The animal kingdom contains many distinct groups called phyla (plural). Each phylum (singular) is divided into a number of classes. Insects represent one of several classes of the phylum Arthropoda (jointed foot); their class is called Insecta or Hexapoda, which means six feet (Table 1). The insect class is further divided into orders (Table 2), families, genera and finally species. The genus, species and name of the author who first described it constitute the scientific name of a species; for example, the codling moth, *Cydia pomonella* (Linn.), was first described by Linnaeus. Often the author’s name is omitted and only the genus and species are listed (e.g., *Cydia pomonella*).

Approximately 1 million insect species have been described, more than 90,000 of them in North America. It is believed that as many as 10 million may exist worldwide. The greatest numbers of species belong to the beetle, fly, moth/butterfly and wasp/ant/bee orders.

Fewer than 1 percent of all insect species are serious pests that affect humans, their animals, crops, structures or fiber. However, this small number can cause serious problems such as:

- Crop loss
- Structural damage
- Transmission of disease-causing pathogens between plants (e.g., fire blight bacteria by pollinating insects), humans (e.g., malaria by mosquitoes) or other animals (e.g., dog tapeworms by fleas).
<table>
<thead>
<tr>
<th>Term</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Abdomen</strong></td>
<td>The third (hind) body region. Composed of as many as 11 segments and lacking legs or wings.</td>
</tr>
<tr>
<td><strong>Antenna</strong> (pl., antennae)</td>
<td>A segmented organ located on the head, usually used for smell.</td>
</tr>
<tr>
<td><strong>Cell</strong></td>
<td>An area in a wing between veins.</td>
</tr>
<tr>
<td><strong>Cercus</strong> (pl., cerci)</td>
<td>A thread-like or sometimes forceps-like tail near the tip of the abdomen (usually a pair).</td>
</tr>
<tr>
<td><strong>Complete metamorphosis</strong></td>
<td>A type of insect development in which the insect passes through the stages of egg, larva, pupa and adult. The larva usually is different in form from the adult.</td>
</tr>
<tr>
<td><strong>Compound eye</strong></td>
<td>An eye with many individual elements or facets.</td>
</tr>
<tr>
<td><strong>Cornicle</strong></td>
<td>A short, blunt horn or tube (sometimes button-like) on the top and near the end of an aphid’s abdomen. Emits a waxy liquid that helps protect against enemies.</td>
</tr>
<tr>
<td><strong>Elytron</strong> (pl., elytra)</td>
<td>One of a beetle’s leathery or hard front wings. Usually covers a hindwing when at rest and sometimes called a wing cover.</td>
</tr>
<tr>
<td><strong>Furcula</strong></td>
<td>A forked “tail” on the underside of the abdomen of Collembola (springtails), used for jumping.</td>
</tr>
<tr>
<td><strong>Gradual metamorphosis</strong></td>
<td>See simple metamorphosis.</td>
</tr>
<tr>
<td><strong>Haltere</strong></td>
<td>A small, knob-like organ (sometimes shaped like a baseball bat or bowling pin) located on the thorax of Diptera. Takes the place of hindwings and helps balance the insect in flight.</td>
</tr>
<tr>
<td><strong>Honeydew</strong></td>
<td>A sticky substance excreted by aphids and some other insects.</td>
</tr>
<tr>
<td><strong>Incomplete metamorphosis</strong></td>
<td>See simple metamorphosis.</td>
</tr>
<tr>
<td><strong>Instar</strong></td>
<td>The life stage between molts.</td>
</tr>
<tr>
<td><strong>Larva</strong></td>
<td>The active feeding stage of insects that go through complete metamorphosis; precedes the pupal stage.</td>
</tr>
<tr>
<td><strong>Mandible</strong></td>
<td>The first pair of jaws: stout and tooth-like in chewing insects, needle- or sword-shaped in sucking insects; the lateral (left and right) upper jaws of biting insects.</td>
</tr>
<tr>
<td><strong>Membranous</strong></td>
<td>Thin like a membrane. Clear or almost clear enough to see through, like cellophane or clear plastic sheeting.</td>
</tr>
<tr>
<td><strong>Mesothorax</strong></td>
<td>The second or middle thoracic segment. Joined to the abdomen. Bears the hind pair of legs and second pair of wings or rudiments of these wings, e.g., the halteres found on flies (Diptera).</td>
</tr>
<tr>
<td><strong>Molt</strong></td>
<td>The shedding of skin during growth.</td>
</tr>
<tr>
<td><strong>Nymph</strong></td>
<td>The active feeding and growing stage of insects that go through simple metamorphosis.</td>
</tr>
<tr>
<td><strong>Ovipositor</strong></td>
<td>Tube from which a female insect deposits her eggs.</td>
</tr>
<tr>
<td><strong>Palpus</strong> (pl., palpi)</td>
<td>A small “feeler” near the mouth, probably used to help select food.</td>
</tr>
<tr>
<td><strong>Parasite</strong></td>
<td>An insect that lives in or on another animal and damages its host.</td>
</tr>
<tr>
<td><strong>Pheromone</strong></td>
<td>Vapor or liquid emitted by an insect that causes a specific response from a receiving insect. Some pheromones are used to find a mate. Also used in pest control products.</td>
</tr>
<tr>
<td><strong>Predator</strong></td>
<td>An insect that eats another insect.</td>
</tr>
<tr>
<td><strong>Proleg</strong></td>
<td>A fleshy, unjointed false leg found on caterpillars (hooked) and the larvae of some sawflies (lacking hooks). Used for clinging to surfaces and for support in locomotion.</td>
</tr>
</tbody>
</table>
Insect terminology (continued)

**Pronotum**—The upper side of the prothorax.

**Prothorax**—The first thoracic ring or segment; it bears the first pair of legs but lacks wings.

**Pupa**—The stage between larva and adult in insects that go through complete metamorphosis.

**Segment**—A joint or division of an insect’s body, leg or antenna.

**Simple metamorphosis**—A type of insect development in which the insect passes through the stages of egg, nymph and adult. The nymph usually resembles the adult.

**Stylet**—The tubular, sucking mouthpart of sucking insects.

**Tarsus (pl., tarsi)**—The “foot” of an insect; the last, small segment or joint near the end of the leg. The number varies from one to five.

**Thorax**—The second or intermediate region of the body, found between the head and abdomen; it bears the legs and wings if present. Made up of three rings or segments: first, prothorax; second, mesothorax; and third, metathorax.

**Vector**—An insect that carries a disease organism from one plant or animal to another.

**Vein**—The rod-like or vein-like stiffening or supporting frame of a wing.

**Wing scale**—A powder-like covering that gives color to butterfly and moth wings. Actually, a very small scale that overlaps other scales like shingles on a roof.

---

### Table 1.—Major classes of the phylum Arthropoda.

<table>
<thead>
<tr>
<th>Class</th>
<th>Examples</th>
<th>Body segments</th>
<th>Pairs of legs</th>
<th>Horticultural importance</th>
</tr>
</thead>
<tbody>
<tr>
<td>Chilopoda</td>
<td>Centipedes</td>
<td>many</td>
<td>many</td>
<td>Feed on insects; can be beneficial.</td>
</tr>
<tr>
<td>Crustacea</td>
<td>Sowbugs, pillbugs</td>
<td>2</td>
<td>5</td>
<td>Can be minor pests.</td>
</tr>
<tr>
<td>Arachnida</td>
<td>Spiders, mites, ticks</td>
<td>2</td>
<td>4</td>
<td>Some mites are major pests.</td>
</tr>
<tr>
<td>Diplopoda</td>
<td>Millipedes</td>
<td>many</td>
<td>many</td>
<td>Can be minor pests.</td>
</tr>
<tr>
<td>Symphyla</td>
<td>Symphylans</td>
<td>2</td>
<td>12</td>
<td>Can be major garden pests.</td>
</tr>
<tr>
<td>Insecta</td>
<td>Beetles, aphids, bees, butterflies, etc.</td>
<td>3</td>
<td>3</td>
<td>Some beneficial, some pests.</td>
</tr>
</tbody>
</table>

---

### Table 2.—Major orders of the class Insecta.

<table>
<thead>
<tr>
<th>Order</th>
<th>Common name</th>
<th>Metamorphosis</th>
<th>Mouthpart</th>
<th>Wings</th>
</tr>
</thead>
<tbody>
<tr>
<td>Coleoptera</td>
<td>Beetles</td>
<td>Complete</td>
<td>Chewing</td>
<td>2 pairs</td>
</tr>
<tr>
<td>Colembola</td>
<td>Springtails</td>
<td>None</td>
<td>Chewing</td>
<td>None</td>
</tr>
<tr>
<td>Diptera</td>
<td>Flies</td>
<td>Complete</td>
<td>Chewing or piercing-sucking</td>
<td>1 pair</td>
</tr>
<tr>
<td>Hemiptera</td>
<td>True bugs</td>
<td>Simple</td>
<td>Piercing-sucking</td>
<td>2 pairs</td>
</tr>
<tr>
<td>Homoptera</td>
<td>Aphids, scales, etc.</td>
<td>Simple</td>
<td>Piercing-sucking</td>
<td>2 pairs</td>
</tr>
<tr>
<td>Hymenoptera</td>
<td>Bees, wasps, ants</td>
<td>Complete</td>
<td>Chewing</td>
<td>2 pairs or none</td>
</tr>
<tr>
<td>Lepidoptera</td>
<td>Butterflies, moths</td>
<td>Complete</td>
<td>Chewing or siphoning</td>
<td>2 pairs</td>
</tr>
<tr>
<td>Odonata</td>
<td>Dragonflies</td>
<td>Complete</td>
<td>Chewing</td>
<td>2 pairs</td>
</tr>
<tr>
<td>Orthoptera</td>
<td>Grasshoppers, etc.</td>
<td>Simple</td>
<td>Chewing</td>
<td>2 pairs</td>
</tr>
<tr>
<td>Neuroptera</td>
<td>Lacewings</td>
<td>Complete</td>
<td>Chewing</td>
<td>2 pairs</td>
</tr>
<tr>
<td>Siphonoptera</td>
<td>Fleas</td>
<td>Complete</td>
<td>Chewing or piercing-sucking</td>
<td>None</td>
</tr>
<tr>
<td>Thysanoptera</td>
<td>Thrips</td>
<td>Intermediate</td>
<td>Piercing-sucking</td>
<td>2 pairs</td>
</tr>
<tr>
<td>Thysanura</td>
<td>Silverfish</td>
<td>Simple</td>
<td>Chewing</td>
<td>None</td>
</tr>
</tbody>
</table>
Fortunately, most insects are either beneficial or harmless. Some are predators, such as lady beetles, which feed on aphids. Some insects eat weeds. Others are parasitic (for example, some wasps). Parasitic insects kill other insects, often pests, by laying their eggs on or in their victims’ bodies or eggs.

Still others, such as honeybees, produce honey and pollinate fruits, vegetables and flowers. Melons, squash and many other crop plants require insects to carry their pollen before setting fruit. Many ornamental plants, such as chrysanthemums, iris, orchids and yucca, are pollinated by insects.

Many insects are responsible for decomposition of plant and animal matter. Insects condition the soil and promote fertility by burrowing through the surface layer. Also, their bodies and waste droppings serve as fertilizer. A good example is the carpenter ant. Obviously, when carpenter ants attack the timber of homes they are pests; however, when they break down fallen trees in the woods, they act as nature’s recyclers and are harmless to humans. Some insects perform an essential service as scavengers, devouring dead animals and plants and burying carcasses and dung.

Size varies greatly throughout the insect world. The extremes include tiny wasps and beetles (less than a millimeter long), longhorned beetles (as much as 6 inches long) and tropical stick insects, which are giants at 12 to 18 inches long.

Insects also vary a lot in appearance. Some have bizarre-looking horns and spines, while others resemble dead leaves. On the other hand, some insects are quite attractive. Some butterflies are beautiful, but “beautiful” hardly describes a cockroach.

Thus, while insects are fascinating to investigate, their classification is complex. It is important to learn the main differences among insects so you can distinguish one group from another. Knowledge of insect classification, identification procedures and life cycles is of primary importance in carrying out proper control procedures and quality pest management programs.

Proper insect identification is extremely important. If a beneficial or nondamaging insect is improperly identified as a pest, the resultant unnecessary and undesirable pesticide application usually disrupts natural control agents. This disruption may in turn necessitate additional chemical control. Sometimes, such mistakes cost only money, but they can be much more serious. In some cases, the result is crop loss or environmental damage.

Do not make recommendations based on a verbal description of a pest. Insist on seeing it, or at least its damage, before you volunteer control information. If you are uncertain of a pest’s identity, do not guess. Wrong identification leads to ineffective control measures and unnecessary expense or environmental problems. Many university Extension and research personnel provide insect identification at no charge to master gardeners. There also are many Extension publications (see “For more information”) to help you identify pests and pest problems. Also see Chapter 19, Diagnosing Plant Problems.

**Insect anatomy**

Insects are animals, but unlike many animals, they have no backbone. They have an outer support system called an *exoskeleton* rather than the inner support system (*endoskeleton*) characteristic of most large animals.

The tough exoskeleton is referred to as the *cuticle*. The cuticle contains a layer of wax that determines permeability to water
(and to insecticides) and prevents desiccation (drying). Each segment’s cuticle is formed into several hardened plates called sclerites, separated by infolds (sutures), which give it flexibility. The cuticle of larvae usually is not as hard as that of adults.

The following characteristics are useful in comparing insects with other animals.

### Three body regions

An adult insect’s body is made up of three parts: head, thorax and abdomen (Figure 1). However, the division between thorax and abdomen is not always obvious.

The thorax is made up of three segments: prothorax, mesothorax and metathorax. Each of these segments bears a pair of legs. The wings are attached to the mesothorax and/or metathorax, never to the prothorax (first segment).

The abdomen usually has 11 or 12 segments (although some insects have fewer), but in many cases they are difficult to distinguish. Some insects have a pair of appendages ( cerci) at the tip of the abdomen. They may be short, as in grasshoppers, termites and cockroaches; extremely long, as in mayflies; or curved, as in earwigs.

### Wings

Insects are the only flying invertebrates. Most adult insects have one or two pairs of wings. Some, however, have no wings. Wing function for flight varies among insects. Wing surfaces may be covered with fine hairs or scales, or they may be bare.

The thickened front wings of beetles serve as protective covering for the hind wings when the beetle is not flying. The membranous hind wings are the actual flight mechanisms.

Venation (the arrangement of veins in the wings) is different for each group of insects; thus, it serves as a means of identification (Figure 2). Often wing venation is common to all members of a family or genus. There are systems for designating types of venation for descriptive purposes.

The names of most insect orders end in “ptera,” which comes from the Greek word meaning wing. Thus, each name denotes some feature of the wings. Hemiptera means half-winged; Hymenoptera means membrane-winged; Diptera means two-winged, and so forth.

![Figure 1.—Parts of an adult insect.](image1)

![Figure 2.—Examples of insect wing venation: (a) fly; (b) mayfly; (c) earwig; (d) butterfly; (e) lacewing; (f) certain ants; (g) certain wasps; (h) certain moths.](image2)
Legs

Another important characteristic of insects is the presence of three pairs of jointed legs on the thorax. These legs almost always are present in adult or mature insects and generally are present in other stages as well. In addition to walking and jumping, insects often use their legs for digging, grasping, feeling, swimming, carrying loads, building nests and cleaning themselves. Because insect legs vary so greatly in size and form, they are regularly used in classification, especially the extreme part of the leg (the feet, or tarsi). Figure 3 illustrates some examples of insect legs.

Prolegs (fleshy body projections or false legs) occur only on larvae of certain insect orders. They are used for clinging to plants.

Antennae

One of the main features of an insect’s head are its antennae (Figure 4). All adult insects (except, at times, scale insects) have one pair. They usually are located between or in front of the eyes. Antennae are segmented, vary greatly in form and complexity and often are referred to as horns or feelers, which is misleading. They primarily are organs of smell, but serve other functions in some insects.

Figure 3.—Examples of insect legs with various functions: (a) Running (ground beetle); (b) jumping (cricket); (c) digging (mole cricket); (d) walking on grass (walking stick); (e) swimming (whirligig beetle); (f) grasping (praying mantid); (g) hanging onto hairs (louse); (h) clinging by suction cups (diving beetle).

Figure 4.—Examples of insect antenna: (a) Filiform (grasshopper); (b) clubbed (carpet beetle); (c) pectinate or feathered (certain moths); (d) aristate (flies); (e) lamellate (June beetle; (f) moniliform (some termites). (Source: Elementary Entomology, Ginn and Company, 1912.)

Figure 5.—Types of insect mouthparts: (a) Chewing type; (b) sucking type.
Mouthparts

The most remarkable structural feature of insects, and the most complicated, is the mouth (Figure 5). Mouthparts vary in form and function, but they fall into two basic types: chewing and sucking.

Although the two types differ considerably in appearance, the same basic parts generally are found in both. There also are intermediate types of mouthparts: rasping-sucking (found in thrips) and chewing-lapping (found in honeybees, wasps and bumblebees).

The chewing mouth type is more primitive and generally stronger than sucking types. Sucking types vary greatly. For example, piercing-sucking mouthparts are typical of Hemiptera (bugs), Homoptera (aphids, scales and mealybugs), bloodsucking lice, fleas, mosquitoes and the so-called biting flies. In siphoning types, seen in butterflies and moths, there are no mandibles, and the labial and maxillary palpi are greatly reduced. Houseflies have sponging mouthparts.

Some insects have different mouthparts as larvae and adults. Larvae generally have chewing-type mouthparts regardless of the kind they’ll have as adults. Nymphs have mouthparts similar to those of adults. For some adult insects, the mouthparts are vestigial (no longer used).

Insect development

One of the distinctive features of insects is the phenomenon called metamorphosis. The term is a combination of two Greek words: meta, meaning change, and morphe, meaning form. It commonly is defined as a marked or abrupt change in form or structure and refers to all stages of development.

Only the most primitive insects do not go through metamorphosis. This group includes springtails, firebrats and silverfish. The only change they undergo during development from egg to adult is an increase in size. In modern classification systems, these groups are not considered insects.

Insects that undergo simple (also known as gradual or incomplete) metamorphosis (Figure 6) change very little during development. They have three stages: egg, nymph and adult. The nymphs develop wing buds early in life, but functional wings do not appear until the adult stage. Nymphs usually look very similar to adults and have similar feeding habits. Cockroaches, earwigs, termites, lice, true bugs and aphids are examples of this group.

The more highly developed insects go through complete metamorphosis (Figure 7). This group includes most insects (e.g., beetles, flies, fleas, moths, wasps and ants).
They develop through the stages of egg, larva, pupa and adult. In pest species, the larval stage usually is the most destructive, although adults also may cause damage. The *pupa* is a non-feeding stage; in most cases it also is inactive.

In higher animals, the most important development takes place before birth (in the embryonic stage), but in insects it occurs after birth. The larval period is primarily one of growth, when the insect feeds and stores up food for the pupal and adult stages that follow. Many insects feed very little, if at all, during their adult lives.

A young insect (larva or nymph) sheds its hard cuticle (*molts*) at various stages of growth because it outgrows the cuticle more than once. Insects do not grow gradually as many other animals do. They grow by stages. When the old skin gets too tight, it splits open and the insect crawls out, protected by a new, larger coat that has grown underneath the old one.

The stage between each molt is called an *instar*. Following each molt, the insect increases its feeding. Plant damage and the size of the insect’s fecal pellets both increase. The number of instars, or frequency of molts, varies considerably, depending on species and, to some extent, on food supply, temperature and moisture.

The pupal stage is one of profound change — a transformation from larva to adult. Many tissues and structures, such as prolegs, are completely broken down, and true legs, antennae, wings and other adult structures are formed.

Hibernation takes place during winter. It may occur in an immature stage or the adult stage, depending on species. It is an insect’s way of adjusting to low temperatures and dwindling food supplies. Many insects start preparing for winter before the end of summer. This behavior is triggered by changes in the amount of daylight (*photoperiod*).

Adult insects do not grow. The adult period is primarily one of reproduction and sometimes is of short duration. Adults’ food often is entirely different from that of the larval stage, and some adults do not eat at all.

**Classification**

The anatomy of an insect places it into a specific insect group called an order. Each order is divided into families, and each family is divided into genera and finally species. A specific insect usually is described by genus and species names; e.g., *Musca domestica* is the common housefly. To categorize insects, professionals observe differences in body parts through a microscope.

Gardeners generally classify insects by common name. Unfortunately, not all insects have common names, and common names often don’t recognize significant differences. For example, ladybug beetles are a widely variable group, but there may or may not be common names that adequately differentiate among them. Also, some insects have several common names, depending on regional or personal preference.
Identification

Most home gardeners can use insect identification handbooks to classify an insect by the common name of its order, identifying it as a beetle, wasp or butterfly. Knowing the insect order gives you valuable information about many insects in the same order. This information includes:

- The type of mouthparts (informing how the insect feeds and giving clues for its control)
- Life cycle (indicating best times for control)
- Type of habitation, including host(s) (where to find it)

Beyond the family category, however, identification is very difficult for all but the most common insects without a magnifying instrument such as a microscope.

The following identification strategies are useful for gardeners:

- **Experience**—Periodically attend plant clinics and hands-on advanced training to gain valuable practice in insect identification. Working with experienced master gardeners also helps you develop valuable insight into solving plant problems when plant disease and other factors can make analysis difficult.
- **Specimen approach**—Use keys, photographs, drawings and descriptions, along with insect specimen data.
- **Symptoms approach**—Compare damage with the insect’s physical characteristics (Figure 8). For example, because of their different mouthparts, a beetle can cause chewing damage, but an aphid cannot.
- **Host approach**—Check references that list hosts and potential insect damage. Like people, many insects have preferences for their meals.

Figure 8.—Types of insect injury.

- **Host location approach**—Use this method to exclude certain insects. For example, large praying mantid species are not expected to be found in Alaska unless released. Also, some insects prefer dry or wet conditions.
Common garden insects

The following insect orders include many of the most common garden, home and forest insects. Many of these orders include both beneficial insects and pests.

Coleoptera (beetles, weevils)

These insects undergo complete metamorphosis. Larvae have a head capsule, and most have three pairs of legs on the thorax but no legs on the abdomen. Weevil larvae, however, lack legs on the thorax.

Adults have a hard, horny outer skeleton, chewing mouthparts and usually noticeable antennae. They have two pairs of wings; the outer pair is hardened, and the inner pair is membranous. A few beetles are practically wingless, and some have only an outer pair of hard wings.

Some species are beneficial as pollinators or as predators of harmful insect species. Others are pests of plant foliage and roots.

See Figure 9 for examples.

Diptera (flies, mosquitoes, gnats, midges)

Species in this order undergo complete metamorphosis. Larvae may have mouth hooks or chewing mouthparts. Most are legless. Larvae of advanced forms (housefly and relatives) have no head capsule, possess mouth hooks, and are called maggots. Lower forms, such as mosquito larvae and relatives, have a head capsule.

Adults have only one pair of wings and are rather soft bodied and often hairy. They have either sponging (housefly) or piercing (mosquito) mouthparts.

This order demonstrates a multitude of lifestyles. Houseflies are a nuisance as adults, but their larvae are major recycling organisms. Mosquitoes and others are vec-
tors of human and animal diseases, although an important food source for fish and wildlife populations. Many other members of this order are either parasitic or predaceous on other insects, which makes them among the most important beneficial insects.

See Figure 10 for examples.

**Hemiptera (stinkbugs, plant bugs, flower bugs, shore bugs)**

Metamorphosis is simple in this order. Nymphs usually resemble adults.

Adults have piercing-sucking mouthparts and two pairs of wings; the first pair is membranous and thickened on the basal half, and the second pair is membranous throughout.

Adults and nymphs are both damaging in pest species. Some species, however, are predators of harmful insect pests and considered beneficials.

See Figure 11 for examples.
Homoptera (scale insects, mealybugs, whiteflies, aphids, psyllids, leafhoppers)

These insects undergo simple metamorphosis. Nymphs usually resemble adults. Adults generally are small and soft bodied. There can be winged and unwinged adults within the same species. Adults have sucking mouthparts and most all members of this family feed on plant sap.

Many members of this order are carriers of plant pathogens.

See Figure 12 for examples.

Hymenoptera (bees, ants, wasps, sawflies, horntails)

These insects undergo complete metamorphosis. Larvae either have no legs (wasps, bees and ants) or legs on the thorax and prolegs on the abdomen (some sawflies).

Adults have two pairs of membranous wings. Adults are rather soft bodied or slightly hard bodied and generally have chewing mouthparts.

Figure 12.—Insects of the order Homoptera.

Figure 13.—Insects of the order Hymenoptera.
Many beneficial species of this order prey on or parasitize harmful insects. Others are important pollinators. See Figure 13 for examples.

**Lepidoptera (butterflies, moths)**

Members of this order undergo complete metamorphosis. Larvae are worm-like caterpillars, which vary in color and are voracious feeders. They have chewing mouthparts and generally have legs on both the abdomen and the thorax.  

Adults are soft bodied with four well-developed membranous wings covered with small scales. The mouthpart is a coiled sucking tube. Adults feed on nectar. Many moths and butterflies are major pollinators. The caterpillars of some, however, are plant pests or forest defoliators. See Figure 14 for examples.
Neuroptera (lacewings, antlions, snakeflies, mantispids, dobsonflies, dustywings, alderflies)

Metamorphosis is complete in this order. Adults have two pairs of similar wings and chewing mouthparts. Many are aquatic. Many of these insects are important predators of garden pests and can be purchased for biocontrols in either the garden or greenhouse. Alaska has native populations of lacewings.

See Figure 15 for examples.

Orthoptera (grasshoppers)

These insects go through simple metamorphosis. Nymphs resemble adults, except for being wingless. Adults are moderate to large size and often rather hard bodied. They usually have two pairs of wings. Forewings are elongate, narrow and hardened; hind-wings are membranous with an extensive folded area. Adults have chewing mouthparts. The hind legs of forms other than cockroaches and walking sticks are enlarged for jumping.

Both adults and nymphs of many species are damaging. Praying mantids, however, are beneficial predators.

See Figure 16 for examples.
Thysanoptera (thrips)

The type of metamorphosis varies in this order (a mixture of complete and simple). Adults are small, soft-bodied insects with rasping-sucking mouthparts. They have two pairs of slender wings, which are fringed with hairs. Thrips often vector plant disease. See Figure 17 for examples.

Strategy for insect management

1. Determine whether damage is caused by insect(s). Sometimes gardeners jump to conclusions and blame damage on insects that happen to be present. It is important to determine whether damage is caused by other factors, such as cultural problems or disease. Cultural problems are the most common cause of damage, followed by disease, and then insects.

2. Determine and apply an appropriate remedy utilizing an IPM approach. First apply nontoxic or least toxic remedies. Use more toxic controls only as a last resort. Some gardeners want fast results, so they use the most toxic pesticides because advertising and labels promise a quick, effective cure. Unfortunately, this approach may have unintended side effects. For example, beneficial insects and other animals may be killed or sickened even if the pesticide is applied legally according to label directions. As a result, the insect infestation may worsen because nature’s balance has been disrupted.

3. Monitor results.

4. Determine whether further remedy is necessary.

For more information

UAF Cooperative Extension publications

Beneficial Insects and Spiders of Alaska, PMC-10075.
Cockroaches, PMC-10071.
Identifying and Controlling Pests in Alaska, PMC-10074.
Houseplant Pests and Control, PMC-10073.
Pantry Pests, HGA-00062.
Root Maggots is Alaskan Home Gardens, PMC-00330.
Slugs, PMC-10070.
Stinging Insects, PMC-10072.

USDA Forest Service publications

Birch Aphids, R10-TP-98.
Engraver Beetles in the Alaska Forests, R10-TP-94.
Carpenter Ants: Insect Pests of Wood Products.
Eriophyid Mites, 100C-1-066.
Gall and Woolly Aphids on Spruce and Hemlock.
Large Aspen Tortrix.
Spruce Needle Aphid.
Spruce Budworm, R10-TP-11.
The Spruce Beetle, PMC-10060.
Wood Boring Insects in Alaska, R10-TP-19.
Other resources

Books