

## LABORATORY EXERCISE 3: Higher Exopterygota and Endopterygota

The more specialized orders within the neopterous subdivision Exopterygota are the **hemipteroids** [Paraneoptera]: true “bugs” and their relatives, characterized by piercing-sucking adaptations of their mouthparts. The sucking “beak” or rostrum is fully developed only in the huge, diverse order **Hemiptera**, which includes both “false” bugs like aphids, scale insects, spittlebugs, leaf- and treehoppers, planthoppers, and cicadas, and “true bugs” like water striders, water bugs, backswimmers, water-boatmen, ambush bugs, squash bugs, seed bugs, stink bugs, and others. Whether a bug is considered to be true or not is based on details of wing and mouthpart morphology: true bugs (suborder **Heteroptera**) possess half-coriaceous front wings and a rostrum originating at the front of the head, while other bugs (suborders **Auchenorrhyncha**, including the cicadas and hoppers, and **Sternorrhyncha**, the plant lice, display totally membranous wings and a beak originating more ventrally or even posteriorly on the head. Examples of both major types of Hemiptera are on display; compare the front wings in an outline drawing (**Drawing #4**) using a cicada and a squash bug or water bug, labeling membranous and hardened areas.

Other hemipteroid orders seem “transitional” between the orthopteroid orders and the Hemiptera. These include the **Zoraptera** (a tiny order); **Psocodea** (lice), including **Psocoptera** (book lice) and **Phthiraptera** (including the bird and biting lice or **Mallophaga** and the sucking lice or **Anoplura**); and **Thysanoptera** (thrips). All have more or less asymmetrical, partially-sucking, or uniquely modified mouthparts and considerably consolidated (fused) central nervous systems and feed on a variety of soft or liquid foods: plant sap, blood, skin fragments, or fungi. Examples of each of these smaller, transitional orders are on display; all are relatively small, inconspicuous insects, although several are extremely important pests of humans or of domesticated plants and animals.

Complete metamorphosis originated in some generalized exopterygote stock: insertion of a dormant pupal stage between larval (nymphal) and adult stages encouraged larvae and adults of single species to utilize different ecological niches and subserve distinct roles more efficiently. Consequently (or so it seems), endopterygote or holometabolous orders have pretty much overwhelmed their exopterygote and paleopterous predecessors in most environments. Evolutionary affinities of the eleven orders of **Endopterygota** are unclear; however, one commonly accepted view places the **Coleoptera** (beetles) and **Neuroptera-Megaloptera-Raphidioptera** (lacewings etc.) in one monophyletic assemblage called **Neuropterodea**, while **Panorpodea** encompasses most of the remaining orders, including **Diptera** (true flies) and **Lepidoptera** (butterflies and moths). Odd man out is **Hymenoptera** (bees, wasps, ants). (Other smaller orders are listed below). The major differentiating feature between “neuropteroids” and “panorpooids” (including Hymenoptera) is the location of the spinnerets, from which silk is elaborated during cocoon construction: larval neuropteroids usually spin silk from anal spinnerets, while panorpooids accomplish the same task using oral spinnerets. Examine representative specimens of the 11 endopterygote orders, on display in the lab room.

Classification summary:

INSECTA  
  APTERYGOTA  
  PTERYGOTA  
    PALEOPTERA  
    NEOPTERA  
      EXOPTERYGOTA (Hemimetabola)  
        ORTHOPTERODEA [POLYNEOPTERA]  
        HEMIPTERODEA [PARANEOPTERA]  
          Zoraptera (Zorapterans) [may be a polyneopteran]  
          Psocodea (lice)  
            Psocoptera (book-lice)  
            Phthiraptera  
              Mallophaga (bird- or biting-lice)  
              Anoplura (sucking lice)  
          Thysanoptera (thrips)  
          Hemiptera (bugs)  
      ENDOPTERYGOTA (Holometabola)  
        NEUROPTERODEA  
          Megaloptera (dobsonflies & alderflies)  
          Raphidioptera (snakeflies)  
          Neuroptera (lacewings, antlions, and relatives)  
          Coleoptera (beetles)  
          Strepsiptera (strepsipterans)  
        PANORPODEA  
          Mecoptera (scorpionflies)  
          Diptera (true flies)  
          Siphonaptera (fleas)  
          Trichoptera (caddisflies)  
          Lepidoptera (moths and butterflies)  
        HYMENOPTERA (bees, wasps, ants)

Now that you've covered all the major insect taxa in this whirlwind romp through the orders, try your hand at keying out three unknown specimens given to you by your teaching assistant, using the ordinal keys provided (handout). She will confirm your identifications, discuss with you any problems you encounter, and tabulate the results.