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# Insects

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### Learning Objectives

- Learn the basic characteristics and major classifications of insects.
- Understand the basic anatomy of insects.
- Describe the differences between incomplete and complete metamorphosis life cycles in insects.
- Understand the basic philosophies of integrated pest management (IPM) and how this relates to insect management.
- Understand the importance of insect pollination.
- Learn the common symptoms of insect damage and how to diagnosis insect damage.
- Be aware of the most common insect pests found in Illinois landscapes.

# Insects

## Insects and Their Relatives

Insects and their relatives have been coexisting with man for thousands of years. It is estimated that there are over 30 million unidentified species of insects in the world. Although many people may consider insects as undesirable creatures, of the approximately 850,000 identified species (with an estimated total of one million described) it is generally agreed that “only” a small number (approximately 10,000) of these species are actually destructive. The remaining species may be broadly grouped as either beneficial or harmless insects.

Before developing strategies for insect pest management, it is important to study the insect world and the often delicate and fragile relationship that exists between insect species, other animals, plants and people.

Throughout history, serious problems have occurred due to insect pests. They have been known to cause devastating crop losses and transmit disease to crops, animals and humans.

### ■ Classification of Insects and their Relatives

Insects are members of the vast and diverse animal kingdom. The animal kingdom is organized into groups based on similar structural features. The first classification is called the Phylum. There are ten common phyla in the animal kingdom and members of each of these phyla exhibit similar features.

KINGDOM  
PHYLUM  
CLASS  
ORDER  
FAMILY  
GENUS  
SPECIES

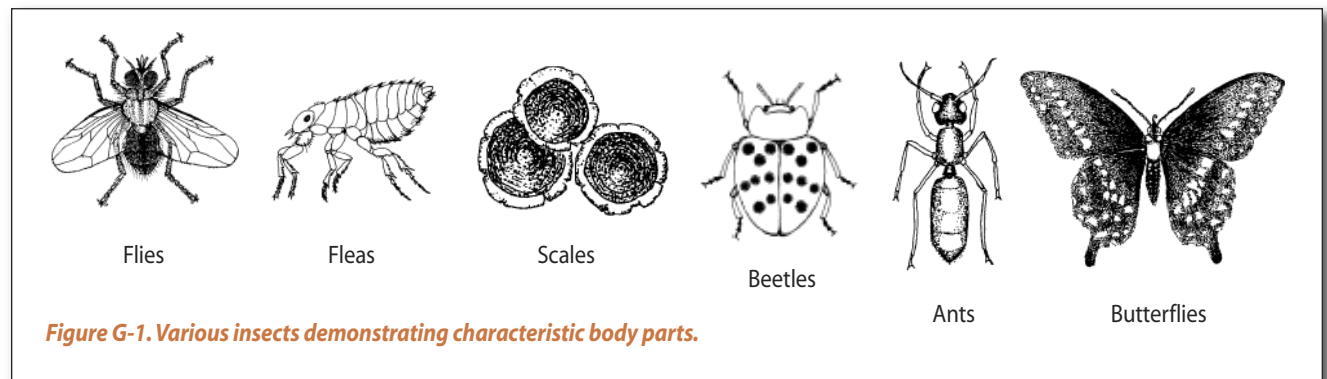


Figure G-1. Various insects demonstrating characteristic body parts.

### PHYLUM

Each phylum is further divided into the subgroups: class, order, family, genus, and species based upon similarities. Insects and “insect relatives” belong to the phylum arthropoda—literally meaning “jointed foot.” All arthropod members have the following characteristics:

- A segmented body
- Paired segmented appendages
- An exoskeleton that is periodically shed (“molted”) and renewed (humans have an endoskeleton)
- An open circulatory system (the insect hemolymph (blood) is not in vessels but sloshes through the tissue)
- A ventral nervous system (humans have a dorsal nervous system)
- Respiration by gills or a system of tubes (tracheae)
- The hemolymph usually does not carry oxygen
- Separate sexes

### CLASS

Arthropods are further divided into five major classes: Arachnida, Chilopoda, Crustacea, Diplopoda, and Hexapoda (Insecta). The Hexapoda class is the largest of these classes and includes 7/8ths of all arthropod members. True insects are members of the Hexapoda (Insecta) class. This class includes true bugs, butterflies, bees, beetles, flies, fleas, scales, termites, ants, etc.

### INSECT ORDERS

Millions of insects exist and they are further organized into groups (taxa) with similar characteristics such as mouthparts, wing structure, and metamorphosis. Depending upon classification, 26 to 30 different orders are recognized.

### ■ Characteristics of Insects (Figure G-1.)

- Three body regions (head, thorax, abdomen)
- One pair of antennae
- Chewing or piercing-sucking mouth parts
- Thorax usually with two pairs of wings (sometimes only one or none)
- Thorax usually with three pair of legs (sometimes none)

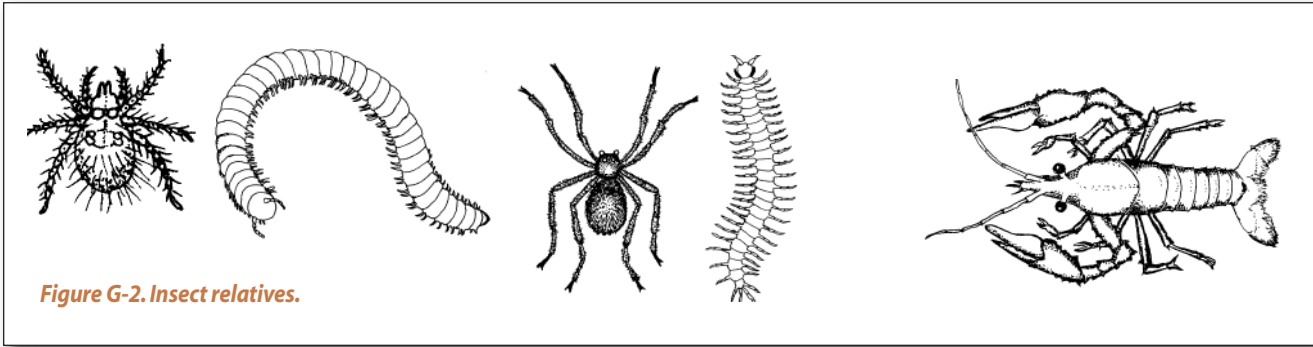


Figure G-2. Insect relatives.

### ■ Characteristics of Insect Relatives (Figure G-2.)

#### Spiders, Mites and Ticks (Arachnida)

- Have two body regions (cephalothorax, abdomen)
- Have four pairs of legs
- No antennae
- Spiders have eight simple eyes
- Ticks are large mites

#### Millipedes (Diplopoda)

- Two body regions
- Elongate or “wormlike”
- Rounded in cross section
- Two pairs of legs per body segment

#### Centipedes (Chilopoda)

- Resemble millipedes
- Flattened in cross section
- One pair of legs per body segment

#### Crustaceans—Lobsters, Crayfish, Barnacles, Sowbugs (Crustacea)

- Two body regions
- Mostly aquatic species, except for the sowbugs
- One pair of compound eyes
- Two pairs of antennae
- Five–seven pairs of legs

### ■ Insect Anatomy

All insects have three body regions: head, thorax, and abdomen (see Figure G-3.). The head contains the mouth parts, antennae, and eyes. The thorax is where the legs and wings are attached, and the abdomen contains reproductive and sensory structures.

#### EXTERNAL ANATOMY

##### EXOSKELETON

The exoskeleton has three major functions. The first is for protection and support; it protects the insect’s internal muscles and organs from many outside influences such as disease organisms, natural predators and parasites, desiccation, pesticide penetration, etc. Secondly, the exoskeleton acts as a receptor of vari-

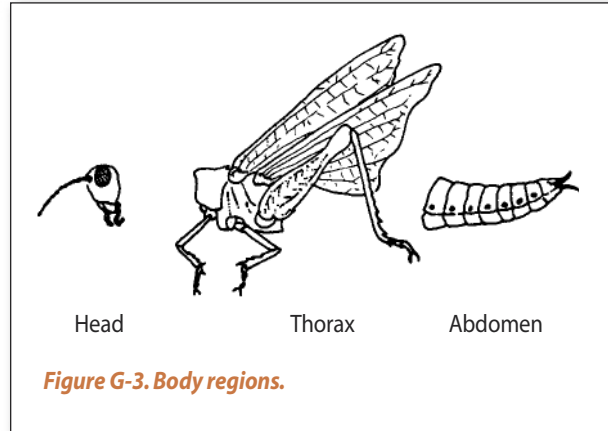


Figure G-3. Body regions.

ous stimuli and aids in communication between the outside world and inside the insect. For example, some epidermal cells may be modified to recognize heat and humidity changes, or changes in wind direction. Also, the exoskeleton is directly involved with insect movement. The muscles are attached to this outer body wall. The insect body is segmented which allows for flexibility. These segments are fused together to form the three body parts: head, thorax and abdomen.

##### HEAD

The major parts associated with the head are the antennae, eyes, and mouthparts. The head position is dependent upon its mouthparts and the type of food that it eats (Figure G-4.).

The mouthparts may project forward, downward or backward.

The antennae are located between or just below the eyes and act as sensory structures. Using their antennae, insects can detect a wide range of environmental conditions, such as chemical cues, changes in humidity, the surface they are walking upon, and vibrations.

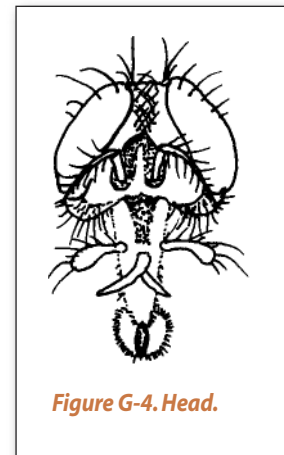


Figure G-4. Head.

**Antennae** may be very conspicuous and their structure can differ greatly between insect species. Antennae can be helpful for taxonomic (identification) purposes (Figure G-5.).

**Compound eyes** are the major sight organs. Most adult and many young insects have compound eyes. Each compound eye is made up of individual receptor units. Each individual receptor unit can perceive shape, movement and light.

**Simple eyes** contain only one receptor unit or lens and perceive only light. This eye does not provide a reliable image.

Insect mouthparts have evolved into a wide variety of types and are directly related to their food source. For example, caterpillars, termites, beetles and other insects that feed on solid material have **chewing** mouthparts. Their mouthparts have specially developed structures called **mandibles** that act like jaws with teeth. Insects with chewing mouthparts literally cut and chew plant tissue. Beetles and caterpillars may completely defoliate a tree or leave behind ragged, hole-filled leaves.

Some liquid feeders such as aphids, mealybugs and leafhoppers, have **piercing-sucking** mouthparts that are needle-like and are inserted into plants or prey to suck up the fluids. Attacked plants may have curled and puckered leaves or stems, discolored or spotted leaves, or bumpy or malformed fruit.

Mouthparts may be generally classified into the following types: **chewing, siphoning, piercing-sucking, rasping/sucking, sponging, chewing/lapping** and **cutting-sponging**. The following are some examples (Figure G-6. on page G-4):

- Chewing: beetle, grasshopper, grub, wasp, ant, termite, caterpillar
- Siphoning: butterfly, moth
- Piercing/sucking: flea, mosquito, aphid, scale, true bug, leafhopper
- Rasping/sucking: thrips
- Sponging: housefly
- Chewing/lapping: honeybee
- Cutting-sponging: deerfly, horse fly

### THORAX

The second body region of the insect is the **thorax** and it is the site of **legs** and **wings** (if present). The thorax is divided into three segments, each with a pair of legs. In winged insects, each of the posterior two segments has a pair of wings (Figure G-7.).

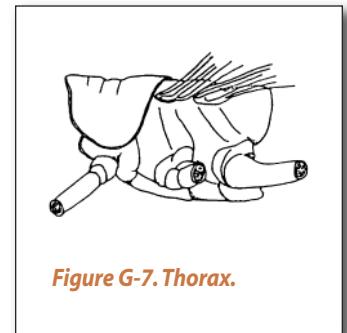


Figure G-7. Thorax.

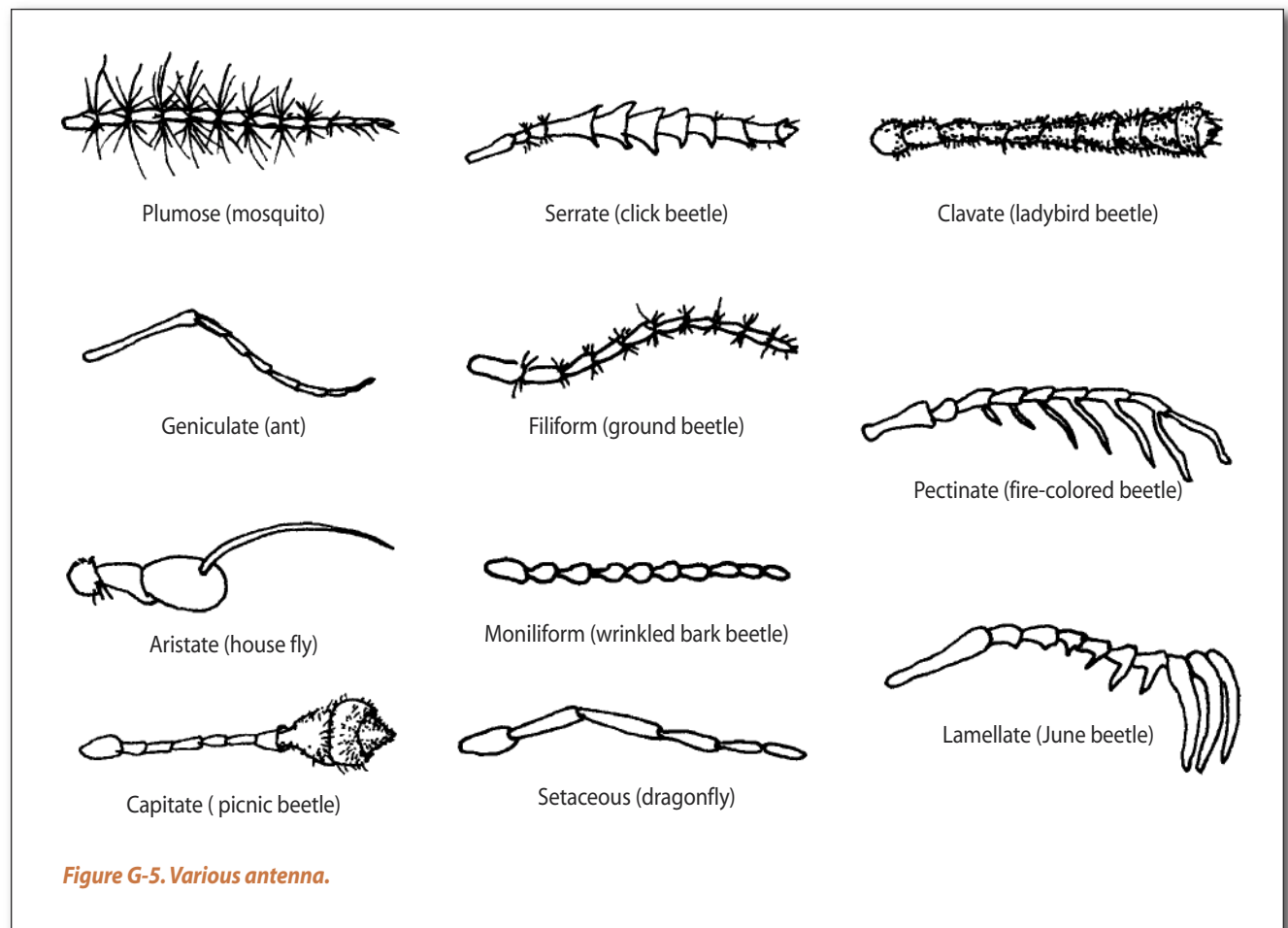


Figure G-5. Various antenna.

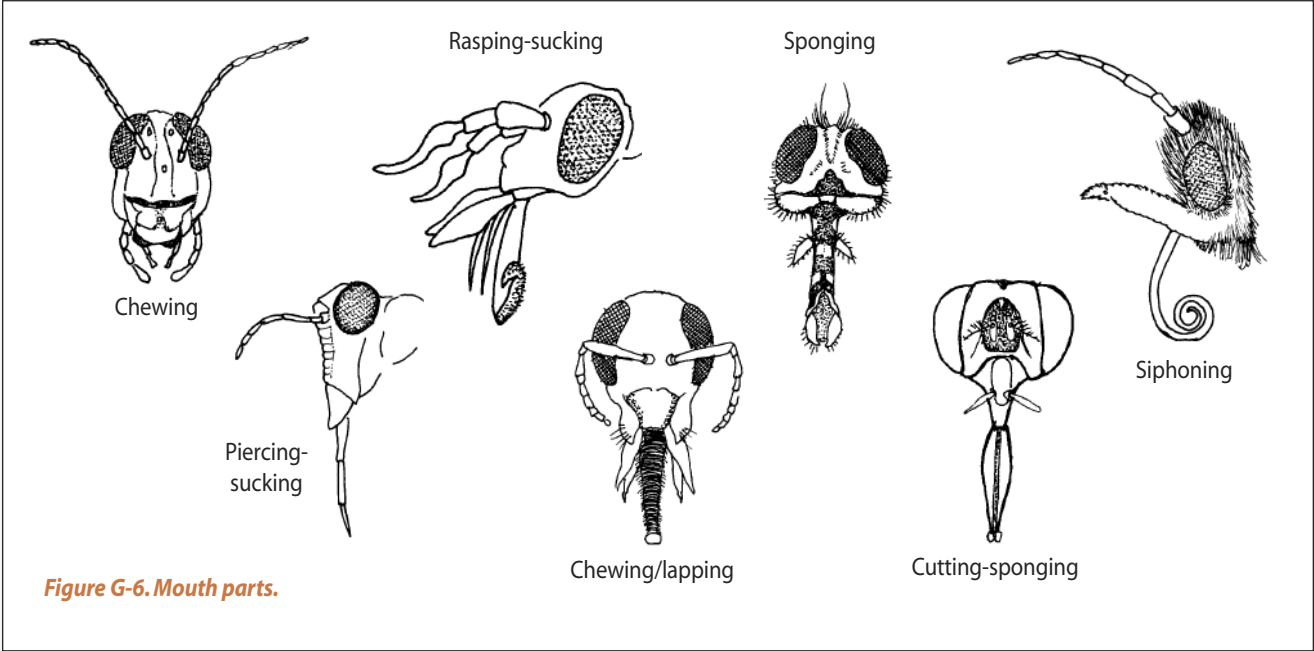


Figure G-6. Mouth parts.

**LEGS**

Insects have three pairs of legs which enable them to move about readily. These legs may have many modifications. They may be specifically adapted for jumping with enlarged legs (grasshoppers), or for running with long and slender legs (cockroaches), or even for swimming with flattened and hairy legs (water beetles).

Five segments comprise the standard walking leg progressing from the body to the end of the leg (see

- Figures G-8. and G-9.):
1. The COXA—a thick short segment connecting the rest of the leg to the thorax.
  2. The TROCHANTER—another short segment.
  3. The FEMUR—a larger muscular and robust segment that usually turns upward.
  4. The TIBIA—a larger and thinner segment turning downward and often having spines.
  5. The TARSUS—the “foot,” consisting of one to five shorter segments, with the last segment taking the form of claws or pads.

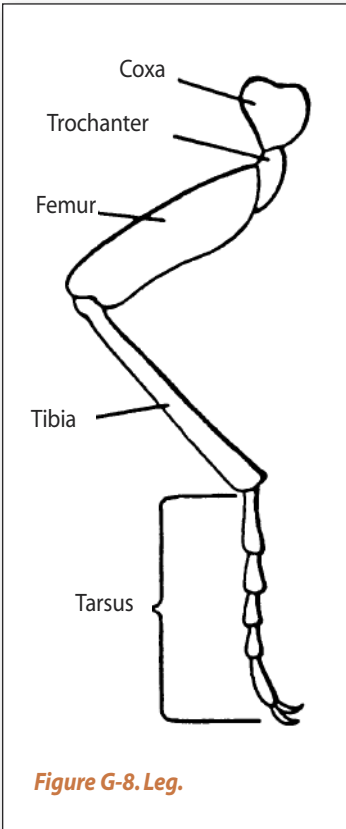


Figure G-8. Leg.

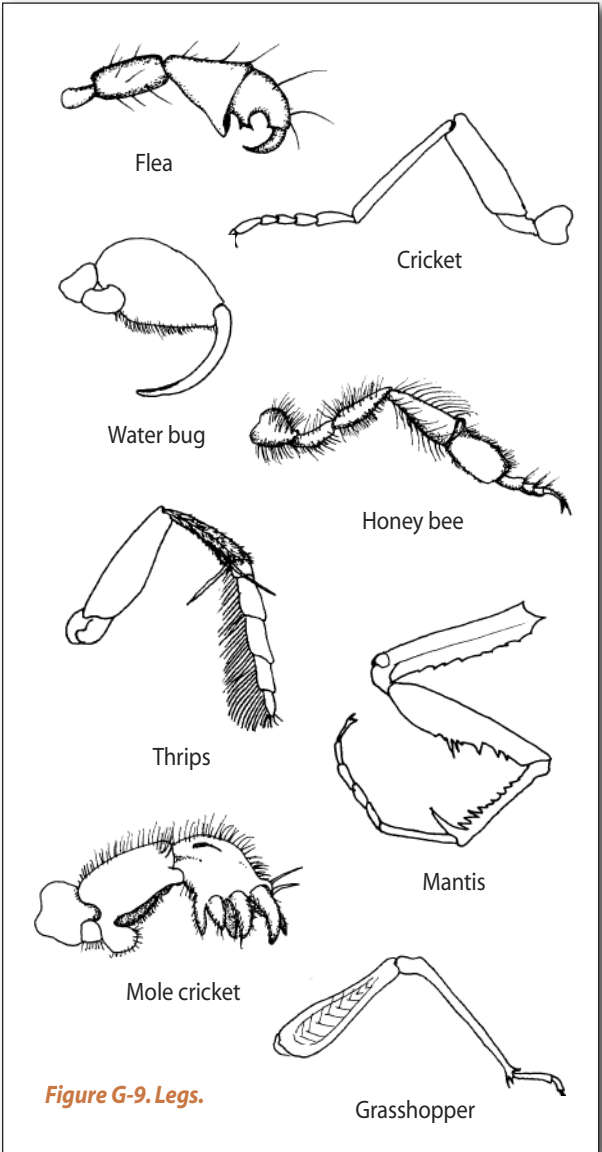


Figure G-9. Legs.