

SECTION 2  
CHAPTER 5

# INSECTS AND THEIR RELATIVES

## LEARNING OBJECTIVES

After completely studying this chapter, you should:

- Know the common characteristics and the various classes of “arthropods.”
- Understand how divisions are used in insect classification.
- Know the different stages of insect growth and development.
- Understand why knowledge of insect growth and development is an important pest management consideration.

Plants, in many forms from great trees to tiny mosses, cover the land. The plant kingdom began as microscopic single cells—pond scum. Their descendants are the algae, bacteria, and fungi living today. Larger prehistoric plants developed from their smaller ancestors; finally, flowering plants, modern shrubs, and trees evolved.

Forebears of insects were the first animals to move onto land—before plants had flowers. As plants developed, so did the insects, feeding on evolving plant structures such as flowers, pollen, nectar, leaves, bark, stems, roots, and their dead remains.

At the time of early insect development, the land had a uniform climate: one with moisture and temperature adequate for constant growth. Later, the surface land mass (continents) shifted, moving northward and southward, creating seasons, and setting the stage for the world as we know it.

## INSECTS AS PART OF THE ANIMAL KINGDOM

Living things are divided into the plant kingdom, the animal kingdom, and several smaller kingdoms of microscopic life. Insects are part of the largest group in the animal kingdom—the phylum Arthropoda. In this group the “arthropods” include spiders, mites, ticks, millipedes, centipedes, crabs, shrimp, and insects.

### Phylum Arthropoda

An arthropod has:

- A body made of segments, which are grouped or fused together.
- Legs, antennae, and other appendages attached in pairs.
- A hard or tough external covering with some pliable, or soft parts. This hard outer covering holds the body together and gives it shape. It performs the same function as the mammal’s bony internal skeleton and is called an *exoskeleton*.

Principal classes of arthropods are:

**Arachnida.** This class includes spiders, mites, scorpions, daddy longlegs and others. These arthropods usually have mouthparts with two prominent structures that end in needle-like piercing tips. They have four pairs of legs and two body regions: the mouthparts and legs are attached to the first region; the reproductive organs and digestive system are contained in the second.

**Crustacea.** This class includes aquatic crabs, lobsters, and shrimp, as well as crustacea that dwell on land (pillbugs and sowbugs).

**Myriapoda.** This group is made of two classes—millipedes and centipedes. The millipedes are many-segmented and worm-like; they are cylindrical with short antennae and two pairs of legs per segment. Centipedes are also many-segmented and worm-like, but they appear more flattened and have one pair of legs per segment; antennae and hind legs are long (all legs of the house centipede are very long).

**Insecta.** This class contains the insects: arthropods with three body regions—head, thorax, and abdomen. The head bears a single pair of antennae. The thorax bears three pairs of legs and usually wings. The abdomen contains most of the digestive system and the reproductive organs.

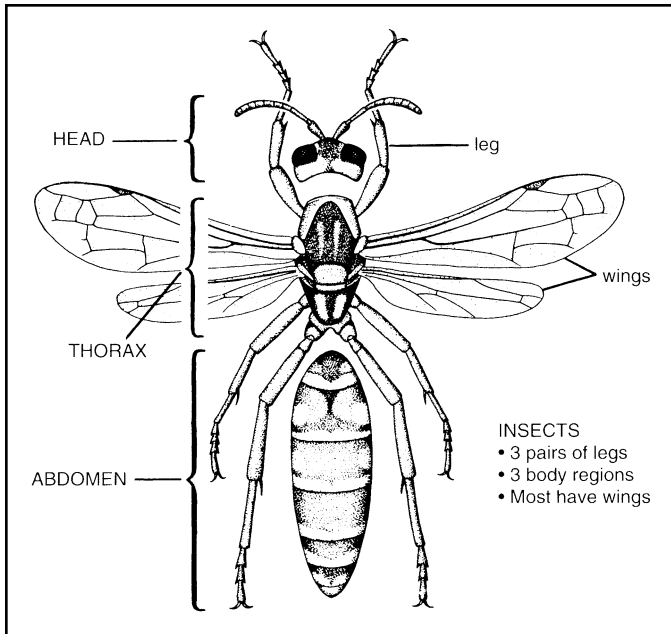


Figure 5-1. The three principal regions and parts of an insect's body, as shown on the paper wasp. (Provonsha)

### Other Divisions Used in Classification

Classes of arthropods, insects, for example, are divided into **orders**. These are distinct groups whose members look very much alike (e.g., the order of moths and butterflies, or the order of beetles).

Orders are subdivided into **families** made up of related **species**. Species of animals can be thought of as specific kinds of animals. Very closely related species are grouped together in a **genus**. Species or types of animals (and plants) are given scientific names that always consist of two words—the first word is the genus name (the first letter is always a capital), the second is the species name (always lower case). Both are written in italics or underlined (e.g., *Musca domestica*). Well known species also usually have non-scientific names, called "common names" (e.g., housefly).

## GROWTH AND DEVELOPMENT

### Growth

The arthropod body is confined in its *exoskeleton*. This outer covering can expand only a little at pliable or soft places. It does not grow continuously. Arthropods grow in stages. They form a new, soft exoskeleton under the old one, then shed or *molt* the old one. The new skeleton is larger and allows the animal to grow. The new exoskeleton is white at first, but it hardens and darkens in a few hours. After the molting process, which usually takes place in hiding, the arthropod resumes its normal activities.

### Development

Most arthropods hatch as tiny individuals and grow by molting, usually keeping the same appearance until they become adults. However, a spectacular and very important exception occurs in the class Insecta. The insect class is divided into groups according to the way insects change during their development. This change is called by the technical term *metamorphosis*, which means "change in form." Three main types of metamorphosis have been identified.

### Group 1. Simple Metamorphosis

This group, including the order of silverfish, makes no drastic change in form from juvenile to adult. They simply hatch and grow larger by molting periodically. Only a few orders are included in this group.

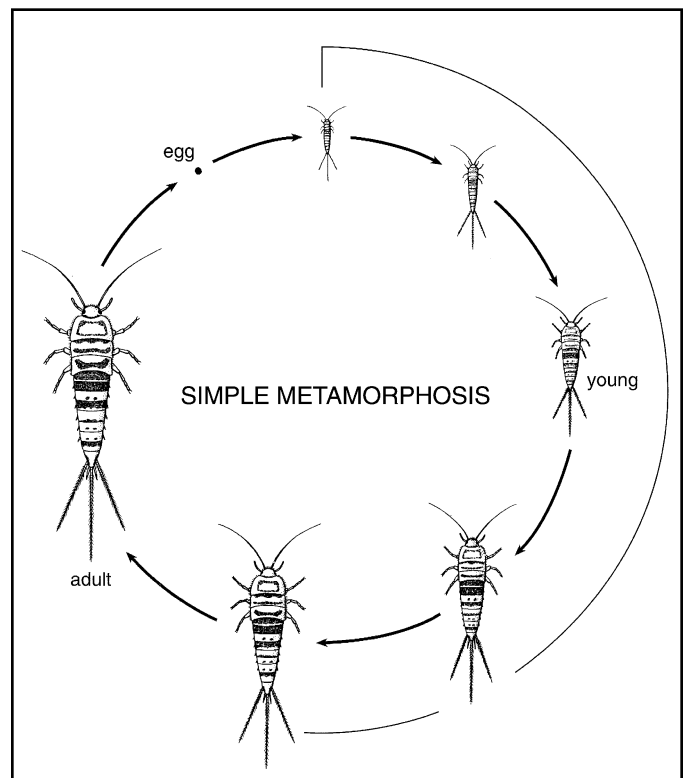


Figure 5-2. Development with simple metamorphosis (example: silverfish). (Provonsha)

## Group 2. Gradual Metamorphosis

In this group (e.g., cockroaches, crickets, grasshoppers, box elder bugs, earwigs, etc.),

individuals hatch from the egg only partially resembling the adults. The immatures, or *nymphs*, do not have wings. Winged insects are always adults. Fourteen orders develop in this way. Some of these orders have many species and include many pests. Nymphs and adults are often found together and usually eat the same food.

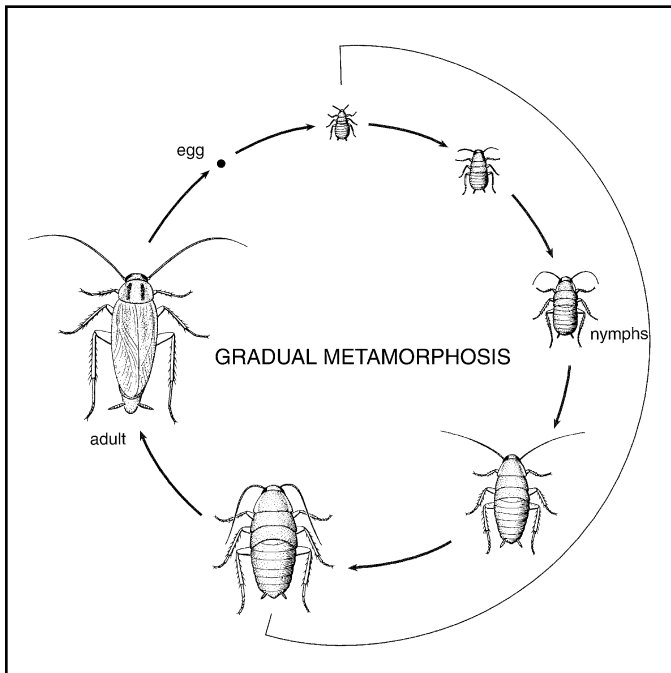


Figure 5-3. Development with gradual metamorphosis (example: cockroach). (Provonsha)

## Group 3. Complete Metamorphosis

Insects that develop by complete metamorphosis make a complete change in appearance from juvenile to adult. These nine orders contain the majority of insect species. *In fact, they number more than all of the other species in the entire animal kingdom!* This major group includes beetles, moths and butterflies, flies, fleas, and stinging insects (ants, bees, and wasps).

Insects with complete metamorphosis hatch from eggs as *larvae* (grubs, maggots and caterpillars). The mission of the larval stage is to feed and grow. Larvae continue their development through a number of molts until they become mature; then, they change into *pupae*. The purpose of the inactive pupal stage is one of change or body rearrangement resulting in a complete change into the adult stage. Reproduction occurs during the *adult* stage.

## Considerations of Pest Management

These developmental stages of insects with complete metamorphosis support rather than compete with each other. It is as if two or three completely different animals with different needs and habits represent the single species. The larvae feed and live in one habitat and some-

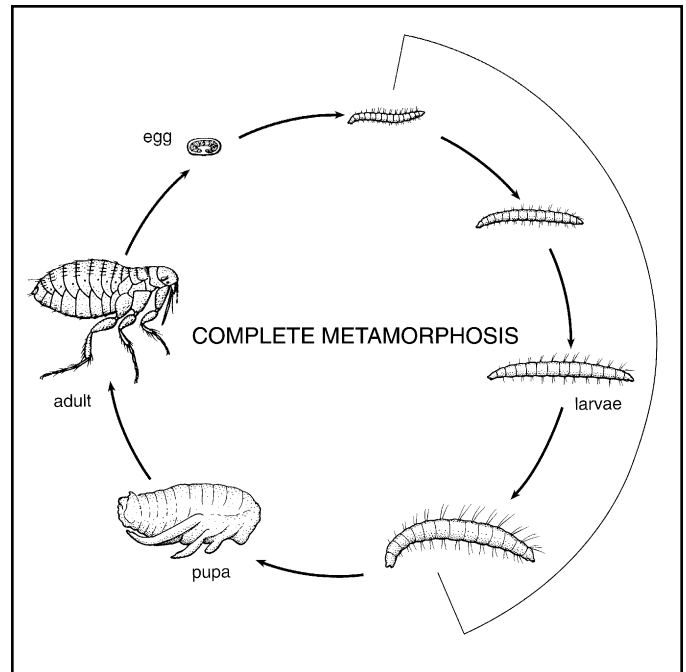


Figure 5-4. Development with complete metamorphosis (example: flea). (Provonsha)

times leave that area to pupate a short distance away. The adult emerges and often eats a different food and lives in another area, returning to the larval feeding site only to lay eggs. For this reason, pest controllers manage species with complete metamorphosis in different ways according to the different stages, where each lives, and what each does. The reader will want to pay special attention to sections that discuss the growth cycle, behavior, and harborage (the area in which the animal lives and finds its food) of each animal.

## SUMMARY

The class Insecta belongs to the phylum Arthropoda, which includes other non-insect classes (spiders, mites, centipedes, crabs, etc). Arthropods are grouped in the same phylum because of similar features, including segmented bodies and exoskeletons. Insects are distinguished from other arthropods in that they do not keep the same appearance as they grow. Instead, they undergo a metamorphosis or a change in body shape as they develop from one stage to another. It is important that the pest control technician understand the different stages of insect development so that the appropriate pest control technique can be applied.

SECTION 2  
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## Review Questions

### Chapter 5: Insects and Their Relatives

Write the answers to the following questions and then check your answers with those in Appendix A in the back of this manual.

- Which of the following characteristics do all arthropods share?
  - Six legs
  - Appendages in pairs
  - Undergo complete metamorphosis
  - Nymphs are wingless
  - A & B
- Match the following with the appropriate description.
  - Arachnida
  - Myriopoda
  - Crustacea
  - Insecta

\_\_\_\_\_ 2. Class that includes pillbugs and sowbugs.

\_\_\_\_\_ 3. Two body regions; class includes scorpions.

\_\_\_\_\_ 4. Many-segmented bodies.

\_\_\_\_\_ 5. Three body regions.
- On which segment of an insect's body are the legs and often the wings attached?
  - Thorax
  - Head
  - Abdomen
  - Antennae
- Which is the correct ranking of divisions used in classification?
  - Class, order, family, species, genus
  - Order, class, family, genus, species
  - Family, class, order, species, genus
  - Class, order, family, genus, species
- Match the following with the appropriate description.
  - Cockroaches
  - Ants
  - Silverfish
  - All three

\_\_\_\_\_ 8. Undergo simple metamorphosis.

\_\_\_\_\_ 9. Nymphs are wingless; adults have wings.

\_\_\_\_\_ 10. Hatch from eggs as larvae.

\_\_\_\_\_ 11. Grow by molting.

\_\_\_\_\_ 12. Have an exoskeleton.

\_\_\_\_\_ 13. Undergo complete metamorphosis.
- Why is it important for pest control technicians to understand the different stages of insects that undergo complete metamorphosis?