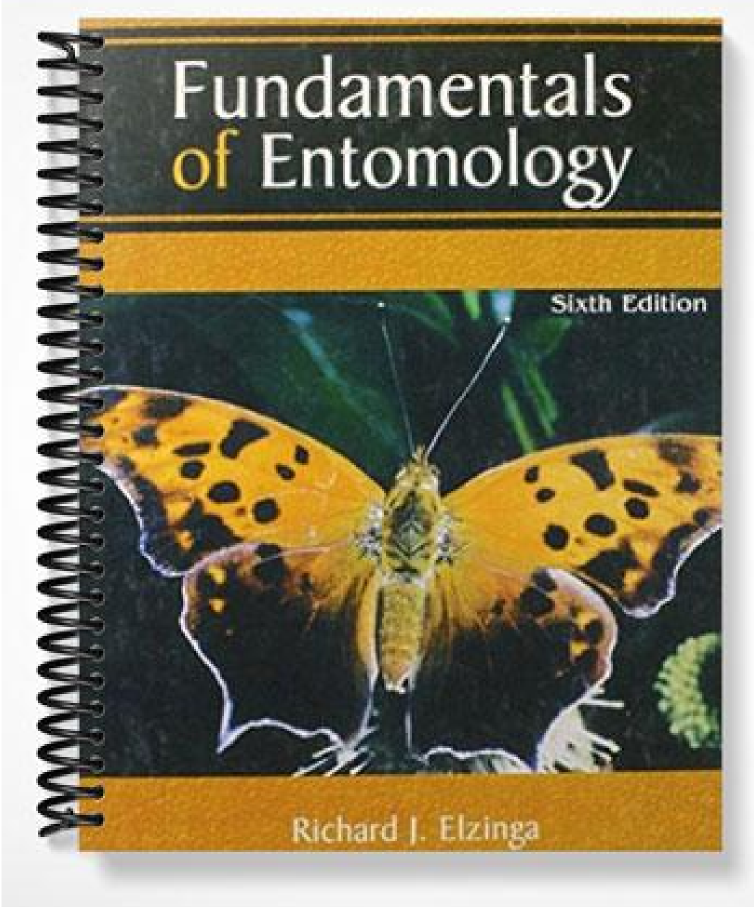
SOLUTIONS MANUAL



CHAPTER 2 - THE INSECT EXTERNALLY

Overview

As learned in Chapter 1, insects possess an exoskeleton and their bodies are organized into three major regions; the head, the thorax, and the abdomen. The head carries out feeding using modified appendages and interacts with nature using its photoreceptors (compound eyes, ocelli, and stemmata) and various receptors in the paired antennae. The thorax has become specialized for locomotion (legs and wings) while the third region, the abdomen, comprises the remainder of the body with the remaining functions. By studying these structural modifications, much of the biology of an insect can be understood.

Objectives

Students should be able to:

- understand the body regions and their major functions, the number of segments in each, and the sclerites of each segment
- understand what appendages are present on each body region and how they function
- know which appendages are involved in obtaining food and how they are modified for different food types
- understand how an insect senses the environment and where these structures are located
- know how locomotion is accomplished
- understand how the male and female genitalia are modified for reproduction

Chapter Questions and Answers

1. What are the major functions of an insect head? How do these compare with those of other animal heads?

Answers – These answers are elaborated upon on Page 28.

2. What insects would be expected to have the most sclerotized heads? Why?

Answer – In the most specialized feeder, especially where hard foods must be chewed, much muscular stress must be applied to the feeding activity without collapsing the head.

3., 4, 5. What appendages are associated with the head? What are their functions? Mouthpart questions.

Answers – The mandibles, maxillae, and labium are appendages used for feeding (see Pages 30 to 40 for adaptation ad use) and the antennae are for sensory pickup (see Pages 44 to 45 for modifications).

6. Is there a correlation between the diet and the number of ommatidia present in the compound eye? Elaborate.

Answers – Generally yes. Predators, flower feeders, and insects that mate while flying require the best visual acuity that comes from having large numbers of those receptors whereas vertebrate parasites, those that remain on the host and need not seek new food sources, have the least.

7. What is the major function of the thorax? How many body segments make up the thoracic region? Which of these is or are the most highly modified? Does any change in the thorax occur in progressing from an immature to an adult?

Answers – This body region is specifically modified for locomotion. There are 3 segments in the thorax, all being similar except in winged adults where the 2^{nd} and 3^{rd} become enlarged and their sclerites subdivided to carry out flight. See Pages 45 to 49.

8. Are wings found in all insects and all stages? How do wings develop? What is the function of wing veins?

Answers – Wings are found only on the meso – and metathorax of adult insects and arise from wing pads of the immatures (see Pages 49 to 50). Wing veins brace the thin membranous wings during flight.

9. What is fluting? How is it advantageous?

Answers – Fluting is the result of longitudinal creases in the wings. Fluting plus the additional bracing of crossveins permits wings to increase in size and bear the weight of this additional size.

10. Do we know how wings evolved? Explain your answer.

Answer- Various theories have been proposed to address this issue, which are summarized on Page 50. Additional details of each theory can be obtained by consulting the references cited.

11. What is the difference between neopterous and paleopterous wings? Which is the most common type?

Answers – Neopterous wings can be folded back over the body when not flying, which gives some insects considerable flexibility in where they can be active (they can hide in restricted habitats yet expand the wings for flight). Therefore, as expected, neopterous wings are highly advantageous and are found in over 80 percent of the insects possessing wings.

12. What advantages are gained by the presence of wings? What are some disadvantages?

Answers – The advantages are listed on Page 55. Disadvantages are mainly one of restricting movements when in confined habitats (paleopterous) and, in some insects, of making the insect more visible to potential predators.

13. Why is it that only the forewings and not the hindwings become protective structures? What are the names of these protective wings?

Answer – Since the wings fold back over one another and over the body, the forewings will always be outside the hindwings and become the only ones that could be selected for a protective role. Leathery textured wings are termed tegmina, wings hardened only at the base are hemelytra, and completely hardened wings are referred to as elytra.

14. What are some of the modifications of insect legs? On which body segment would you expect jumping, digging, and grasping legs to be located? Why? How does each modification better equip the organism to survive?

Answers – These questions are elaborated upon on Pages 55 to 59.

15-17. How many body segments make up the abdomen? What are the functions of the abdomen? Are any appendages associated with the abdomen? What is their function? What is an ovipositor? What selective advantages does it give the possessor?

Answers – The abdomen has many roles and, hence, has many variations in structure. The number of segments varies from 5 in Collembola to the normal of 10 to 11 in other insect orders. The 11th segment, when present, possesses appendages termed cerci and, therefore, has extensive sensory involvement. The 8th and 9th segments contain the appendicular ovipositor (when present) in adult females and the 9th becomes aedeagous in adult males. The ovipositor structure and functions are found on Pages 61 to 62. Internal functions will be presented in Chapter 3. Some immature insects retain locomotor involvement in this region or can possess appendicular gills.