

Unit 6 - Non-pterygote Hexapoda

Open Entomology Project

30 June 2016

Introduction

Here we begin looking at taxa classified in **Hexapoda**. In most cases you will examine multiple families, most of which you will be tested on in lab practicals. You may be shown more families than are on the handout—primarily so that you can better grasp the diversity that exists—but you will not have to sight-identify these other families. Looking at these other families may help to you, though, in identifying specimens for your collection. Some characters (in *italics*) might be impossible to see but are provided for future reference.

Materials

- specimens (provided)
- fine forceps, probes (provided)
- sorting tray, watch glasses, gloves, safety glasses, glycerine, ethanol (provided)
- pencil/paper for sketches

Safety

We will be working with sharp tools. Wear your personal protective gear at all times. Specimens are to be returned to their vials after lab, and glycerine and ethanol will be collected for proper disposal or reuse.

Methods

Working with a partner, organize your space, specimens, tools, and microscope. Use your probe and forceps to manipulate the specimen. In this lab, however, we will not be dissecting specimens (unless otherwise noted). You can start anywhere in the handout.

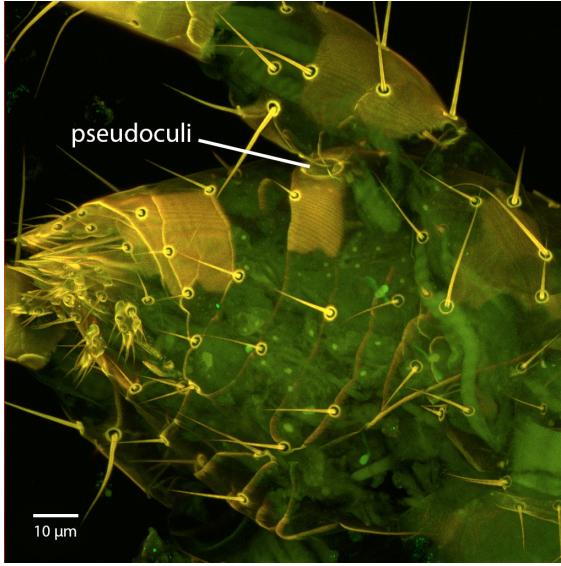
Hexapoda

- 3 tagmata: head, thorax, abdomen
- 3 pairs of uniramous thoracic appendages (legs)

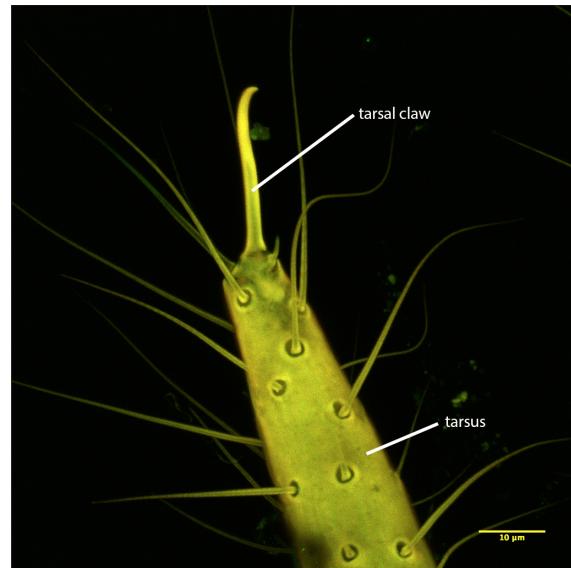
Entognatha

- antennae, when present, truly segmented (*i.e.*, each segment has intrinsic musculature)
- tarsus not subdivided into tarsomeres (Figure 1b)

Looking at the Figure 1a below, can you annotate the mouthparts of an entognathous hexapod? Mouthparts include the mandible but also the maxilla and the labium. Are these components all evaginated and visible?



(a) CLSM volume rendered image showing proturan head (mouth region on the left-middle portion of the image) and base of fore leg. Photo (CC BY 2.0) by István Mikó



(b) CLSM volume rendered image showing proturan fore tarsus. Photo (CC BY 2.0) by István Mikó

Figure 1: Protura

1 Protura (coneheads)

- antennae apparently absent (Figures 2, 3b)
- eyes absent; *sensory organs (pseudoculi) present where one would expect eyes to be*
- *mandibles without molar area (proximal flattened region for grinding food)*
- body very small (<1.5 mm long)
- abdomen 11-segmented, cerci absent (Figure 3a)

How might the absence of antennae be adaptive for these hexapods? Where would you predict they live? Which structure functions as the primary anterior sensory appendage?

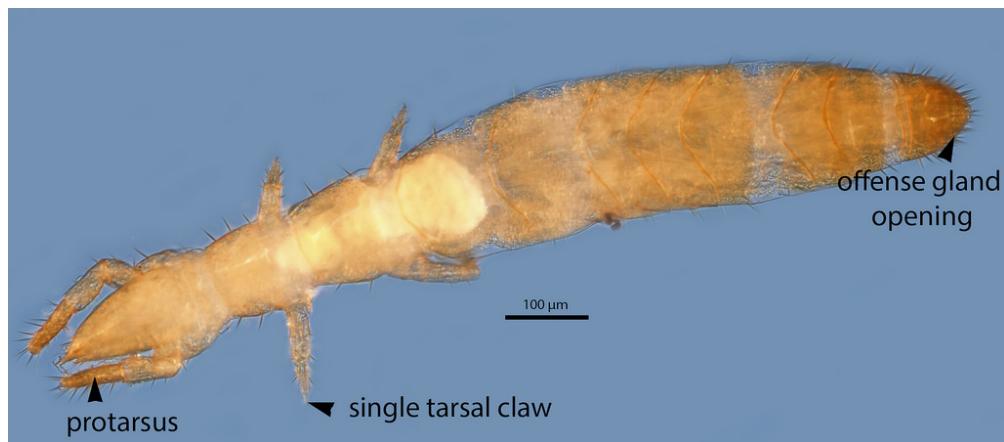
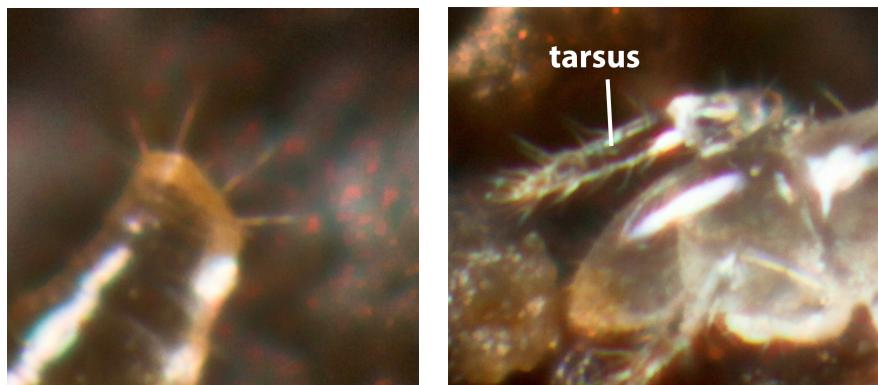


Figure 2: Proturan habitus. Photo (CC BY 2.0) by István Mikó <https://flic.kr/p/yCpxwp>



(a) Apex of abdomen. Photo (CC BY-SA 2.0) by Andy Murray <https://flic.kr/p/eaKZ2B>

(b) Head and prothorax. Photo (CC BY-SA 2.0) by Andy Murray <https://flic.kr/p/eaKZ2B>

Figure 3: Protura

2 Diplura (diplourus)

- antennae filiform
- eyes absent; pseudoculi absent
- *mandibles without molar area*
- body usually >3 mm long
- cerci distinct
- *abdominal segments often with styli*

Compare dipluran fore legs to those of proturans; notice any difference? Now, focusing on Diplura, compare **Japygidae** (Figure 4) with **Campodeidae** (Figure 5). What is your hypothesis for why the cerci vary phenotypically between families? What is their function?

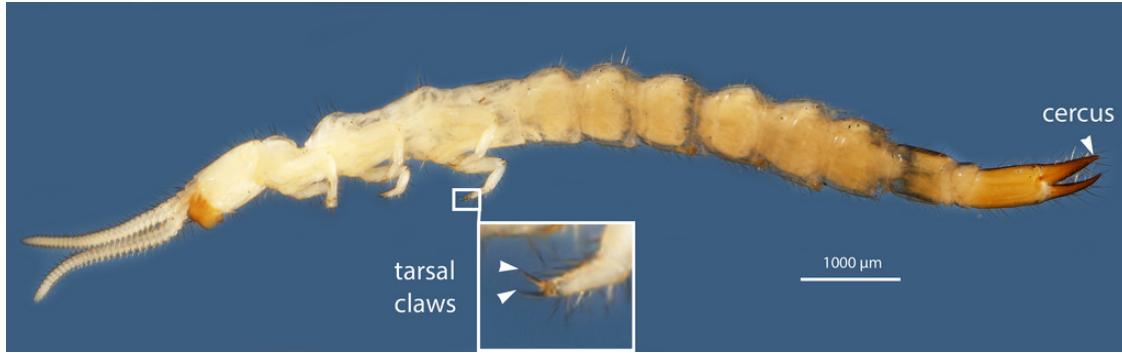


Figure 4: Japygidae habitus. Photo (CC BY 2.0) by István Mikó <https://flic.kr/p/yCo5BK>

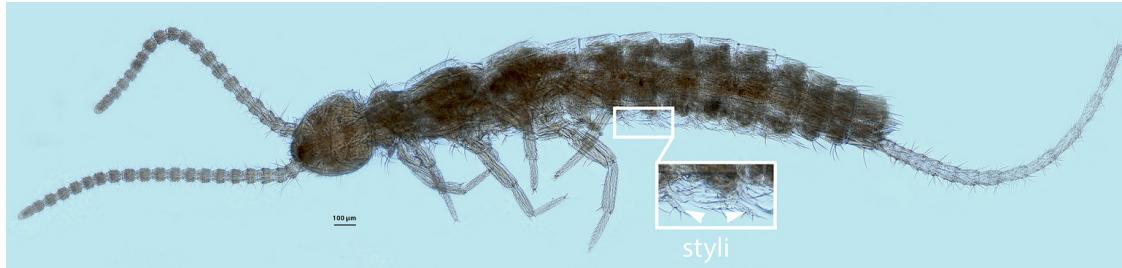
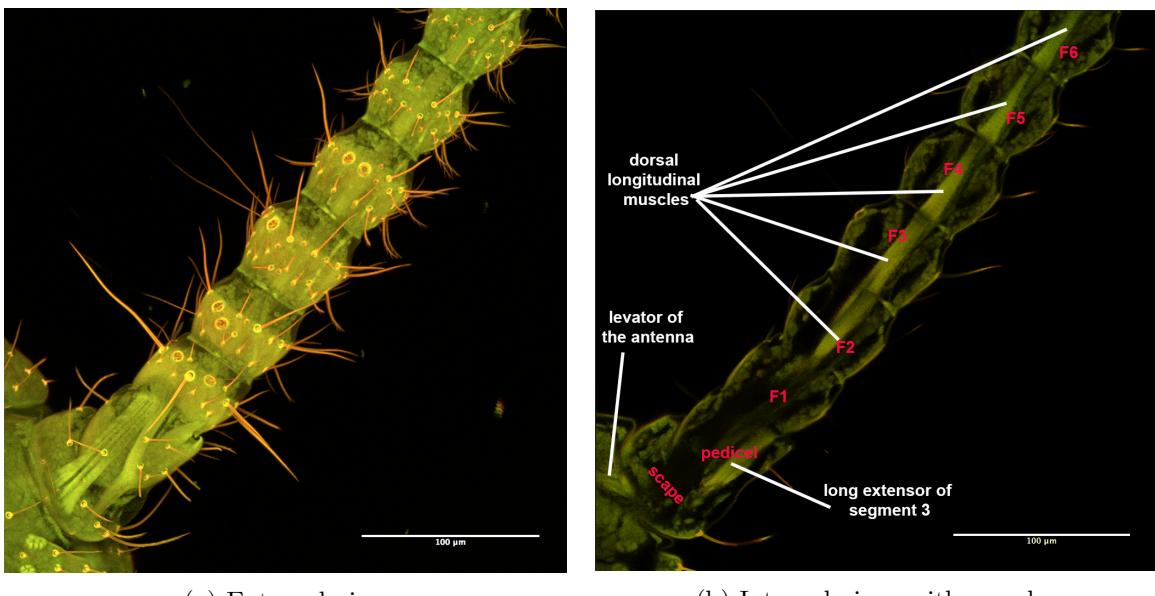


Figure 5: Campodeidae habitus. Photo (CC BY 2.0) by István Mikó <https://flic.kr/p/ykHVxt>

3 Collembola (springtails)

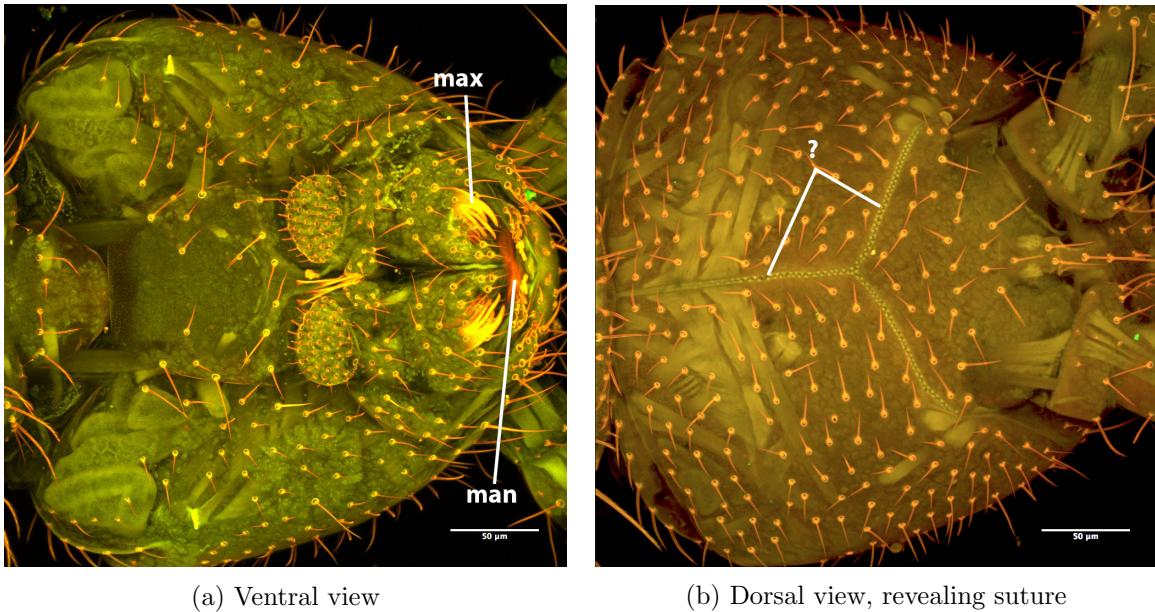
- compound eyes present
- *mandibles with molar area*
- antennae usually ≤ 4 segments
- tibia fused with tarsus (tibiotarsus)
- abdomen with ≤ 6 segments: 1st segment with ventral tube (collophore), 3rd abdominal segment modified ventrally (retinaculum) to receive furculum, 5th abdominal segment with forked structure (furculum), usually folded under abdomen



(a) External view

(b) Internal view, with muscles

Figure 6: CLSM volume-rendered images, showing the antenna of Diplura. Photo (CC BY 2.0) by István Mikó.



(a) Ventral view

(b) Dorsal view, revealing suture

Figure 7: CLSM volume-rendered images, showing the head of Diplura. Photo (CC BY 2.0) by István Mikó

– body length usually 1–3 mm

3.1 Sminthuridae (globular springtails)

- head hypognathous, anteroposteriorly flattened
- antennae longer than head
- prothorax indistinct dorsally, narrowly articulated with head
- abdominal segments 2–4 fused dorsally



Figure 8: Sminthuridae habitus. Photo (CC BY 2.0) by István Mikó <https://flic.kr/p/xFw3ua>)

3.2 Hypogastruridae (snowfleas, in part)

- head prognathous, not anteroposteriorly flattened
- antennae usually shorter than head
- prothorax distinct dorsally, broadly articulated with head
- abdominal segments 2–4 not fused

3.3 Entomobryidae

- head hypognathous to prognathous, not anteroposteriorly flattened
- antennae longer than head
- prothorax indistinct dorsally, narrowly articulated with head
- abdominal segments 2–4 not fused

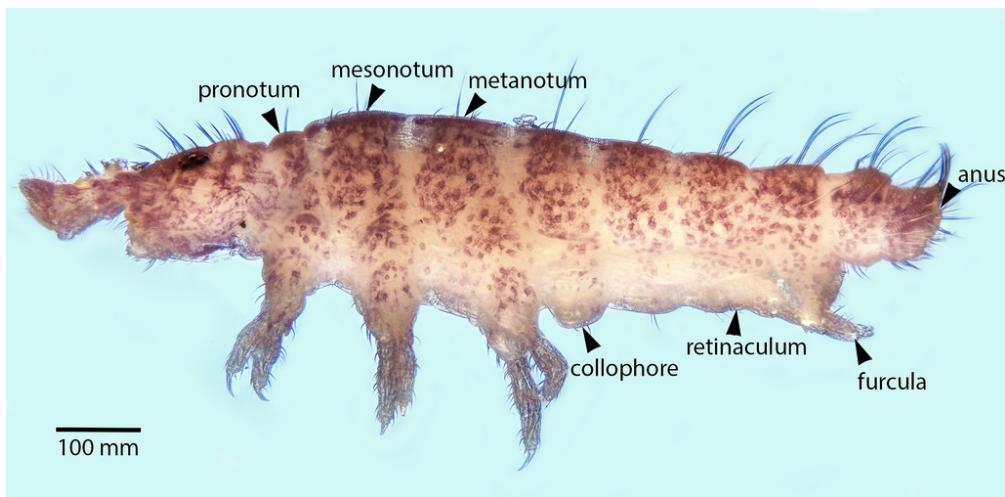


Figure 9: Hypogastruridae habitus. Photo (CC BY 2.0) by István Mikó <https://flic.kr/p/ykEeQC>

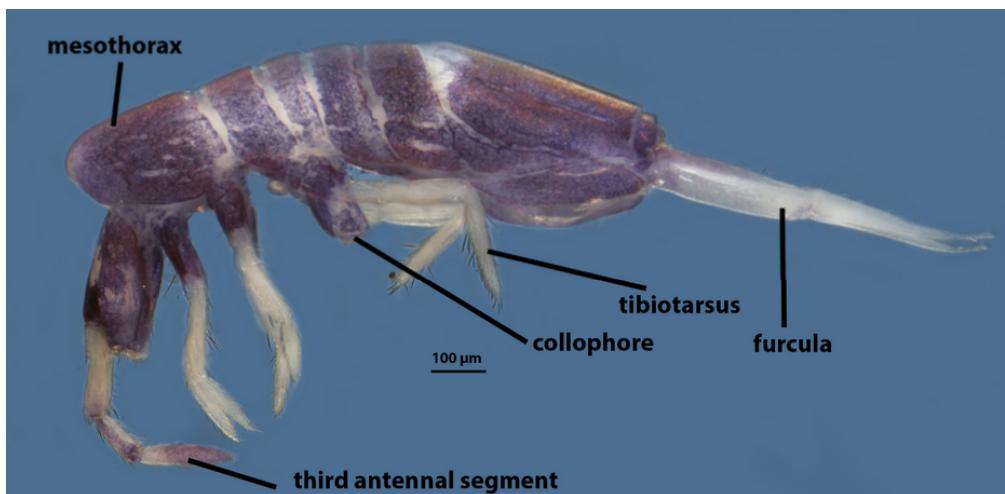


Figure 10: Entomobryidae habitus. Photo (CC BY 2.0) by István Mikó.

3.4 Tomoceridae

- head hypognathous to prognathous, not anteroposteriorly flattened
- antennae usually longer than head, apparently 3-segmented; apical segment longer than other 2 segments
- prothorax indistinct dorsally, narrowly articulated with head
- abdominal segments 2–4 not fused
- often covered in metallic scales

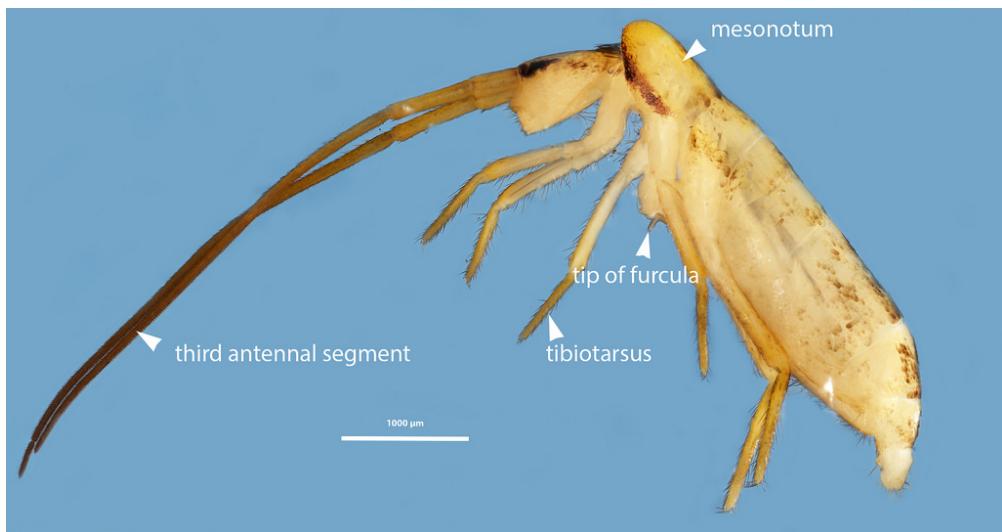


Figure 11: Tomoceridae habitus. Photo (CC BY 2.0) by István Mikó <https://flic.kr/p/yCnGYz>

Lines similar to the one marked on Figure 7b occur on the epithelium of adult Entognatha. These structures are similar to human cranial sutures. What is their function? Winged insect adults do not have these lines, or at least they don't function in the same way. Why not?

Insecta

The remaining arthropods we will examine in lab are true insects. In addition to many internal characters we won't examine (*e.g.*, Johnston's organ) insects can be recognized by the following character states:

- antennae 3-segmented (*i.e.*, segments with intrinsic musculature), with apical segment (flagellum) usually subdivided
- mouthparts not usually enveloped by cuticular evagination (*i.e.*, insects are *ectognathous*)
- ovipositor present

4 Archaeognatha (Microcoryphia, bristletails)

- compound eyes well-developed, adjacent dorsally
- maxillary palps longer than legs, subdivided into 7 annuli

- labial palps subdivided into 3 annuli
- meso- and metacoxa with styli present
- styli present on abdominal segments 2–9
- abdomen with 3 scaly appendages present apically (2 cerci, 1 terminal appendage)
- body “humpbacked”, scaly
- paired eversible vesicles usually present on abdominal segments 1–7



Figure 12: Archaeognathan habitus. Photo (CC BY-NC-SA 2.0) by Kim Fleming <https://flic.kr/p/5pYjac>

Have you seen these insects move? Why do they have a “humpbacked” habitus? Can you find and draw the styli? What might these be remnants of?



Figure 13: Archaeognathan head and thorax. Photo (CC BY-NC-SA 2.0) by Shipher Wu <https://flic.kr/p/62T1m3>

5 Zygentoma (Thysanura, in part; silverfish, firebrats)

- compound eyes small, widely separated
- maxillary palps shorter than legs, subdivided into 6 annuli
- labial palps subdivided into 4 annuli
- styli on meso- and metacoxa absent, usually present on abdominal segments 2–9
- abdomen with 3 bare appendages present apically (2 cerci, 1 terminal appendage)
- body dorsoventrally flattened, scaly
- paired eversible vesicles usually present on abdominal segments 1–7

Acknowledgments

Andrew R. Deans and István Mikó wrote the text. Many of the illustrations were generously made available by the Biodiversity Heritage Library (<http://biodiversitylibrary.org>) and the photographers at Flickr (<http://flickr.com>).



Figure 14: Zygentoman habitus. Photo (CC BY-SA 2.0) by Jean-Raphaël Guillaumin <https://flic.kr/p/4Cavhu>



Figure 15: Zygentoman head. Photo (CC BY-SA 2.0) by Jean-Raphaël Guillaumin <https://flic.kr/p/czicq1>

References