

Lab Exercise 3 - Insect external and internal anatomy

Activity 1- Grasshopper external morphology (see Bland and Jaques)

1a. Orientation to body plan- The grasshopper body includes three regions: its head, thorax, and abdomen. Each body region possesses unique appendages that are specialized for different functions (p. 30, Fig. 28; p. 89, Fig. 88). The degree of segment fusion depends partly on which body region you are examining and whether you are looking at the dorsal or ventral side of the animal. For example, segments on the head are completely fused. Segments on the thorax are separated on the dorsal side by sutures, and on the ventral side by attachments of the walking legs. The abdominal segments are clearly separated by membranous areas called pleura (singular: pleuron).

1b. Anatomy of the abdomen- The abdomen is relatively simple in form. It consists of a series of repeated segments called metameres. Each metamere has a dorsal and a ventral sclerite (hardened plate of exoskeleton). The dorsal sclerite is called the tergum, and the ventral one is called the sternum. The male grasshopper will have a rounded abdomen, while the female has a scissors-shaped structure for egg laying called the ovipositor. Make sure you know how both sexes look. Note the spiracles along the abdomen. These are openings into its tracheal system, which is a network of air-filled tubes for respiration.

1c. Anatomy of the thorax- The locomotory appendages (legs) and wings are attached to the thorax. It consists of three fused segments, which are called prothorax (anterior), mesothorax (middle), and metathorax (posterior). All three segments are visible from the dorsal side (pronotum, mesonotum, metanotum). Remove two wings on the right side of the grasshopper. On the posterior part of the mesonotum and metanotum, you can see a projection called the scutellum.

The sutures on the lateral side of the thorax are less conspicuous than those on the dorsal side. Look for spiracles and the tympanum (hearing structure). The anterior walking legs are attached to the prosternum on the ventral side, the middle ones to the mesosternum, and the posterior ones to the metasternum. Make sure you have located these structures.

Note that the grasshopper has two pairs of wings. Compare the way that the wings are attached to the dorsal side of the thorax with the attachment of the legs to the ventral side. Wings are not true appendages, i.e. they are not homologous to other appendages on the insect. They evolved independently after the evolution of insects.

After completing your examination of the grasshopper, draw its body, viewed from the side, and label the parts listed in 1a and 1c.

1d. Anatomy of the head (pp. 31-32)

Next you should look closely at the head of the grasshopper. Several appendages are also attached to it. They are specialized for feeding and for sensory perception. The head was originally segmented like the thorax and abdomen, but the fusion of segments has progressed so far that their sutures cannot be seen. Turn the head towards you and locate the frons on the anterior and the clypeus just above the mouthparts. The antennae are attached to the anterior.

Next you should remove the mouthparts (Fig. 30). The first structure is the labrum, which is clearly a projection but not an appendage. Below the labrum, chewing mandibles are evident,

and behind them, you can find the maxillae. These structures are for holding and manipulating food. Sensory (taste) structures are also located on the maxillary palps. Below these, you can see the labium. In the grasshopper, the right and left sides of two appendages have been fused into one, which also has a sensory function. After you have removed these appendages, examine them under the dissecting scope. **Draw the mouthparts and label them.**

1e. Anatomy of the leg (pp. 32-33)

The first two legs are similar. Note that the segments differ in size and shape. The relatively small coxa and trochanter provide attachment to the thorax. These are followed by two large segments that support the grasshopper (femur and tibia). These, in turn, are followed by several small segments called tarsi. At the distal end you will see the pretarsus or claws. Note that the hind legs are greatly modified for jumping! **Draw the leg and label its parts.**

Activity 2- Comparing the grasshopper to other insects

2a. Body comparison to 'true bugs'- Bugs are characterized by their beak with piercing and sucking mouthparts. Their bodies are less rounded than the grasshopper. Examine a bug under the dissecting scope. Note the shape of the wings, similarity of the legs to the grasshopper, and the thorax with its conspicuous scutellum (p. 134, Fig. 124). Then turn the bug over and look at mouthparts on the ventral side (p 32, Fig. 30). Note that all parts are highly modified from the general grasshopper form.

Make a list comparing the appearance of the scutellum, mouthparts, and position of the wings on the grasshopper versus the bug.

2b. More mouthpart comparisons- Examine the mouthparts of a beetle and identify as many as you can. You should see that beetle mouthparts are more generalized in form. Locate a microscope slide of a mosquito and note how its mouthparts are also modified for piercing and sucking. Next examine mouthparts of a butterfly. The proboscis is a modified labrum which functions like a straw (p 258, Fig. 233). Finally, look at mouthparts of a housefly to see the extended labrum.

Activity 3- Observing respiration and circulation

There will be several live crickets whose wings have been removed and that have been immobilized by crossing pins over their bodies. Obtain one of these and examine the dorsal side of its thorax carefully. Identify the heart, which looks like a tube that you can see through the intersegmental membranes along the dorsal side of the thorax. You should see the haemolymph being pumped by the heart regularly. Determine the rate at which the heart is pumping. Then examine the abdomen carefully to determine the breathing rate.

Heart rate (beats per minute) _____

Breathing rate (per minute) _____

Activity 4- Cricket dissection

Obtain a dead cricket and several insect pins. Determine its sex, then remove the wings and pin the insect dorsal side up through the head and at the posterior extreme of the animal. Add saline solution and cut the cricket open with a fine scissors. Cut along the dorsal side of the body from posterior to anterior end. Pin the sides of the body wall in your dissecting pan as shown on the diagram (using only a few insect pins)! Position your cricket beneath the dissecting scope so that you can see the internal structure.

You should see the tracheal system leading from the spiracles to the internal organs. The whiteish or silverish tracheal tubes almost resemble a vascular system, but remember that they are filled with air, not haemolymph. You may also see a chalky globular structure, the fat body, which works somewhat like a liver by metabolizing and storing carbohydrates, lipids and proteins.

At the anterior end of the cricket, you should see the digestive tract and you may see the dorsal heart above it. In the cricket, food moves from esophagus into the crop (for storage) and a proventriculus (which grinds solid food). From there it moves into the midgut. The gastric caecae are pouches leading into the ventriculus. Further to the posterior is the intestine, which may be partly covered by the ovaries or testes. You will see malpighian tubules at the juncture of midgut to hindgut. They empty through the ureter into the gut cavity. Now sever the esophagus and rectum, and lift the digestive tract out of the cricket. You will need to cut its tracheal connections to the cuticle to remove it. **Stretch out the gut, draw, and identify the structures shown in the figure.**

Now you should be able to see the reproductive tract of the cricket. Identify the gonads and look for ducts leading to the genitalia. Then rinse out the body of the cricket and pour most of the solution away. Add two drops of methylene blue dye, wait a minute, and add water. Pick away tissue and examine the ventral nerve cord. Look for ganglia along the segments.