



✘ Biology of animals



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ARTHROPODA

✘ system

+ Trilobita

+ Pycnogona

+ Chelicerata

+ Myriapoda

+ Crust



University of Nebraska
Department of Entomology



INSECTA

✗ body plan

+ 3 parts

✗ head - caput

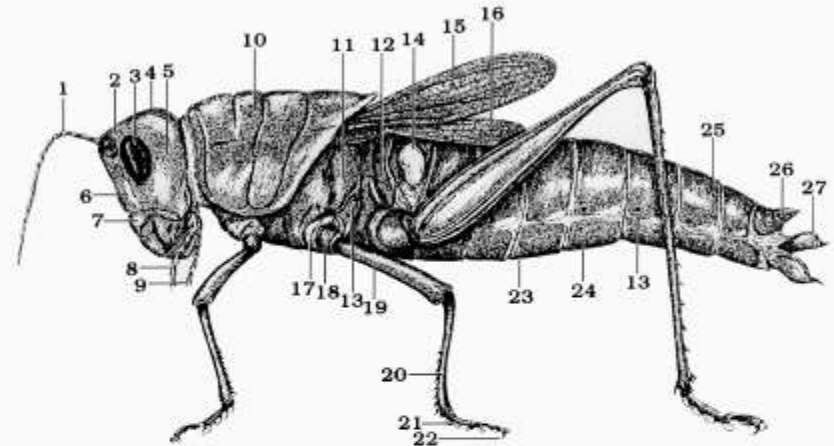
✗ thorax - 3 segments

✗ abdomen

+ size 0,2 mm to 30 cm



GRASSHOPPER ANATOMY External



- | | |
|-------------------|----------------------|
| 1. Antenna | 17. Coxa |
| 2. Ocellus | 18. Trochanter |
| 3. Compound eye | 19. Femur |
| 4. Vertex | 20. Tibia |
| 5. Gena | 21. Tarsus |
| 6. Frons | 22. Claw |
| 7. Clypeus | 23. Abdomen |
| 8. Maxillary palp | 24. Sternum |
| 9. Labial palp | 25. Tergum |
| 10. Prothorax | 26. Cercus |
| 11. Mesothorax | 27. Ovipositor |
| 12. Metathorax | 28. Labrum |
| 13. Spiracle | 29. Mandible (right) |
| 14. Tympanum | 30. Maxilla (right) |
| 15. Fore wing | 31. Hypopharynx |
| 16. Hind wing | 32. Labium |

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+ head

× 6 segments

× eyes

× antennae

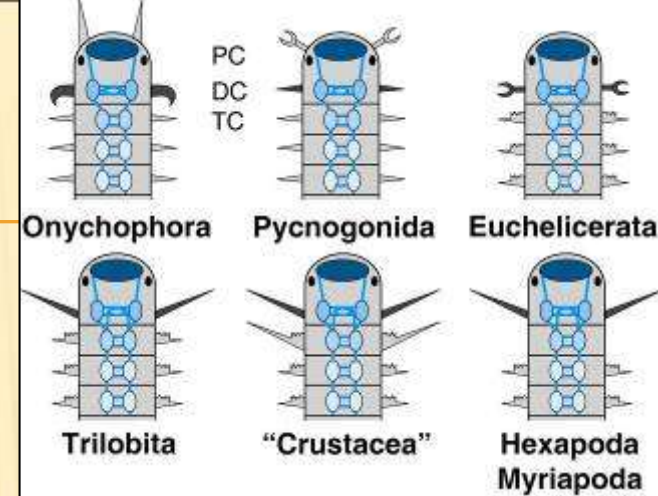
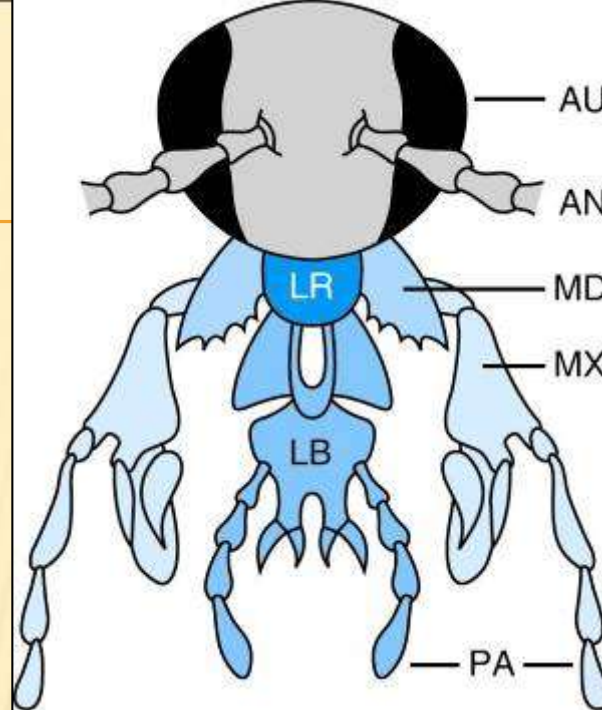
× -

× mandibles

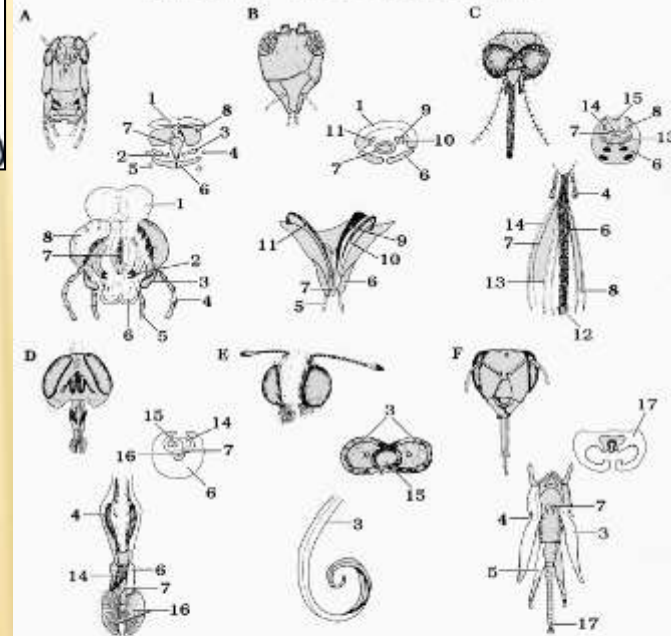
× maxillae (palpi maxillares)

× labium (palpi labiales)

× modifications



INSECT MOUTH PARTS



A. Chewing (Grasshopper)
 B. Rasping-sucking (Thrip)
 C. Piercing-sucking (Mosquito)
 D. Sponging (Fly)
 E. Siphoning (Butterfly)
 F. Chewing-lapping (Bee)

1. Labrum
 2. Lacinia
 3. Galca
 4. Maxillary palp
 5. Labial palp

6. Labium
 7. Hypopharynx
 8. Mandible
 9. Left mandible
 10. Maxillary stylet
 11. Right maxilla
 12. Labelium
 13. Maxilla
 14. Labrum-epipharynx
 15. Food channel
 16. Labellar lobes
 17. Glossa

INSECTA

✗ stavba těla

+ thorax

✗ 3 segments, legs

✗ 2 wing pairs

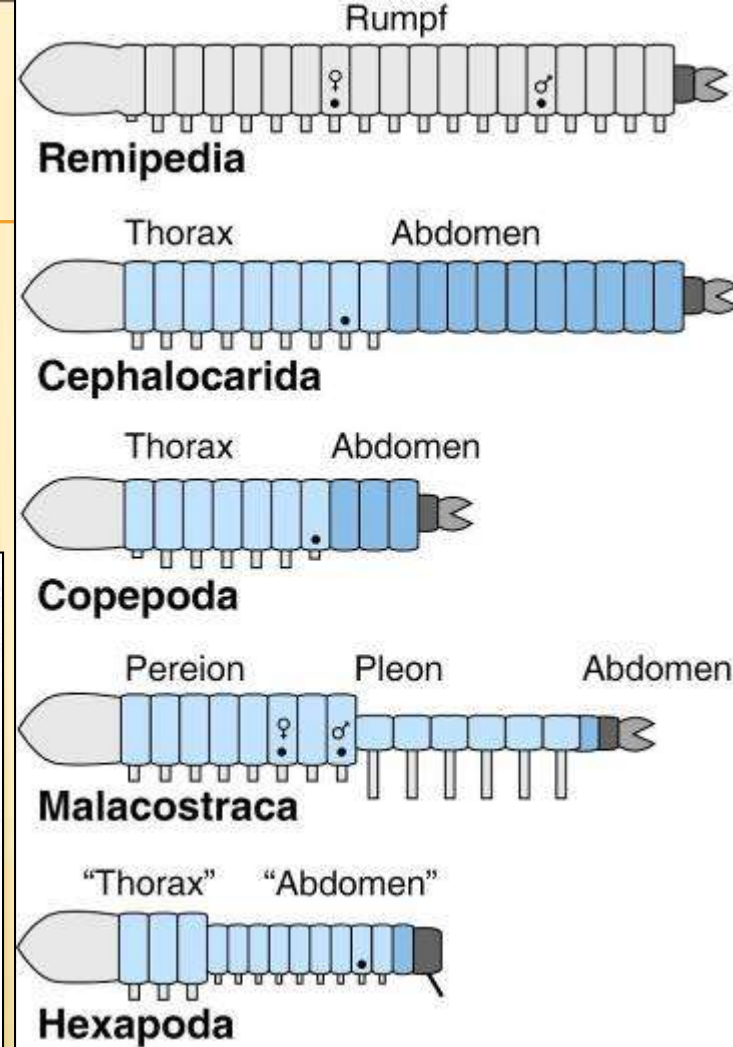
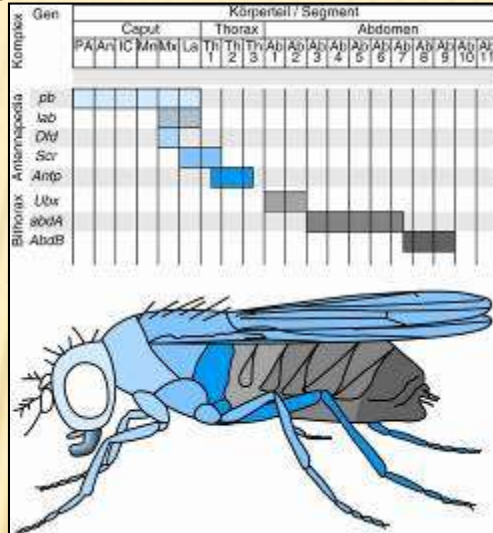
+ abdomen

✗ appendages

★ cerci

★ gonopods = ovipositor

★ sting



INSECTA

✗ leg

✗ coxa

✗ trochanter

✗ femur

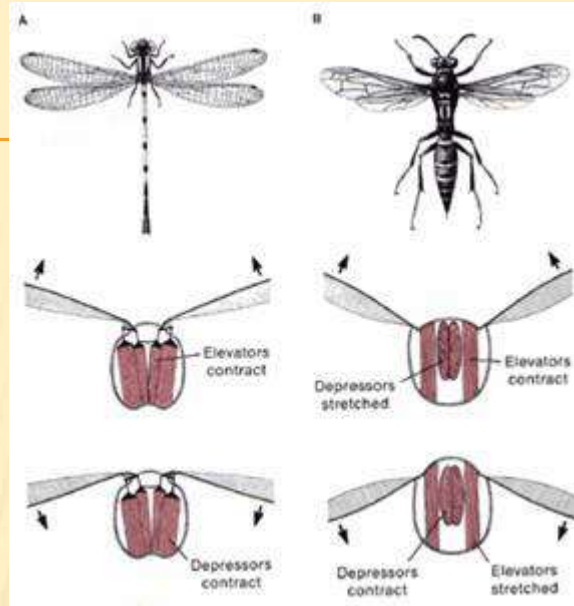
✗ tibia

✗ tarsus

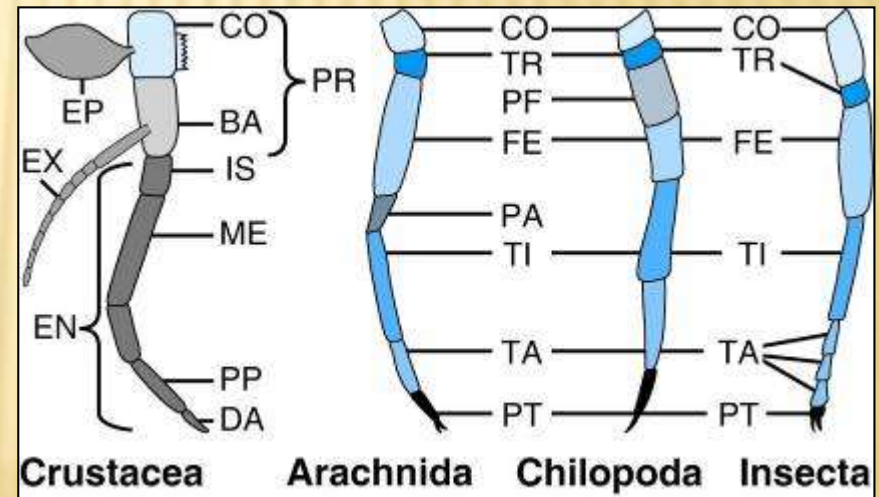
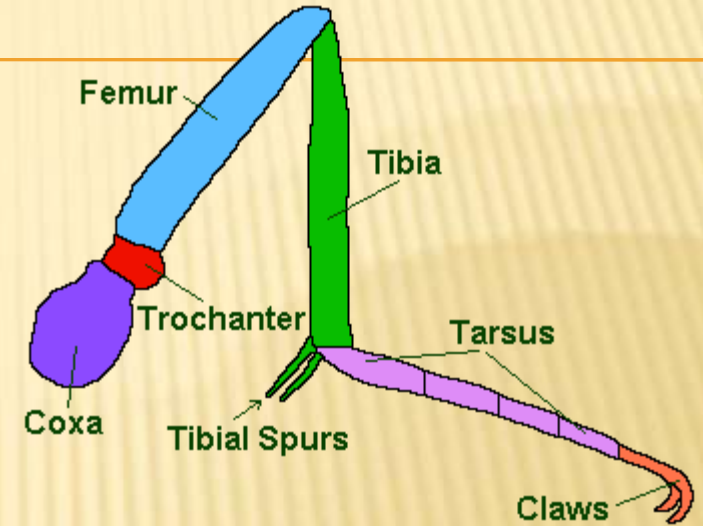
✗ pretarsus: claws, arolium

✗ wings

+ flight



The Insect Leg



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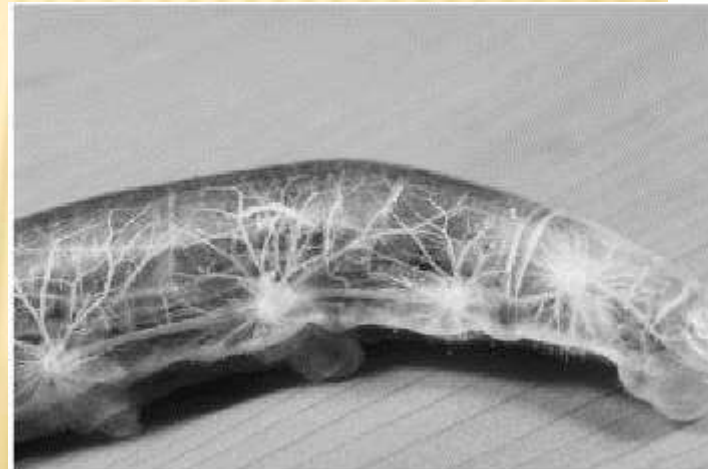
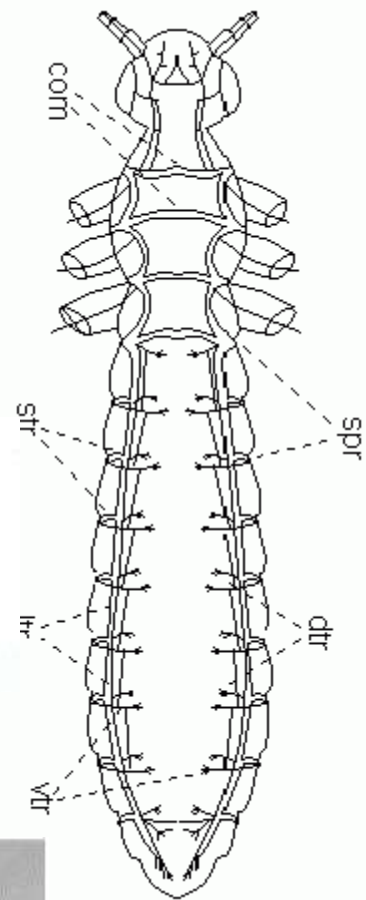
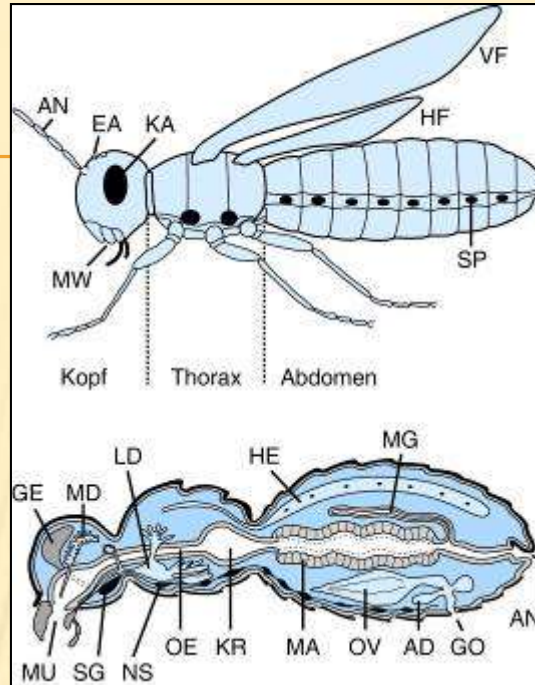
✗ respiration

+ tracheae

✗ spiracles

✗ plastron

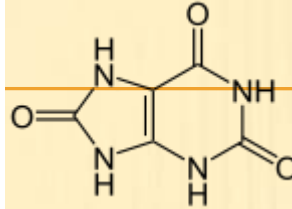
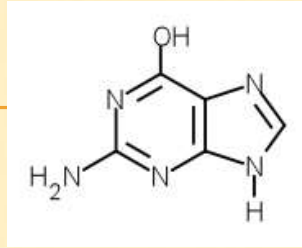
✗ gills



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✘ excretion

- + Malpighi tubules
- + guanin and uric acid



✘ reproduction

- + gonochorists



- ✘ parthenogeny
- ✘ sex determination

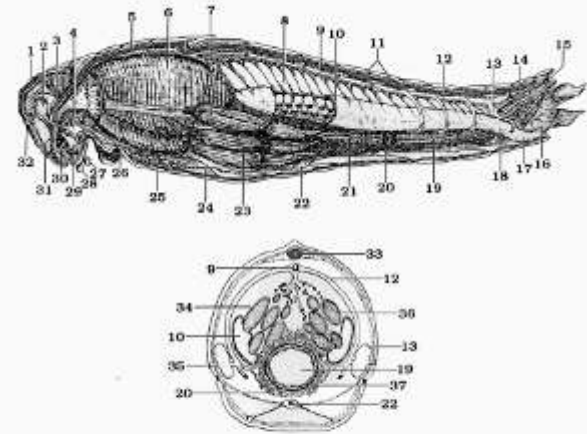


- ★ *Drosophila*: F XX, M XY (or XO)
- ★ *Abraxas*: F WZ, M WW
- ★ Hymenoptera: F AA, M A (haploid)



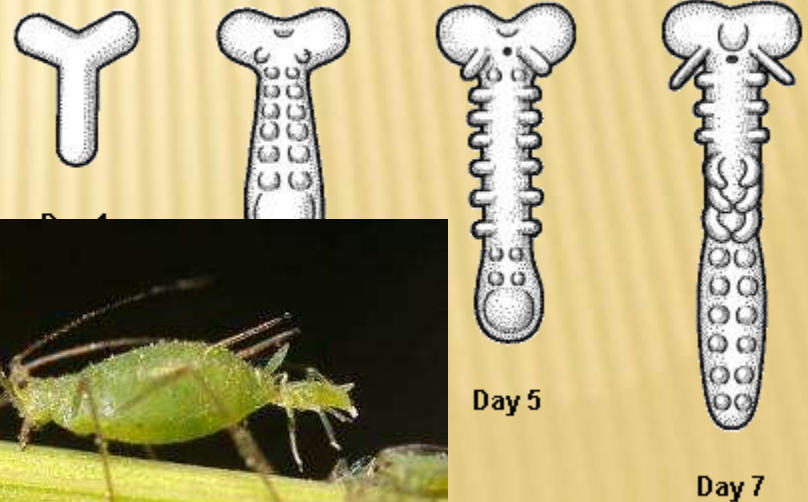
GRASSHOPPER ANATOMY

Dissection



- | | | |
|---------------------------------|--------------------------|------------------------------|
| 1. Antenna | 14. Rectum | 26. Salivary duct |
| 2. Supraesophageal ganglion | 15. Anus | 27. Labial palp |
| 3. Circumoesophageal connective | 16. Seminal receptacle | 28. Maxillary palp |
| 4. Subesophageal ganglion | 17. Vagina | 29. Hypopharynx |
| 5. Aorta | 18. Oviduct | 30. Mandible |
| 6. Crop | 19. Intestine | 31. Exophasus |
| 7. Ovary | 20. Malpighian tubules | 32. Ocellus |
| 8. Egg in egg tube | 21. Midgut | 33. Dorsal heart |
| 9. Dorsal tracheal trunk | 22. Ventral ganglion (8) | 34. Egg tube |
| 10. Calyx | 23. Gastric caeca | 35. Abdominal spiracle |
| 11. Hearts (9) | 24. Ventral nerve cord | 36. Egg |
| 12. Dorsal tracheal branch | 25. Salivary gland | 37. Longitudinal muscle band |
| 13. Air sac | | |

Embryonic Development of Appendages



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✗ development

+ larva (nymph)

✗ instars

+ metamorphosis

✗ hemimetaboly

★ exopterygota

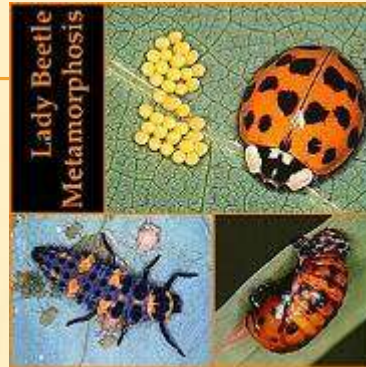
✗ holometaboly

★ Endopterygota - pupa

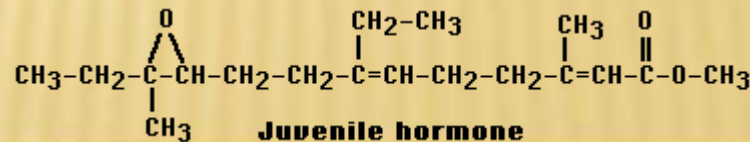
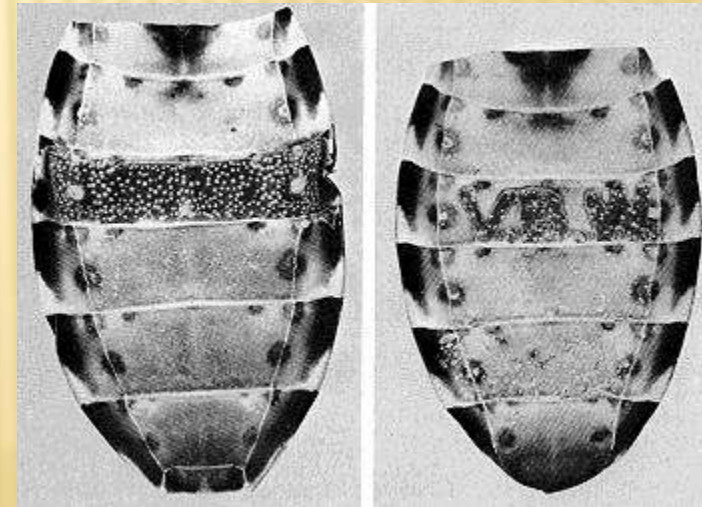
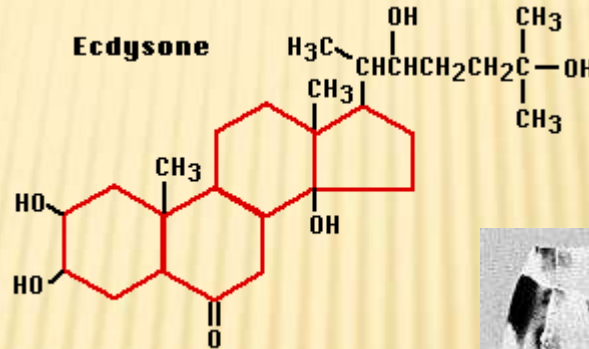
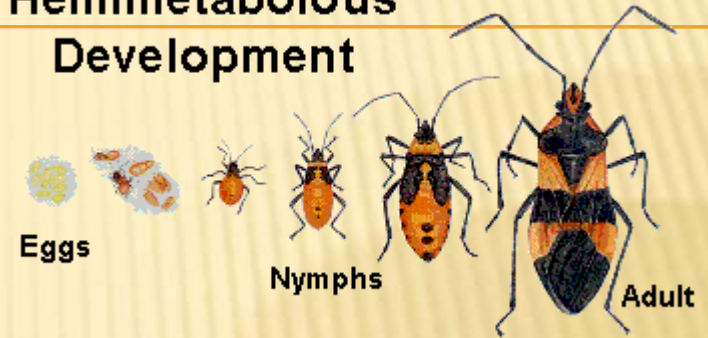
+ adult = imago

+ hormones

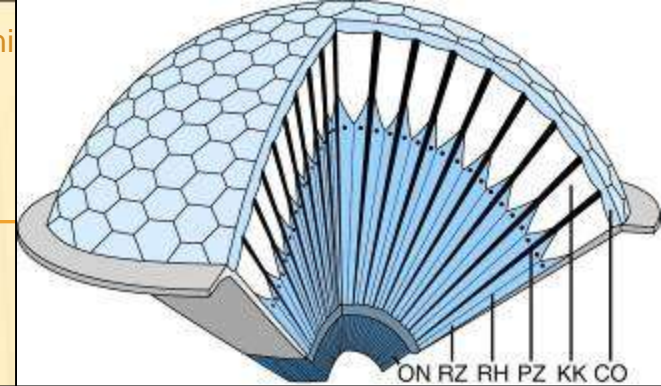
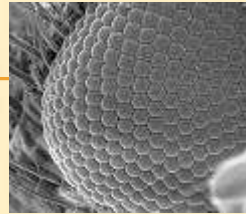
✗ Ecdysone; juvenile hormone



Hemimetabolous Development



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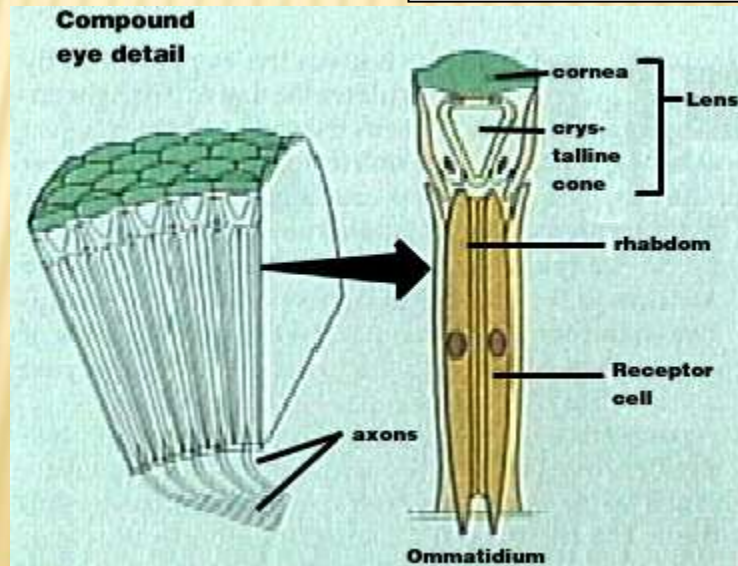
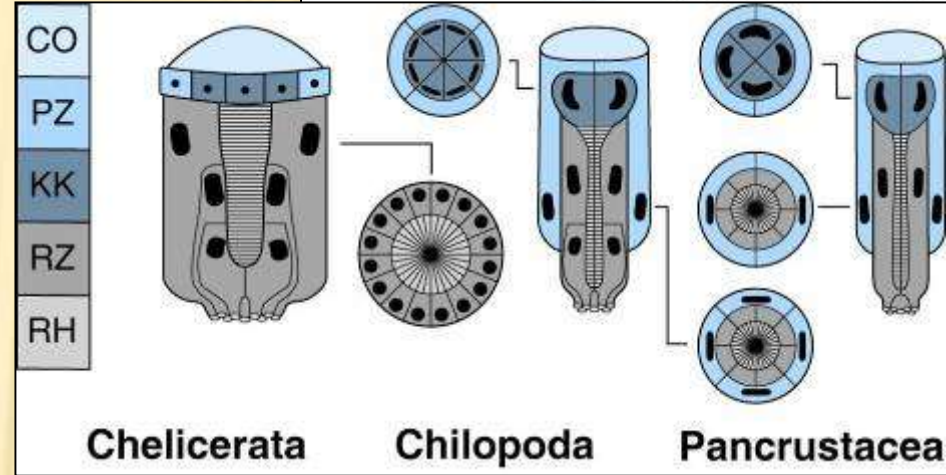


✗senses

+composed eyes

✗ommatidia (to 10 000)

✗short distance focus



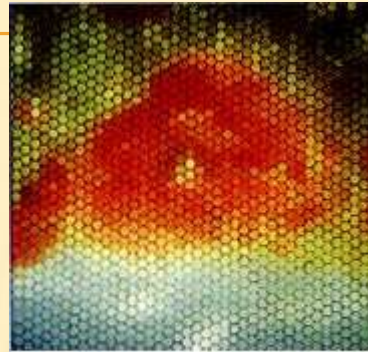
INSECTA

✗ senses

+ composed eyes

✗ UV light

✗ polarised light



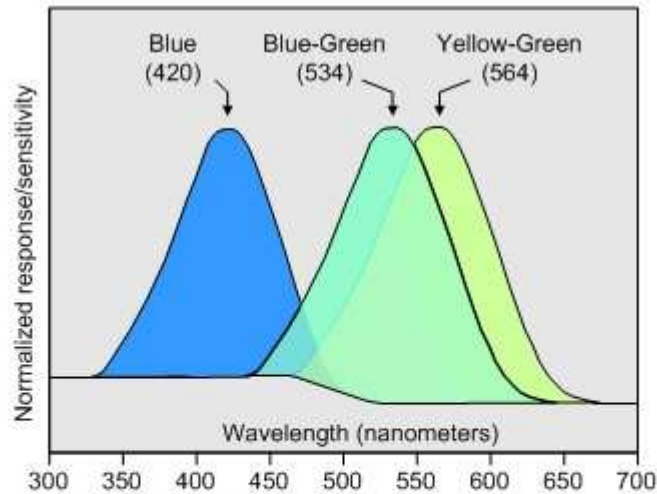
A bee's view of poppies.



Human's view.



Insect's view (simulated through UV film).



Violet Blue Cyan Green Yellow Red

Typical humans are trichromats

(three color cone/pigment types – blue, blue-green, and yellow-green)

INSECTA

✘ senses

+ composed eyes

✘ UV light

✘ Opsins, retinal

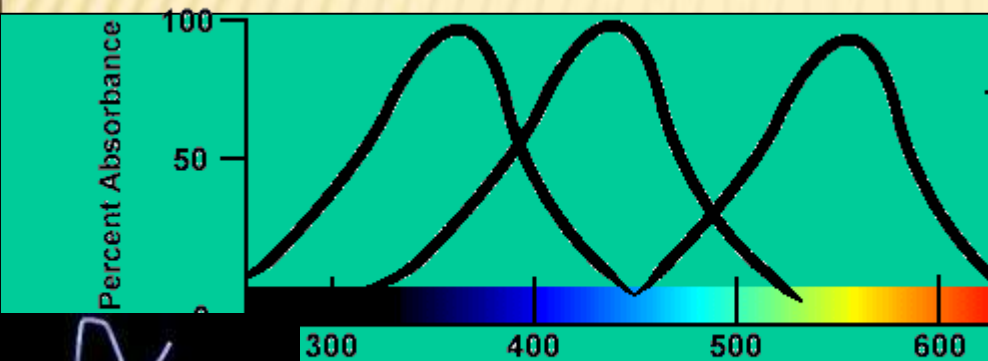
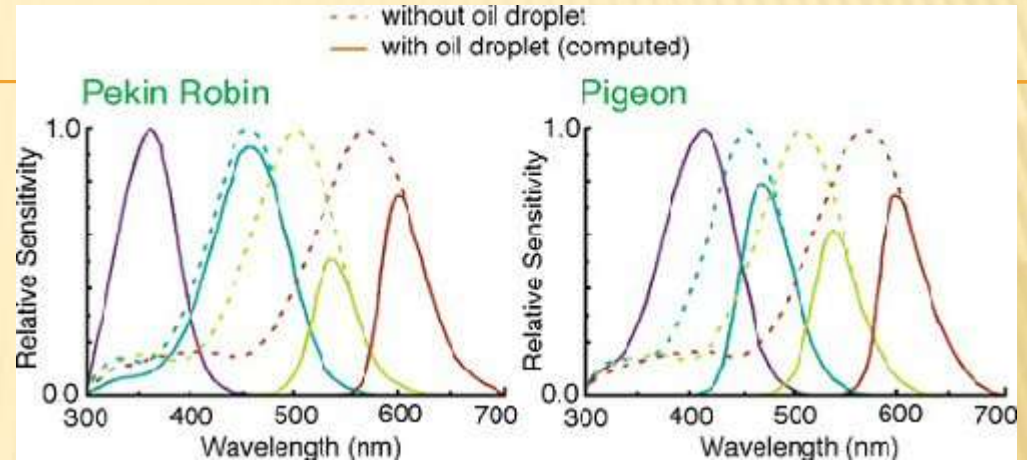


Figure #3

