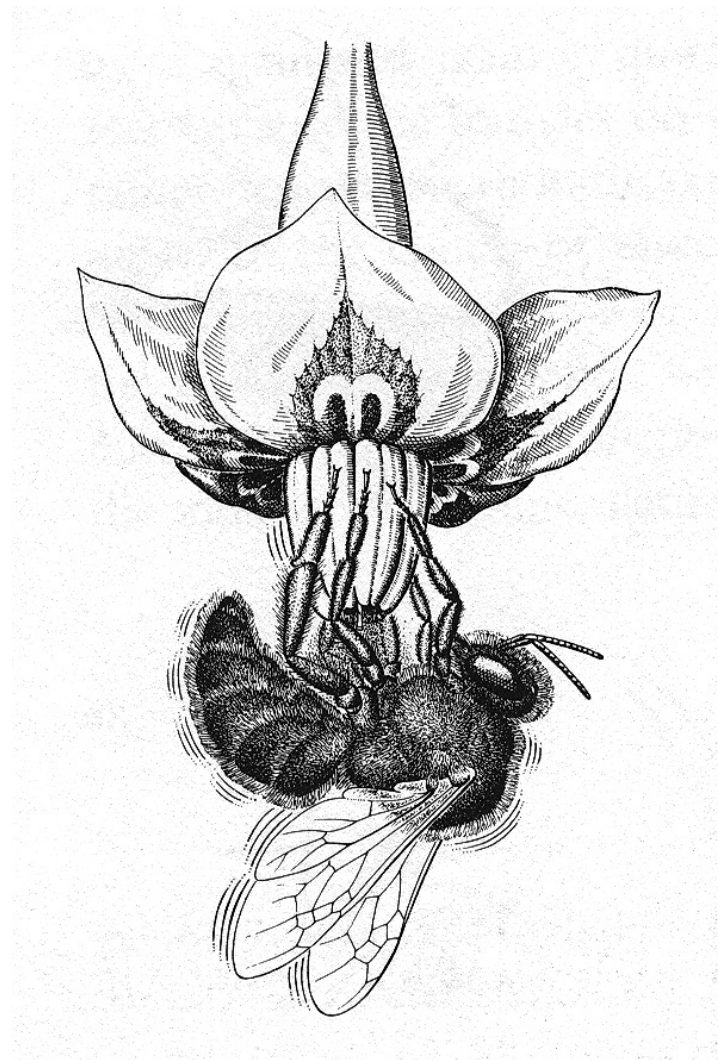
Morphological Adaptations

- Pollen bristles on head and leg comb
 - Hymenoptera: Masaridae (*Celonites abbreviatus*)



Behavioral adaptations

- “Pollen buzzing”
- Waggle dance

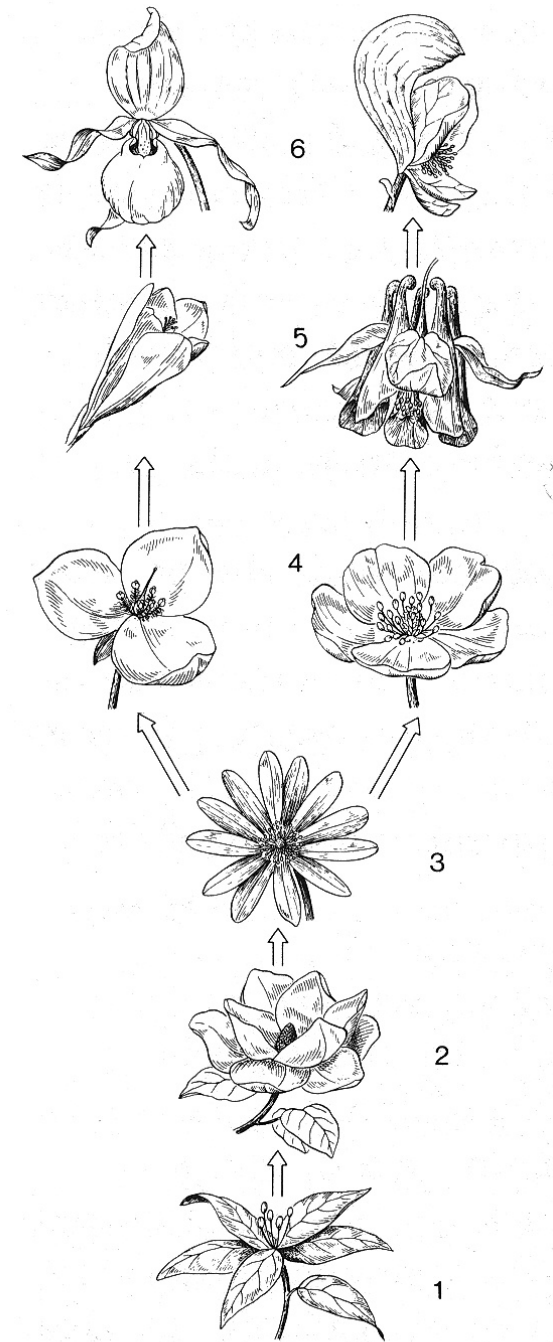


Adaptations - senses

- Color Vision
- Chemoreception

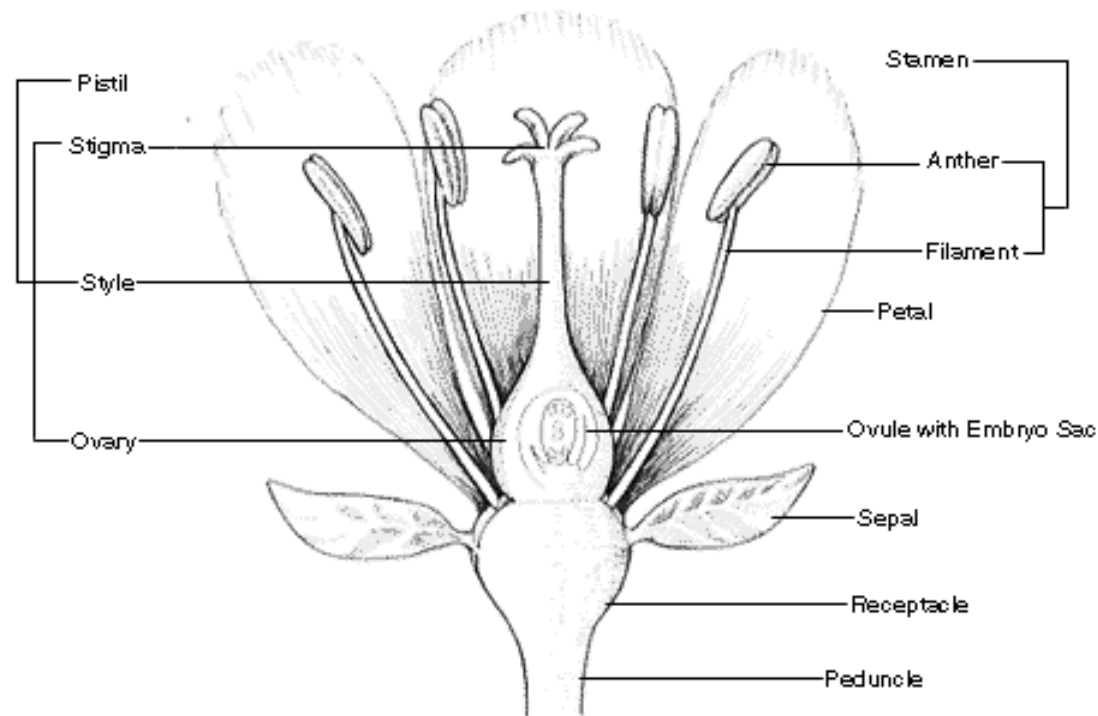
Adaptations of flowers

- Petal shape
 - Open, flat (Coleoptera)
 - Long corolla (Lepidoptera)
 - Bell shapes (Hymenoptera)
- Petal color
 - White, yellow (Coleoptera)
 - Reds, orange (butterflies)
 - White, pale (moths)
 - Yellow, white, blue, UV (Hymenoptera)



Adaptations of flowers

- Nectary glands
 - Secrete sugars, amino acids, lipids,



Adaptations of flowers

- Phenology (timing) of flowering
 - Time of year
 - Time of day
 - Asynchrony of male and female organs
- Excess pollen production



Nectar robbing

Orchids and Wasps



The Fig Wasps

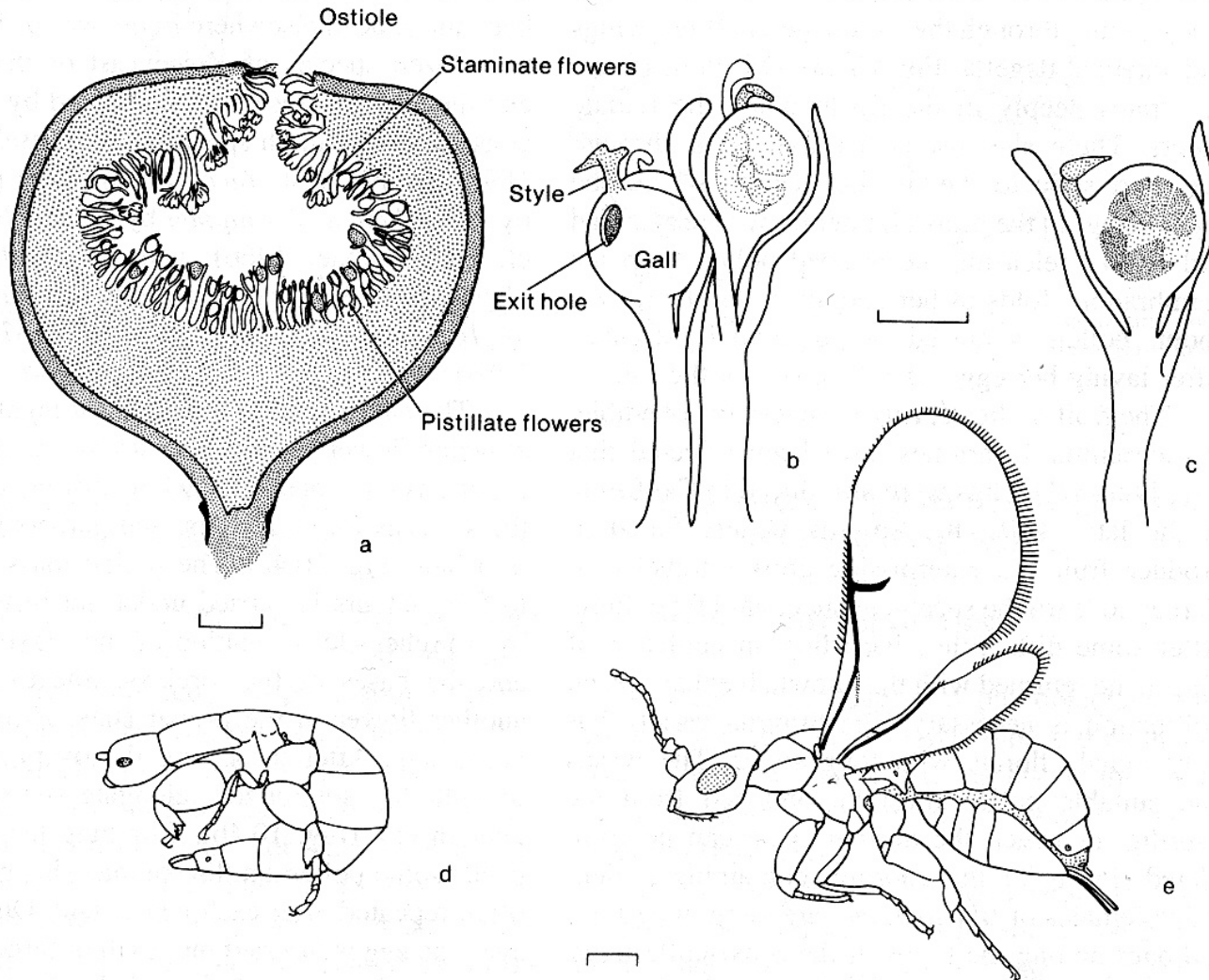


Figure 10.3 Pollination of caprifig by *Blastophaga* wasps (Agaonidae): **a**, caprifig at time of emergence of wasps (scale equals 5 mm); **b**, gall flower with male wasp inside and another with exit hole; **c**, gall flower with female wasp inside (scale for **b** and **c** equals 1 mm); **d**, male of *Blastophaga*; **e**, female of *Blastophaga* (scale for **d** and **e** equals 0.25 mm).

The Yucca Moths

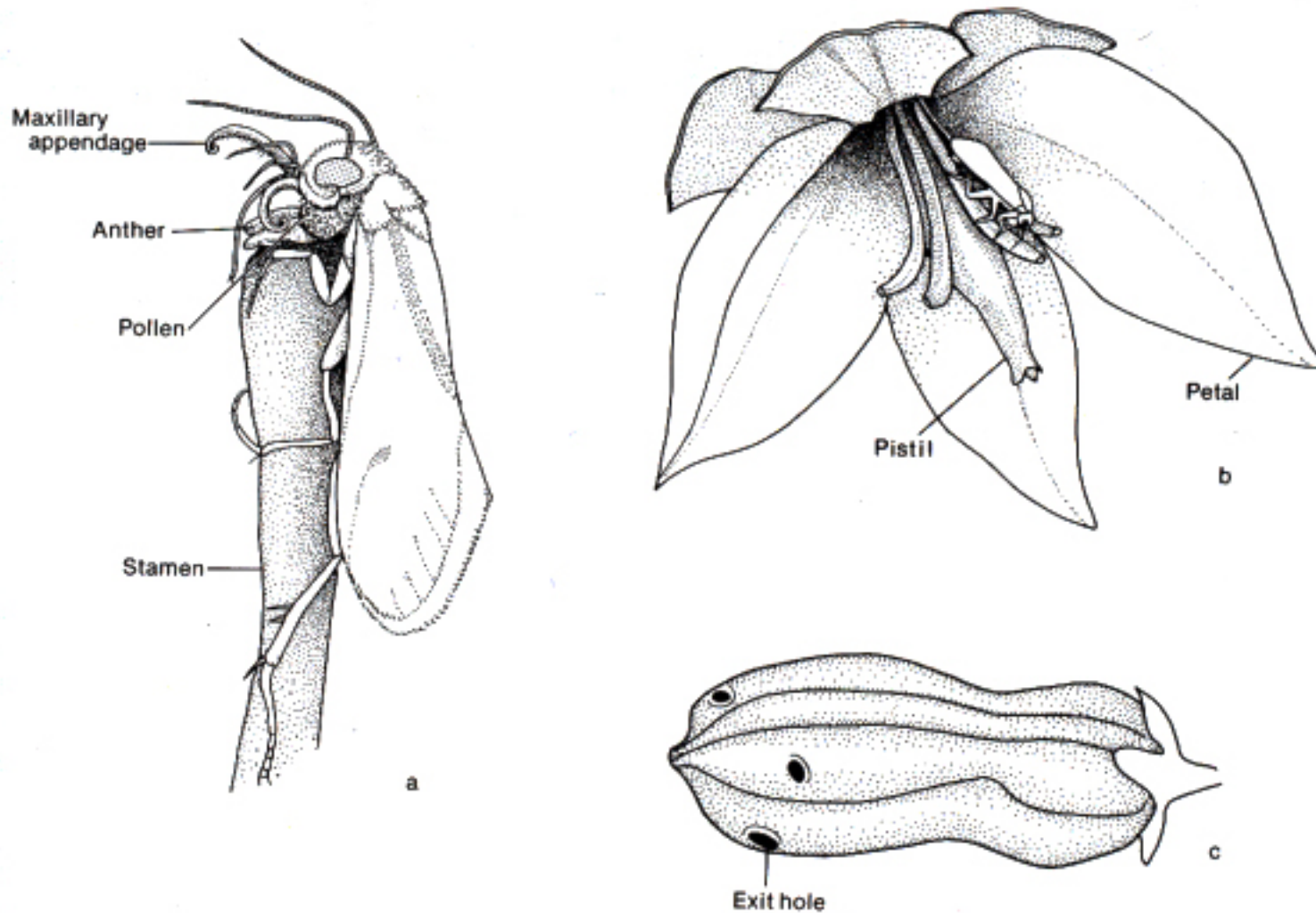


Figure 10.4 Pollination of *Yucca* sp. by *Tegeticula* moths (Incurvariidae): **a**, female of *Tegeticula yuccasella* collecting pollen from anther; **b**, position of female moth during oviposition in ovary of *Yucca*; **c**, mature pod of *Yucca* showing emergence holes. (Redrawn from Riley, 1892.)

Prosoeca (Nemestrinidae) Flies



Thinking in deep time: The evolution of insects

