Ecdysozoa:

• Basic characteristics:
  • Symmetry? Development?

• What is it named for?
  • Hormone involved?

• Also includes Nematoda and Tardigrada
  • Which one of these is not like the other?
Arthropoda:

- Also includes:
  - Trilobitomorpha
  - Chelicerata
    - Phalangium, Pandinus, Sarcoptes, Ixodes, Haplopelma, Nephila
  - Myriapoda
    - Scolopendra, Glomeris
  - Crustacea
    - Daphnia, Triops, Homarus, Stenopus, Birgus, Oniscus

- Biramous appendages

- Coelomate
  - Where is it located?
- Hemocoel
  - What function does it take in insects?
Hexapoda:

- Three thoracic segments
- Three pairs of legs
- ‘Tripod’ walking
- Wings?

Podura aquatica

Also includes entognaths
- Collembola – springtails
  - Short legs, plump oval body, few abdominal segments
  - Furcula ‘tail’ held under tension under the body allows jumping
Insecta:

• Latin *insectum* – divided body
• Primarily land and air – who rules the sea?

• Metamorphosis
  • Anamorphosis
  • Simple metamorphosis – hemimetabolous
    • Nymph, instar
  • True metamorphosis – holometabolous

• First appear in the Devonian period ~400 million years ago
Insect morphology
Thysanura: Silverfish

- Greek *thysanos oura* – tassel tail
  - Two lateral abdominal cerci and a caudal filament

- Wingless
- Long flat body, simple mouthparts, reduced or no eyes, long antennae
- Unique life cycle – effectively no metamorphosis
- Continue to molt after sexual maturity
- Unspecialized chewing mouthparts
- Often mistaken for earwigs - Dermaptera

*Lepisma saccharina*
Pterygota:

- Winged insects
  - Many secondarily wingless

Odonata: Dragonflies

- Greek *odontos* – tooth
  - Toothed mandibles (bad name, lots of other insects also have this)
- Carnivorous chewing mouthparts
- Large compound eyes
- Short filiform antennae
- Hemimetabolous development

*Libellula vibrans*
Neoptera:

• Able to fold wings back over the abdomen

Dictyoptera:

• Greek *diktuon pteron* – net wing
• Also includes Mantodea, the mantids

Blattaria: Cockroaches

• Latin *blatta* – cockroach
• Thickened forewings – tegmina
• Prominent cerci, flat body, small head under extended pronotum, long filiform antennae
• Chewing mouthparts
• Hemimetabolous – young are often very pale

• *Blattabacterium cuenoti* – mutualistic endosymbiont found in all Blattaria
Isoptera: Termites

- *Iso pter* – same wings
- Winged individuals have two sets of nearly identical wings
- Typically wingless
  - Winged alates are reproductive
- Eusocial caste system
  - Differential caste morphology
- Thorax-abdomen connection is often not distinct

![Macretermes glivus](image)
Orthoptera: Grasshoppers, crickets

- Greek *ortho ptera* – straight wing
- Prominent tympanum ‘eardrum’
- Chewing mouthparts
- Simple metamorphosis
Phthiraptera: Lice

• Greek *phtheir a ptera* – louse no wings
• Obligate parasites of mammal and avian species
  • Which mammals don’t get lice?

• Biting/sucking mouthparts - parasitic
• Dorsoventrally flattened body
• Generally colorles
• Often eyeless, or very reduced eyes
• Reduced filiform antennae
• Adapted tarsal hooks

Pediculus humanus
Hemiptera: Generic ‘bugs’ – cicadas, aphids, stink bugs

• Hemimetabolous – how’d you guess?
  • Wingless young slowly develop wings through successive instars
• Some have “half-and-half” forewings
  • Half leathery and half membranous
    • “X marks the bug”
  • Don’t mistake them for beetles!
    • Visibly crossed wings

• Piercing mouthparts – Rostrum
  • Feed on fluids
• Varied antennae

Cicadella viridis

Aphis pomi
Endopterygota:

- *Endo ptery* – internal wings
  - Wings develop within – true metamorphosis
- AKA holometabola
  - All orders of endopterygota are holometabolous

Siphonaptera: Fleas

- *Siphon a ptera* – tube no wing
- Piercing/sucking mouthparts
- Powerful jumping legs
  - Elastic protein resilin stores energy in tarsi
- Sexual maturity in fleas is influenced by hormones in host blood
- Laterally flattened body
  - Allows movement between hairs
- Short recessed antennae

![Pulex irritans](image-url)
Coleoptera: The Beatles

- Also includes weevils
- Greek *koleos pteron* – sheath wing
  - Thickened forewings – elytra
  - Hind wings are membranous flight wings
- Pronounced pronotum
- Downward pointing head
- Often enlarged specialized mandibles

![Carabus nemoralis](image1.png)
![Psylliodes affinis](image2.png)
![Curculio villosis](image3.png)
![Agrilus albogularis](image4.png)
Hymenoptera: Bees, wasps, ants

- Greek *hymen ptera* – membranous wing
- Complete metamorphosis
- Two pairs of wings act as one
  - Hamuli hooks on hind wings attach to forewings
- Some mouthparts modified to sucking proboscis
- Distinctive pinched abdomen
- Major modification of ovipositor to sting

Rhyssa amoena

Apis mellifera

Vespa crabro

Urocerus gigas
Lepidoptera: Butterflies, moths

- Greek *lepis ptera* – scale wing
- Larval chewing mouthparts, adult sucking mouthparts
- Large compound eyes
- Proboscis

![Papilio ulysses](image1)

![Acronicta americana](image2)

![Geometra papilionaria](image3)

![Macroglossum pyrrhosticta](image4)
Diptera: Flies, mosquitoes

- Greek *di ptera* – two wings
- A winged insect with only one pair of wings? That’s impossible!
  - Halteres – greatly reduced wings
  - Originate from which segment?
- Highly modified mouthparts
- Short simple antennae
- Well developed eyes

Tabanus bovinus

Drosophila melanogaster

Eristalis tenax

Culex quinquefasciatus
Drosophila!

- Sexing
- Identifying virgins
- Common mutant phenotypes

Commonly observed mutations: eye and body color, wing shape, hair morphology

Virgins are much lighter in color with a dark splotch in the abdomen – the meconium

Well, at least two out of three sound exciting

Male: Sex combs on forelegs, rounder darker abdomen, dark spots on wings in some species
Female: Pointed abdomen, often larger
Tricky bugs

Who am I?

Who’s who?

Which one of these is not like the others?
Insect behavior

• Lots of mimicry
• Complex social interactions
  • Colonial populations – relatedness influences behavior
  • Sex determination by chromosome count
• Learning and memory
• Symbolic communication