**Hexapods**

**Order Protura**: very small to minute; eyes and antennae absent; forelegs function as antennae

**Order Collembola**: 6-segmented abdomen; furcula and retinaculum; collophone on A1; 2-3mm

**Order Diplura**: 5-15mm; no eyes; antennae present; 10-11 abdominal segments with cerci

**Class Insecta**

**Apterygota**

**Order Archaeognatha (Microcoryphia)**: arched trunk; 3 terminal filaments; dorsally contiguous eyes; styli on A1-9; monocondylic mouthparts

**Order Zygoptera (Thysanura)**: flattened; 3 terminal filaments; eyes reduced or absent; dicondylic mouthparts

**Pterygota**

**Paleoptera**

**Order Odonata**: Predaceous; Adults--Long narrow wings (4); slender, elongate abdomen, large compound eyes, short bristle-like antennae, cerci unsegmented and function as claspers. Nymphs—Damselflies: 3 leaf-like gills arising from abdomen; Dragonflies: gills are internal and ring the anus.

**Suborder Anisoptera**: dragonflies; hindwings wider at base; head not elongate; wings held horizontal at rest

**Libellulidae**: toe well developed on anal loop; no notch on rear wing anal angle

**Gomphidae**: terminal abdominal segments swollen; eyes separated.

**Aeshnidae**: very large; eyes touching; triangle in front and hind wing the same

**Suborder Zygoptera**: Damselflies: front and hind wings similar in shape and narrow at base

**Lestidae**: M3 arises nearer to arculus than nodus

**Coenagrionidae**: Cu1 and Cu2 well developed (well beyond arculus)

**Calopterygidae**: Wings not stalked; >10 antenodal cross veins

**Order Ephemeroptera**: Adults--Short filiform or setaceous antennae; mesothorax enlarged with large triangular forewings; hindwings small or absent; A10 with long cerci and often with medial filament. Nymphs--leaf-like or plumose gills along abdomen w/three long tails (cerci).

**Neoptera**

**Exopterygota**

**Order Zoraptera**: minute (<3mm); tarsi 2,2,2

**Order Dermoptera**: short elytra meeting dorsally in a straight line; cerci well-developed and forceps-like; antennae filiform and about ½ length of body or less

**Order Plecoptera**: stoneflies; aquatic nymphs; usually with 2 terminal cerci; wings usually with numerous crossveins between M and Cu, and Cu1 and Cu2

**Order Orthoptera**: large hind femora; leathery fore-wings

**Suborder Caelifera**: diurnal jumping orthoptera; tympana on A1; short antennae and ovipositer; tarsi 3 or fewer

**Tetrigidae**: pronotum extends over abdomen and is narrowed posteriorly

**Acrididae**: short-horned grasshoppers

**Suborder Ensifera**: nocturnal jumping orthoptera; tympana on front tibiae; long antennae; stridulate with wings; long ovipositor

**Tettigoniidae**: long-horned grasshoppers and katydids; most tarsi 4-segmented; ovipositor flattened

**Gryllidae**: crickets; 3-segmented tarsi; ovipositor reduced

**Gryllacrididae**: wings absent or vestigial; more than 8 longitudinal veins if wings present

**Stenopelmatidae**: same as Gryllacrididae but with antennae at base separated by an equal to or greater than length of the 1st antennal segment.

**Gryllotalpidae**: front legs much dilated and modified for digging; tarsi 3-segmented
Order Mantophasmatidea (see prezi)

Order Gryilloblatodea (see prezi)

Order Embioptera: web-spinners small (4-7mm); tarsi 3-segmented; basal segment of front tarsi greatly enlarged; hind femora thickened; cerci present 1-2 segmented; wings present or absent; mainly tropical

Order Phasmatodea: body long, cylindrical; wings reduced or absent; cerci short, unsegmented

Order Mantodea: large, front coxae and prothorax greatly lengthened; front femora and tibia armed with spines and raptorial; antennae short

Order Blattodea: cockroaches; body flattened and oval; head concealed by pronotum; antennae long and slender

Order Isoptera: termites; social with castes; usually pale colored; antennae short and often moniliform; with and without wings—held flat over abdomen at rest; tarsi 4-segmented

Order Thysanoptera: thrips; minute (.5-2mm); pale to black; with and without wings—long and narrow, fringed with long hairs; sucking mouthparts (conical beak)

Order Hemiptera: mouthparts sucking; antennae with 5 or fewer segments; tarsi with 3 or fewer segments; Important characteristics for distinguishing between families are on legs, antennae, beak, and wings.

Suborder Heteroptera; beak rises from anterior part of head; wings present with hemielytra character = FW thickened at base (corium) and membranous at tip; HW membranous, shorter than FW; at rest wings held flat over body

Nepidae: waterscorpions; front legs raptorial; terminal abdominal appendages long, slender, forming nonretractable breathing tubes

Belostomatidae: giant waterbug; oval, flattened, large usually >20mm; raptorial front legs; hind legs flattened; terminal appendages short and retractable

Corixidae: water boatmen; elongate-oval; front legs short, tarsi 1-segmented and scooped; hind legs elongate and function as oars; dorsal surface flattened with narrow dark crosslines

Notonectidae: backswimmers; front tarsi not scooped; no dark crosslines

Gerridae: long legs; antennae exposed and longer than head; middle coxae closer to hind coxae than front coxae

Hydrometridae: water measurers; very slender; head elongate with conspicuous eyes bulging laterally; usually wingless

Gelastocoridae: toad bugs; short and broad, resemble toads; antennae hard to see; front legs shorter than middle legs

Tingidae: lace bugs; small <5mm; dorsal surface elaborately sculptured; pronotum with triangular process that extends back over scutellum; front wings with numerous closed cells (reticulately shaped)

Miridae: plant/leaf bugs; small, FW with a cuneus and membrane with 2 closed cells; ocelli absent; beak with 4 segments; tarsi with 3 segments

Nabidae: damsel bugs; Antennae usually with 4 segments; beak usually 4 segments; ocelli present; front femora slightly thickened; FW with small cells around margin

Anthocoridae: minute pirate bugs; tiny (3-5mm), FW with cuneus, ocelli present; antennae with 4 segments; beak and tarsi with 3 segments

*Cimicidae: bed bugs; wings vestigial, antennae with 4 segments, beak and tarsi with 3 segments, ocelli absent

Reduviidae: assassin bugs; beak with 3 segments and fitting into a groove in prosternum; head elongate with transverse groove between eyes; edges of abdomen often extend laterally beyond wings; front femora thickened

Lygaeidae: seed bugs; antennae and beak with 4 segments; tarsi with 3 segments and pad at base of each claw; membrane of FW with only 4 or 5 veins; all abdominal spiracles dorsal
**Largidae**: similar to Lygeidae but without ocelli and with more veins in membrane of FW

**Coreidae**: leaf-footed bug; similar to Lygeidae but with many veins in membrane of FW; head narrower and shorter than pronotum; hind tibiae sometimes leaf-like; scent glands on sides of thorax between middle and hind coxae

**Rhopalidae**: scentless plant bugs; like coreids but without scent glands

**Scutelleridae**: shield-backed bug; antennae with 5 segments; somewhat shield-shaped; scutellum very large, oval, and extending to apex of abdomen.

**Pentatomidae**: stink-bugs; antennae with 5 segments; somewhat shield-shaped; scutellum large and triangular, but not reaching to apex of abdomen.

**Suborder Auchenorrhyncha**: beak short and rising posteriorly (appears like it comes from between front coxae); with and without wings; forewings uniformly textured; wings at rest usually held rooflike over body

**Cicadidae**: large insects; FW membranous; 3 ocelli

**Membracidae**: treehoppers; small (12mm or less); pronotum prolonged backward over abdomen

**Cercopidae**: froghoppers; small; hind tibiae with 1 or 2 stout spines and usually a circket of spines at the apex; antennae short and stylate

**Cicadellidae**: leafhoppers; like cercopids, but body tapers posteriorly or is parallel sided; hind tibiae with 1 or more rows of small spines; antennae short and stylate

**Fulgoroidea**: (superfamily); antennae rise on sides of head beneath eyes; middle coxae elongate and separated; head often modified or elongated in front of eyes

**Suborder Sternorrhyncha**: beak arises from between procoxae; wings held roof-like over abdomen; forewings uniformly textured; with and without wings

**Aleyrodiidae**: whiteflies; tiny and white; with and without wings—FW and HW equal in size

**Aphididae**: aphids; soft bodied; pear shaped; nearly always with pair of cornicles near posterior end

**Coccidae**: scales; flat and oval; body hard and smooth and covered with wax; legs present or absent

**Order Psocodea**

**Phthiraptera** (see prezi)

**Psocoptera**: psocids; small soft bodied; <6mm; antennae with >13 segments, long and hair-like

**Neoptera**

**Endopterygota**

**Order Raphidioptera** (snakeflies): prothorax elongate; front legs rise from posterior end of prothorax and are similar to other legs; female with long, slender ovipositor

**Order Megaloptera**: HW broader at base than FW; longitudinal veins at wing margin NOT branched.

**Corydalidae** (dobsonflies/fishflies): HW broader at base than FW; 4th tarsal segment cylindrical; ocelli present; soft-bodied; males with greatly enlarged mandibles.

**Order Neuroptera**: 4 membranous wings: FW and HW about same size or HW a little wider at base; wings usually held rooflike over body at rest; wings generally with many veins; antennae long, many segmented, tarsi 5-segmented.

**Mantispidae** (mantidflies): mantidlike in appearance: prothorax elongate, front legs raptorial and rise from anterior end of prothorax.

**Chrysopidae** (lacewings): wings usually greenish and without bifurcate costal crossveins, eyes golden or copper-colored; Sc and R1 not fused at wing tip.

**Hemerobiidae** (brown lacewings): similar to Chrysopidae, but smaller and brown; distinct wing venation from Chrysopids by having bifurcate costal crossveins.

**Myrmeleontidae** (antlions): like zygoptera; antennae about as long as head and thorax together; antennae clavate to capitate; elongate cell distal to fusion of Sc and R1

**Ascalaphidae** (owlflies): short cell distal to fusion of Sc and R1; antennae capitate and nearly as long as the body

**Order Strepsiptera** (see prezi)
Order Coleoptera: largest order of extant animals with >250,000 species; with elytra (modified FW) meeting in a straight line down the back and covering HW; mouthparts chewing; Holometabolous (complete metamorphosis); tarsi usually 3-5 segmented.

Suborder Adephaga: hind coxae dividing the 1st visible abdominal sternum; filiform antennae, tarsi 5,5,5; notopleural sutures present.

Carabidae (ground beetles): hind trochanters large, femora almost touch coxae, head narrower than pronotum, antennae inserted between eyes and base of mandibles, antennae filiform, 11, tarsi 5,5,5

Cicindelinae (tiger beetles): hind trochanters large, femora almost touch coxae, large head, antennae on front of eyes, clypeus widened beyond antennal insertions, underside often metallic, antennae filiform, 11, tarsi 5,5,5

Dytiscidae (predaceous diving beetles): hind trochanters large, femora almost touch coxae, legs fringed and flattened; filiform (threadlike)

Gyrinidae (whirligig beetles): front legs long and slender; antennae short and clubbed, 3rd antennomere greatly expanded (earlike); 2 pairs of eyes, 2 dorsal and 2 ventral

Suborder Polyphaga: 1st visible abdominal sternum is not divided by the hind coxae; hind trochanters normal; notopleural sutures lacking

Silphidae (carrion beetles): elytra broad posteriorly, often exposing 1-3 abdominal segments; palps visible, flexible; antennae clubbed, 9-11, tarsi 5,5,5, densely pubescent

Staphylinidae (rove beetles): elytra very short (with HW folded beneath) exposing most of abdomen, antennae threadlike, clavate or capitulate

Hydrophilidae (water scavenger beetles): eyes large, maxillary palps long and slender (look like antennae), hind legs flattened and fringed, metasternum often contains a long spine, antennae short, clubbed, 6-9, tarsi 5,5,5

Passalidae (bess beetles): mentum of labium deeply notched; lamellate club of 3-8 antennomeres; fore coxal cavity closed; distinct horn arising between eyes

Scarabaeidae: antennae lamellate with 3-7 leaves, 8-11 (usually 10), tarsi (variable), 5,5,5 usually

Buprestidae (metallic wood-boring beetles): usually metallic, head retracted into prothorax to eyes, metacoxae platelike, antennae short, slender, finely serrate, 11, tarsi 5,5,5

Elateridae (click beetles): posterior corners of pronotum prolonged backward into sharp points, mandibles short and retracted, procoxae small and rounded, antennae more or less serrate, widely separated, inserted in pits before eyes, 11, tarsi 5,5,5

Lampyridae (lightning bugs, fireflies): body elongate and parallel sided, head nearly covered by pronotum, mesocoxae contiguous, tarsi 5,5,5

Cleridae (checkered beetles): elongate, pronotum narrower than elytra, head often wider than pronotum, procoxal cavities open posteriorly, antennae capitate or clavate 10-11, tarsi 5,5,5

Melyridae (soft-winged flower beetles): head prolonged into a short, broad beak, procoxal cavities opened posteriorly, antennae frequently serrate, 11, tarsi 5,5,5, tarsal claws usually have a lobe between them

Coccinellidae (ladybird beetles): nearly hemispherical but some are more elongate, head retracted into thorax, antennae with 3-segmented club, 11, tarsi 3,3,3

Tenebrionidae (darkling beetles): mandibles short, eyes almost always notched, antennae moniliform or clavate, 11, tarsi 5,5,4

Meloidae (blister beetles): elongate, head and elytra wider than pronotum, head constricted far behind eyes into a neck, legs long, antennae 11, tarsi 5,5,4, tarsal claws usually have a long appendage below them

Cerambycidae (long-horned beetles): antennae usually 1-4 times the length of the body, sometimes serrate, sometimes moniliform, tarsi 5,5,5, 4th always small, 3rd deeply bilobed

Curculionidae (weevils): head with well-developed beak (often curved downward), antennae usually geniculate with a three-segmented club

Chrysomelidae (leaf beetles): usually oval (but vary), antennae less than half length of body, tarsi appear 4,4,4

Scolytidae (bark beetles): small, cylindrical and compact with short legs (look like miniature bullets), antennae geniculate with a compact club, tarsi 5,5,5
Order Trichoptera: Slender, elongate and mothlike; long, filiform antennae (as long as body or longer); 4 membranous wings; HW a little shorter than FW; wings held rooflike over body at rest; reduced mouthparts

Order Lepidoptera: 4 membranous wings; HW a little smaller than FW; wings largely or entirely covered with scales; mouth parts sucking, with proboscis usually in the form of a coiled tube

Sessiidae (Clearwing Moths): greater part of both wings lack scales; transparent areas on all wings; FW with reduced anal area; HW with well-developed anal area; wasplike

Pyralidae (Snout and Grass Moths): small; FW narrow and elongate or somewhat triangular; HW broad w/ 3 anal veins; Cu appearing four branched in FW; Sc and R veins may be fused or parallel opposite the discal cell in HW; scaled proboscis.

Hesperiidae (Skippers): antennae clavate and usually hooked at tip, head as wide or wider than thorax, hind tibiae with 2 pairs of spurs; all five R veins in FW are unstalked and arise from the discal cell.

Papilionoidea (Butterflies): antennae capitate or clavate, but never hooked at tip; wings generally large in proportion to the body

Papilionidae (Swallowtails): FW with 5-branched R vein; HW with 1 anal vein and usually a tail-like prolongation

Pieridae (Whites, Sulfurs, and Oranges-tips): usually white, yellow or orange with black marks, tarsal claws forked; FW with 3rd anal vein.

Lycaenidae (Hairstreaks, Coppers, Blues): FW with R vein 4-branched; small brownish, blue or reddish; often with little tails on HW; antennae are usually ringed with white, and eyes are encircled with line of white scales.

Nymphalidae (Brush-footed Butterflies): variable in size and color; front legs often very reduced, some veins swollen at base

Danainae (Milkworm Butterflies): usually orange and black; antennae w/o scales; forelegs greatly reduced; short 3rd anal vein in FW.

Satyrinae (Satyrs, Wood Nymphs, and Arctics): Sc and others greatly swollen at base; usu brown w/ eyespots on undersides of wings

Ithomiinae: clear or tiger-striped wings; weak antennal clubs; small eyes; long, slender abdomens

Heliconiinae: elongate FW; large eyes; long antennae; humeral vein in the HW bent basad.

Melitaeinae: antennal club well developed and flattened at the tip

Morphinae: very large; usually iridescent blue

Nymphalinae (Anglewings, Crescents, and Checkerspots): hairy eyes; wings are irregularly notched, and often bear tail-like projections.

Geometridae (Measuringworms, Loopers, Geometers): Basal part of Sc vein in HW makes abrupt bend into the humeral angle; Cu in FW appears 3-branched

Saturniidae (Silkworm Moths): large with feathery antennae; wings broad, usually with eyespots

Sphingidae (Sphinx Moth, Hawkmoth): Large, heavy-bodied, wings small and narrow, FW much longer than HW, antennae spine shaped

Arctiidae: (Tiger Moths) heavy-bodied, bright spots and bands common; Sc and R fused until about the middle of the discal cell in HW.

Noctuidae: labial palps usually long; thread-like antennae, Cu in FW appears 4-branched, often dark colored or grey
**Order Siphonaptera**: body laterally flattened, bristly and heavily sclerotized; antennae short; ocelli lacking; coxae large; mouthparts sucking

**Order Mecoptera**: long-faced; mouth parts chewing and at end of long snoutlike structure; 4 membranous wings, HW about same size as FW; antennae filiform and about half body length; male genetalia in some families bulbous and curved upward (like the stinger of a scorpion).

**Order Diptera**

**Suborder Nematocera**: Antennae with more than 5 segments, often threadlike.

- **Tipulidae** (Crane Flies): very long legs, mesonotum with V-shaped suture, ocelli absent
- **Bibionidae** (Lovebugs): many with yellow or red thorax, mesonotum w/o V-shaped suture, no closed discal cell present, wings w/ 7 or more longitudinal veins, antennae usually shorter than thorax, arising below eyes.
- **Chironomidae** (Midges): mesonotum with straight suture, R veins go almost to wing tip, ocelli absent
- **Culicidae** (Mosquitoes): wings long and narrow with scales along veins and wing margin, ocelli absent
- **Cecidomyiidae** (Gall Midges or Gall Gnats): Costal vein extends around wing tip, wings w/ 3-6 veins, often w/o cross veins

**Suborder Brachycera**:  

A. **NO Ptilinal suture (Orthorrhapha and Cyclorrhapha; Aschiza)**  
   - **Tabanidae** (Horse or Deer Flies): stout bodied, large, 3rd antennal segment elongate and subdivided, tarsi with 3 pads, calypters large  
   - **Stratiomyidae** (Soldier Flies): Veins in wings form a "window", no tibial spurs.  
   - **Asilidae** (Robber Flies): long legs, thorax stout and abdomen usually long and tapering, top of head hollowed out between eyes  
   - **Bombyliidae** (Bee Flies): stout bodied and hairy, round-headed, often with patterned wings  
   - **Dolichopodidae** (Long-legged Flies): often metallic and smaller than housefly, Rm cross vein and R joins C all in basal half of wing, often with fringed calypters  
   - **Phoridae** (Hump-backed Flies): Humped back, wing has 3 veins coming down from R with no cross veins  
   - **Syrphidae** (Flower Flies): bee-like or wasplike, spurious vein  

B. **Ptilinal suture (Cyclorrhapha; Schizophora)**  
   1. **Lower calypters SMALL or absent (often all calypters absent). (Acalyptate muscoid flies)**  
   2. **Lower calypters LARGE. (Calyptate muscoid flies)**
      a. **No hypopleural and pteropleural bristles**
      b. **Hypopleural and pteropleural bristles**

- **Muscidae** (House Flies): No hypopleural (and pteropleural) bristles, R5 parallel sided or narrowed distally
- **Tachinidae**: Postscutellum well developed, R5 narrowed or closed distally, arista usually bare
- **Calliphoridae** (Blow Flies): often metallic, hypopleural and pteropleural bristles, 2-3 bristles on mesothorax
- **Sarcophagidae** (Flesh Flies): body not metallic (black or grey with black stripes), 4 bristles on mesothorax
Order Hymenoptera

Suborder Symphyta (abdomen broadly joined to thorax)

Sirecidae (Horntails): Large, pronotum in dorsal view wider than long and shorter along midline than laterally, apex of abdomen usually with a dorsally located spear or spine, single apical spur on the front tibiae

Tenthredinidae (Common Sawflies): 2 apical spurs on front tibiae, 2 marginal cells on forewing, threadlike antennae with 7-10 segments

Suborder Apocrita (abdomen narrowly joined to thorax)

Formicidae (Ants): 1st abdominal segment nodelike or with a dorsal hump, differing from remaining segments, antennae with 6-13 segments and strongly elbowed in females, the 1st segment very long, venation of winged forms is usually slightly reduced.

B. Trochanter 1 segmented

1. (Pronotum short and collarlike with a small rounded lobe on each side that does not reach the tegulae.)

   Sphecidae: venation complete (or almost), unbranched or little hair on body, hornet-like

   Apidae (Bees): jugal lobe on hind wing shorter than basal cell, usually 3 submarginal cells, first two segments of labial palps elongate and flattened

   Anthophoridae (Carpenter Bees): jugal lobe on hind wing shorter than basal cell, first two segments of labial palps elongate and flattened, Scopa is a brush of dense hairs

   Megachilidae: jugal lobe on hind wing shorter than basal cell, usually 2 submarginal cells, first two segments of labial palps elongate and flattened

2. Pronotum touches tegulae or with lobe that reaches tegulae.

   Vespidae (Hornets, Yellow Jackets): Notched eyes and clavate antennae, wings fold longitudinally (like a fan) when not flying, 1st discoidal cell in FW very long (1/2 as long as wing)

   Pompilidae (Spider Wasps): No notched eyes, filiform antennae that are often curled, horizontal or near horizontal furrow on Mesopleuron, hind femora usually extending to apex of abdomen

   Mutillidae (Velvet Ants): very hairy and often brightly colored, male winged, female wingless with very painful sting

C. Trochanter 2 segmented or wing venation greatly reduced (in minute forms)------

1. Costa vein present

   Braconidae: 1 m-cu crossvein or none (no second rv), antennae long

   Ichneumonidae: 2 m-cu crossveins, 2nd submarginal cell small or lacking, antennae with 16 or more segments and usually at least half as long as the body, base of cubital vein lacking, often with long ovipositors, possibly the largest of insects

2. Costa vein absent

   a. Filiform antennae

      Cynipidae: Small wasps, often black

   b. Elbowed antennae, wing venation greatly reduced, (Chalcidoidea)

      Chalcididae: hind femora greatly swollen and toothed behind, hind coxae considerably larger than front, antennae elbowed, wing venation greatly reduced

      Eurytomidae: Usually black with sculpted thorax that is MUCH larger than head and abdomen

      Eulophidae: small metallic wasps, collapse when dried, 4 tarsal segments