4-H and Youth

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How to Make an Awesome Insect Collection

A Beginner's Guide to Finding, Collecting, Mounting, Identifying, and Displaying Insects

Authors: Timothy J. Gibb and Christian Y. Oseto

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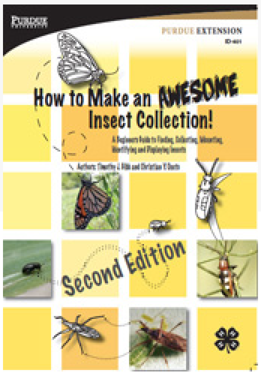

In spite of their small size, insects are among the most interesting and adaptable creatures on planet Earth. Each is distinct in appearance and has a behavior that, when studied, is truly fascinating. Insects are as plentiful as they are diverse. An enthusiastic insect collector will find no end to the number of treasures hidden in fields and woods, along the shores of lakes and streams, in soils or leaf litter, and in a myriad of other places. In fact, insects are so universally present that they can be found nearly everywhere, any time of the day or night, and even during the winter months, if one knows how and where to search for them.

Making an insect collection is the best way to get to know the insects. This book teaches all that a beginning student needs to know about how to find, collect, identify, preserve and display insects. Dispatching, pinning, spreading, and mounting specimens are all part of this process.

To order this book from The Education Store click here.

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Happy Collecting!

How to Know Insects

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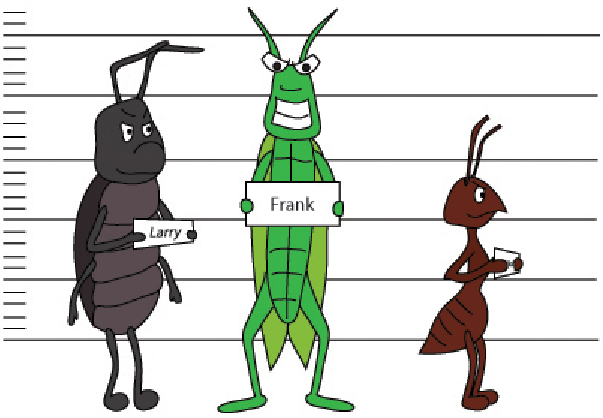

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What Is an Insect?

Beginning collectors must know something about what insects are, how they live, behave, develop, and reproduce. Although there are many advanced texts written about any one of these topics, this book provides a very basic foundation for beginning entomologists. Understanding the principles of insect growth, development, morphology, and behavior allows us to more easily rear, collect, identify and, in the case of pest insects, control them.

Nearly 75 percent of all animals are insects. Scientists have described and given scientific names to about 920,000 species of insects in the world, which represent almost 85 percent of all known animal species. Just think — there are more different species of dragonflies than of all mammals combined. There are about 9,000 species of birds, but almost twice as many species of butterflies. No wonder you can find insects nearly everywhere.

The fact that more species of insects are known than all other animals and plants combined is phenomenal, but even that number does not represent all of the insects on Earth. Some estimate that the number of named and recorded insects is only a fraction of the total number of living insect species. Many are very small and hard to find. Many live in areas where collection and study are difficult. Still others are right under our noses and are just waiting to be discovered.

Scientists who study the fossil record have estimated that insects have been around for more than 350 million years, much longer than people. Some early insects were huge dragonflies with wingspans in excess of 3 feet; others were very small. Today, the largest insects have bodies that measure 3 to 4 inches in length and may have wings that span 6 or 8 inches, but insects have become very diverse as they have adapted to life on Earth. You'll find them in nearly every type of habitat, with truly amazing features and behaviors that allow them to live and thrive in these conditions. Insects' relatively small size, high reproductive potential, and diverse feeding habits allow them to become very successful animals in our world. They have not only developed ways to live in nearly every habitat, but they have developed the ability to feed on a vast array of foods.

The greatest challenge to learning how to identify insects properly will be learning the names of the various components of an insect's body. Beginners usually compare collected specimens with published photographs or line drawings of the insect. This is sufficient for the most basic identification, but because there are so many insects, a photograph of every one would be very cumbersome. Many are very similar either in color, size, or shape. Often small differences in how an insect is constructed determine whether it is one species or something entirely different. As a result, written keys are constructed that, if followed, will lead a student to the proper identification. The process of identification will be discussed in greater detail in a later section. For now, it is important to gain a working knowledge of the anatomy or morphology of an insect, so that written keys can be followed. For example, some references may be made to particular structures such as tarsi. To answer questions relating to tarsi, you should consult a line drawing of the leg of a typical insect to determine where tarsi are. Similarly, a general recognition of other parts of basic insect anatomy or morphology is required.

Compared to people, insects are constructed inside out and upside down. For example, people have skeletons inside their bodies to which muscles attach and allow movement. Insects have external skeletons (exoskeletons) and their muscles are attached inside to allow for movement. People have nerve cords running along their backs (dorsal), with hearts closer to the front of the body (ventral). Insects have dorsal hearts and ventral nerve cords.

You'll find many more differences between people and insects. A human has four appendages (arms and legs); an insect has six. People breath with lungs, insects breathe through tiny holes along the sides their bodies. The heart and blood of an insect are not important to moving oxygen in the insect body. Insects smell with their antennae, taste with their feet, and hear with special organs in their feet, abdomen, and sometimes antennae. Insects are the only invertebrates that have developed the ability to fly, although they have also mastered running, burrowing, jumping, climbing, swimming, and hopping.

Insects are successful and fascinating, because they are unique in so many ways. Collecting and identifying insects requires a basic understanding of insect anatomy (morphology), development, and physiology (digestion, reproduction, nervous system, circulation, and respiration), as well as behavior. We shall begin with how to distinguish an insect from its close relatives.

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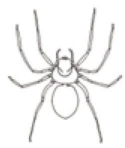
Distinguishing Insects from Their Relatives

Insects and their relatives are all animals (Kingdom: Animalia) that belong to the group or phylum called Arthropoda. These all share many characteristics, including possessing segmented bodies and jointed appendages (legs and antennae). The following five classes of Arthropods are quite common and insect collectors should be able to recognize them. The Latin or Greek translations of their scientific names (provided in parentheses following the name) are helpful in separating these groups.

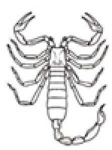
Arachnida (arachnid=spider-like)
spiders, mites, ticks, scorpions, harvestmen

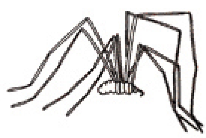

Spider

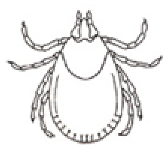
An arachnid has four pairs of legs, lacks antennae, and possesses a head and thorax that is combined into one part called a cephalothorax.

The arachnids represent the second-largest and (next to insects) second most agriculturally injurious class of arthropods. Arachnids have very diverse life histories. Most spiders are beneficial predators. Most ticks are parasitic and some may transmit important diseases to people. Mites can be beneficial predators, parasites on insects and mammals, or extremely damaging pests on plants.

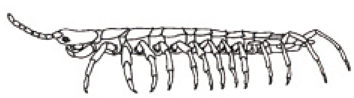

Mite


Scorpion


Harvestman


Tick

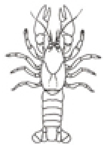
Chilopoda (chili=thousand, poda=legs)
centipedes


Centipede

A centipede has a long, flattened, many-segmented body with one pair of legs attached to each body segment. It also has a pair of moderately long antennae.

Centipedes are often confused with millipedes, but they differ by having more flattened bodies, one pair of legs per body segment, and the ability to move quite rapidly. Centipedes are always predatory upon other small arthropods and each centipede possesses a pair of strong fangs, which it uses to hold and poison their prey.

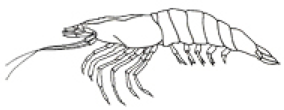
Crustacea (crust=shell-like)
lobsters, crabs, sowbugs, shrimp

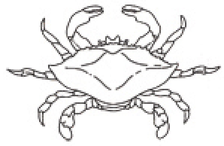

Lobster

A crustacean has a hardened exoskeleton, at least five pairs of legs and a cephalothorax. Some have two pairs of antennae.

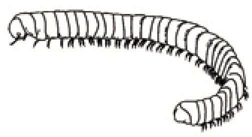
The class crustacea contains many aquatic animals, including crayfish, lobsters, and prawns, which are important human foods. Insect collectors very commonly encounter one order of this class in terrestrial environments. This order (Isopoda) includes the sowbugs and pillbugs. Both sowbugs and pillbugs occasionally feed on vegetable matter, but seldom cause damage. Isopods breathe through gills that must be kept wet and, therefore, must remain in relatively moist habitats. As a result, they are commonly found under rocks, logs, mulch, or other debris on the ground or in wooded areas. Isopods have seven pairs of legs and shield-shaped heads. The pillbug is recognized by most as the tiny animal that rolls itself into a tight ball when disturbed.


Sowbug


Shrimp


Crab

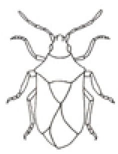
Diplopoda (di=two, poda=legs)
millipedes


Millipede

Millipedes have long rounded, many-segmented bodies with two pairs of legs attached to each body segment. They each have one pair of antennae.

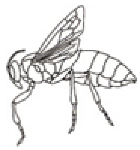
The millipedes are slow-moving, wormlike arthropods. They eat plants, but seldom cause economic damage to them. They normally feed on dead or decaying plant matter. Millipedes can become nuisance pests in and around homes where they live under patio decks, crawl spaces, and often landscape mulch.

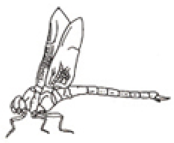
Hexapoda (hex=six, poda=legs)
insects


Bugs

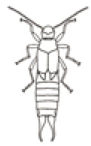
Insects have six legs, three body parts and two antennae in their adult form.

The largest and most important class of Arthropods is Hexapoda. Hexapods range in size from very tiny (almost too small to be seen with the naked eye) to quite large. As a group, insects are the most damaging pests of human foods, both during production and storage. Certain insects damage ornamental plants, agricultural crops, and stored foods. Some damage structures and buildings, and some transmit very important diseases to people. Other insects are beneficial organisms to the environment, our economy, or human health and welfare. Most add to the beauty and interest of nature.

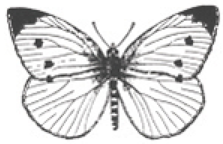

Bees & Wasps


Dragonflies


Beetles


Earwigs


Flies


Butterflies & Moths

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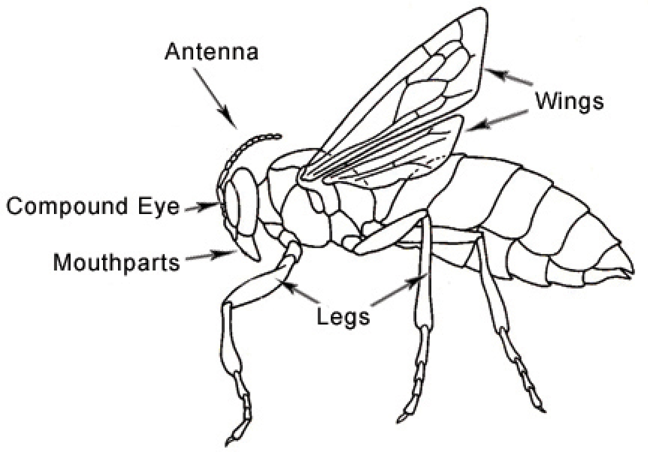
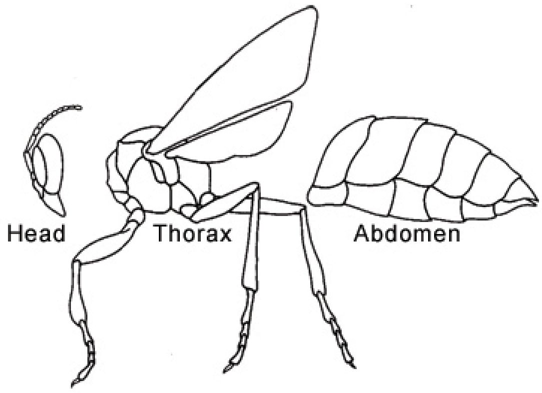
Insect Anatomy

In the adult stage, an insect has three pairs of legs (total = 6) and three distinct body parts. An insect also normally has a pair of antennae, two pairs of wings, and eyes and mouthparts adapted especially for its specific lifestyle.



An insect exoskeleton is composed of a hardened material called chitin that is similar to human fingernails. This gives the insect the structure to which muscles can attach and operate, allowing movement. The exoskeleton also protects the insect from desiccation, physical injury, and allows for the myriad of colors, shapes, and sizes that make insects so diverse and interesting.

The three main insect body parts are *head, thorax,* and *abdomen.* The head contains the antennae, eyes, and mouthparts. The thorax is the middle body part to which the legs and wings are attached. The abdomen contains digestive and reproductive organs internally and often reproductive structures externally. The sides of both the thorax and the abdomen are lined with tiny openings called spiracles, through which an insect obtains oxygen.



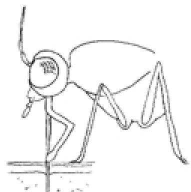
Mouthparts

Insect mouthparts differ in appearance due to the fact that the diets of insects vary widely. One of the evolutionary marvels in the study of insects concerns the ability of these animals to feed on such a wide assortment of foods. Nearly all organic materials may be consumed by one or another insect. It is no wonder, then, that insect mouthparts are so different. Mouthparts are often used as a basis for separating insects into their respective orders or families. The four most common mouthparts are illustrated below.

Solid foods are consumed by insects with biting-chewing mouthparts. Beetles, caterpillars, and grasshoppers all have biting-chewing mouthparts. These insects leave behind tell-tale signs of feeding, holes in leaves, trunks of trees, or they simply consume the whole plant or animal.

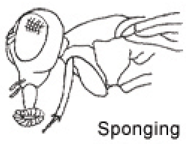
Biting - chewing

Several different insects, such as mosquitoes, fleas, assassin bugs, and aphids have evolved a piercing-sucking mouthpart in which stylets actually pierce into plant or animal tissue allowing the fluids there to be sucked into the insects. Insects with this type of mouthpart are commonly associated with disease transmission in both plants and animals.



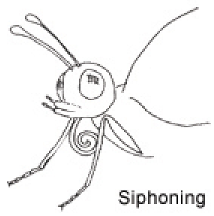
Piercing-sucking

Specialized flies such as, the house fly, exhibit sponging mouthparts. In this group, saliva and regurgitated foods are pumped externally onto the food source to begin the digestion process. The dissolved or suspended food is then sucked up into the alimentary canal of the insect.



Sponging

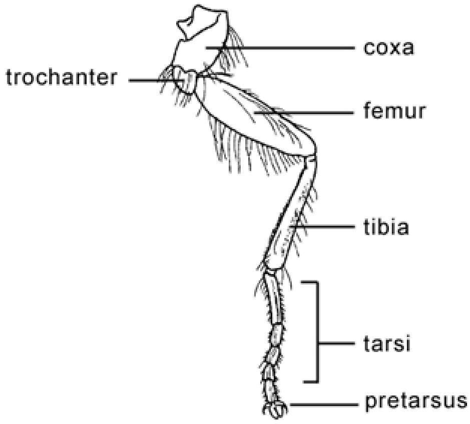
Butterflies and moths uncoil their long tube-like proboscis and insert it into the nectaries of a flower to siphon out the fluids found there. These specialized mouthparts are referred to as siphoning mouthparts.



Siphoning

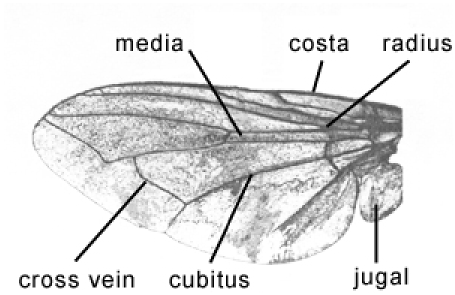
Legs

Insect legs can be as different in appearance as the insects themselves and are often referred to in identification keys. They may be modified according to the specific behavior of the insect, whether it is for jumping, digging, swimming, hopping, grasping, or running. All legs typically consist of the segments shown in the diagram.



Wings

The essential make-up of all functional insect wings is the same: a thin membrane, which is supported by veins both around and within the margin. Stark contrasts between the wings distinguishes the four largest orders of insects. Minor differences in wing venation or shape further differentiate insect species. The major veins in an insect wing are illustrated below.



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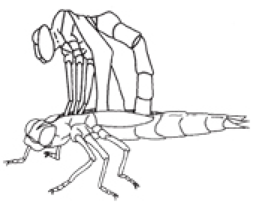
Insect Growth

Insects grow differently than do other animals. Due to the rigid exoskeleton on the outside of an insect body, it cannot gradually expand in size like vertebrates do. To become larger, an insect must periodically shed the old exoskeleton, expand in size, and then grow a slightly bigger exoskeleton than the one it just shed. This process is called molting. It can be illustrated with an example of an adult damselfly pulling itself out of its old skin.

The new flexible skin is expanded by pumping it up with air or water. After expansion, the new exoskeleton will harden and take on color. This process of molting may occur several times during the growth of an insect, depending upon what species it is. Once the insect becomes an adult, however, growth ceases.



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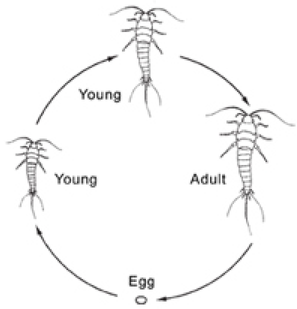
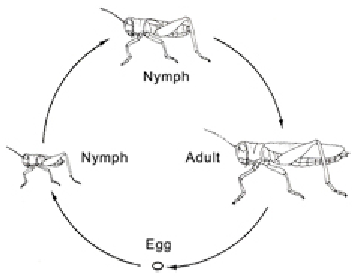
Insect Development

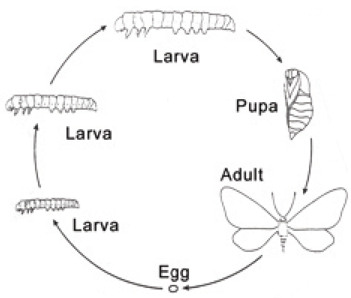
With few exceptions, insects begin life as eggs. The change in form from eggs through to adults in insects is termed *metamorphosis.* Authorities use slight differences in metamorphosis to help describe and separate insect groups. For purposes of this publication, the most primitive insects (Collembola and Thysanura) are said to develop *without metamorphosis.* The insect that comes from the egg appears exactly like the fully grown insect, except that it is not as large.



More advanced insects are described as having *incomplete metamorphosis.* Insects with incomplete metamorphosis change shape gradually as they grow. There are three stages of growth: the egg, nymph, and adult. Grasshoppers, termites, bugs, and lice are all of part of this group.



Insects with *complete metamorphosis* go through four stages of growth. None of the stages look at all like the others. These stages are referred to as egg, larva, pupa, and adult. Fleas, flies, beetles, bees, and moths all belong to this group.



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Insect Behavior

Insects are recognized as cold-blooded or *ectothermic* animals. This means that an insect's internal body temperature is determined by the temperature of the external environment. Because they have little control over their internal temperatures, insects do not remain active during cold periods and winter months.

Insect behavior consists of active responses to various stimuli in the environment. Strictly speaking, these are motor responses. When a series of motor responses are put together, the actions elicited are referred to as a behavior.

Unlike much of human behavior, insects do not think or reason, but only act. Thus, it is incorrect to assign likes or dislikes to insect behaviors. *Responding* is the proper term to describe insect behavior. Feeding, defensive, migratory, communication, social, and reproductive behaviors are often complex but exist as a sequence of motor responses to various stimuli.

Insect behavior is a fascinating study. It can lead to an understanding of insects that will not only help us know how they live, and what they do, but also assist in our discovery of ways to manipulate them, which is especially useful in pest management.

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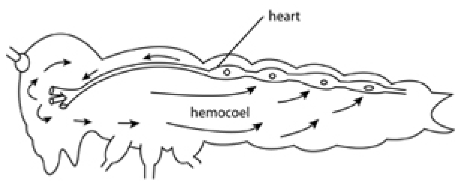
Insect Physiology

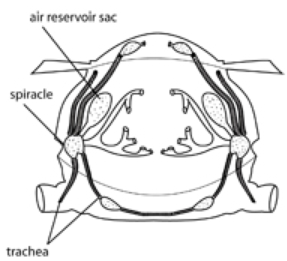
Circulatory System

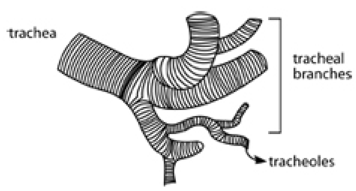
Insects possess an "open" circulatory system in which an insect's blood (hemolymph) fills its body (hemocoel) rather than being contained within vessels (closed systems) as in most higher animals. Hemolymph comprises up to 40 percent of an insect's body weight. The only vessel that most insects possess is called an aorta, or sometimes simply referred to as a heart. This long tube lies dorsally inside the insect and serves as a pumping chamber. The insect blood enters through small holes in the aorta and then is pumped forward as the vessel contracts and is dumped into the insect body homocoel again. In this way, hemolymph sloshes around in the insect body and reaches all necessary tissues. Insect blood is clear in color rather than red, because it does not have need for red blood cells to transfer oxygen.



Respiratory System

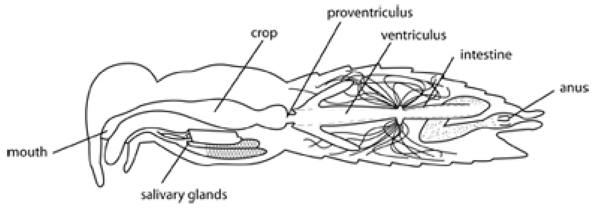
Oxygen reaches internal tissues by means of tiny tubes (invaginations) of the exoskeleton. The outer holes along the insect's body, called spiracles, allow air to diffuse into the small tracheal tubes, which further branch into progressively smaller tubes that eventually enter into the muscles, internal organs, and tissues of the insect. In this manner, insects are able to get the necessary oxygen to cells for respiration.





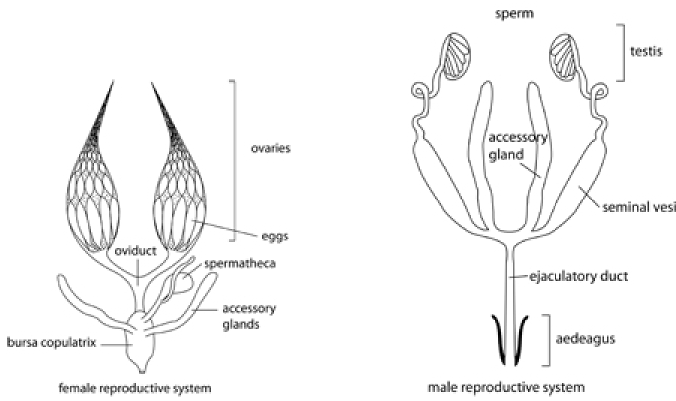
Digestive System

Insects ingest food through one of the several kinds of mouthparts described earlier. Solid or liquid food is taken in through the mouth leading into a complete alimentary food canal. Food is broken down by enzymatic hydrolysis and is absorbed through the gut wall and into the insect. Undigested material is excreted through the anus at the rear of the alimentary canal.

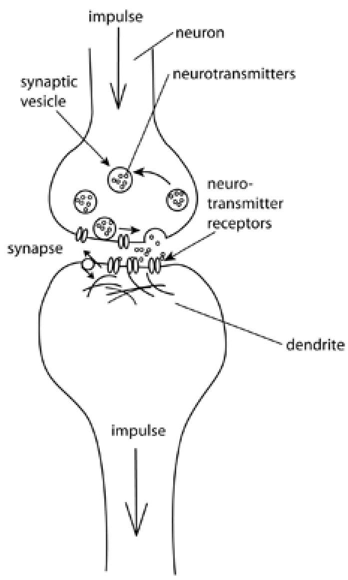


Reproductive System

Insect reproduction is almost always sexual (requiring a male and a female) but in a few cases it may be asexual (requiring a female only). Some insects use both. In sexual reproduction, the males copulate with the females, sending sperm into the egg chamber of the female. Eggs there are fertilized and then pass out of the oviduct and are usually deposited either singly or in clusters in the environment.

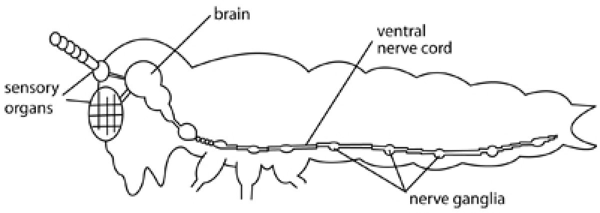


Nervous System

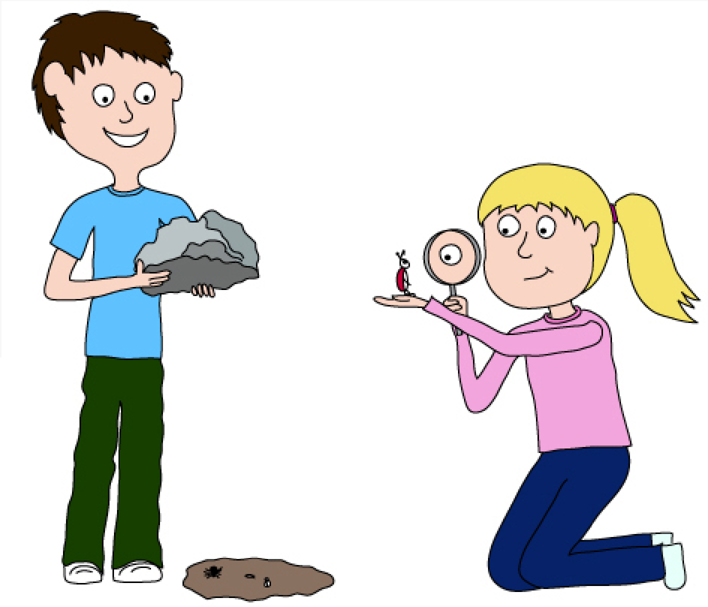


Individual insect nerve cells are constructed much like vertebrate nerves. A sensory structure, such as an eye or antennae, triggers a nerve impulse that travels along the length of the nerve cell. This nerve ends in close contact with other nerves in a junction called a synapse. Specific chemicals are released in this junction and if adequate amounts are picked up by the second nerve, the impulse will again be carried to yet other nerves or to muscle tissue, causing them to contract or expand. Many common insecticides work by disrupting the communication process at this junction.

The nervous system in insects consists of a long nerve cord made up of many nerves bundled together. This cord lays ventral in the insect body and runs the length of the insect. Several nerve masses form a primitive brain toward the anterior end of the nerve cord but, unlike verterates, the central insect nervous system also has smaller centers along the nerve cord in the thorax and even the abdomen. These smaller masses spread along the nerve cord help direct coordinated processes such as reproduction, movement and other life supporting functions, independent of the larger brain in the head area. This is why cutting the head off of an insect often does not stop it from walking or mating.



How to Collect Insects



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How to Make a Magnifying Lens

How to Make a Magnifying Lens

Make a Magnifying Lens from Teaming with Insects on Vimeo.

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Insect Collecting Equipment

Large insect collections may be made with a few pieces of inexpensive equipment. A net, insect pins, identification guide, collecting jars and display cases are the most essential and allow any beginning entomologist a great start. A few other pieces of equipment come in handy and enable the more advanced collector to obtain an even larger variety of specimens.

You can buy most equipment for catching, handling, identifying, and displaying insects from biological supply outlets. Some of these can be made at home. Both serve the purpose equally well. This booklet describes how to make or where to purchase the basic equipment for collecting and displaying insects. It also serves as a basic insect guide for identification and classification. As students gain experience, however, their identification skills will improve if they buy and use any of several field guides to insects. Many different field guides are available from bookstores and libraries. In most cases, the more color photos, the more helpful the guide.

4-H and Youth

Catching Insects

All insect collectors use nets to help catch elusive insects. You can use a net in one of three ways.

1. One is to *sweep* foliage. To sweep means to swing the net back and forth such that it scrapes the tops of plants and dislodges the insects that are feeding or resting there, causing them to fall into the open net. After a series of sweeps, the collector then carefully examines the insects caught in the net and selects the specimens of interest.
2. Another, more common, way in which a net is used is by swinging it quickly through the air to catch flying insects such as bees, wasps, butterflies, dragonflies, and other wary insects.
3. The third way is to use a sturdier net to collect insects from water.

Sweep nets, aerial nets, and aquatic nets can be either purchased from entomological supply houses or made at home. A general purpose net is one that is sturdy enough to sweep plants, yet light and porous enough to be swung quickly through the air. Variations in the basic plan or the materials used are common and can be adjusted to suit specific collectors needs.

Generally, a net (Figure 1) consists of a handle fitted on a heavy wire loop to which a bag is fastened. The bag is cone-shaped and twice as long as the diameter of the hoop. This length lets the bag loop over the rim and prevents the escape of insects while sweeping. An ideal material for making the bag is nylon mosquito netting, available from surplus stores. A good quality marquisette or similar material also can be used, but cotton mosquito netting or cheesecloth is not satisfactory.

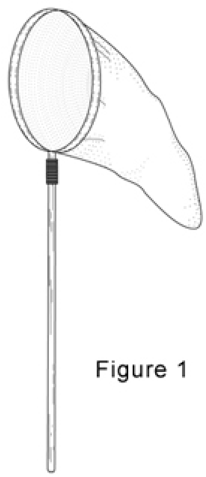

Figure 1

To construct the net bag, cut out a piece of net material the size and shape shown in Figure 2. The bag may be placed on the wire loop before it is attached to the handle, or it may be sewn to the loop after it is attached.

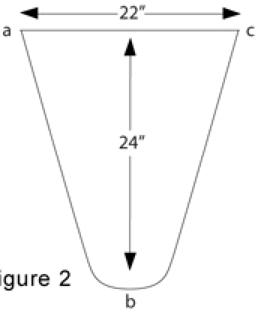

Figure 2

It is advisable to sew a muslin or denim band over the loop to increase the durability of the net. Use a strip of heavy muslin or denim 5 x 44 inches. Fold it lengthwise to form a hem around the top of the bag (see Figure 3). The top edge of the net should be placed between the two sides of the folded muslin. Tuck the cut edges of the muslin so that the edge of the net and the tucked edges of the muslin overlap at least ½ inch. Join these by twice sewing completely around the material near the middle of the overlap.

When choosing a handle, select a strong, lightweight wooden dowel approximately 3 feet long. A ¾-inch dowel rod is ideal for this purpose. Cut two grooves along the sides at one end as shown in Figure 4. These grooves cradle the bent arms of the hoop and are cut as deep as the thickness of the wire. Make one groove approximately 3½-inches long and the other 2½-inches. At the end of each groove, drill a small hole at a right angle into the handle to anchor the wire.

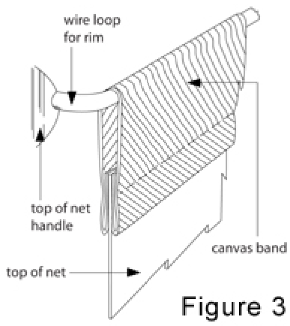

Figure 3

To make the loop, bend a 4-foot length of approximately 1/8-inch durable steel wire (preferably piano wire) into a hoop with short arms at each end as shown in Figure 5. Take care that the arms and the little hooks at their ends are bent correctly to fit along the grooves and into the holes in the handle. After fitting the hoop to the handle and properly attaching the bag, one is ready to make the joint fast between the handle and the hoop.

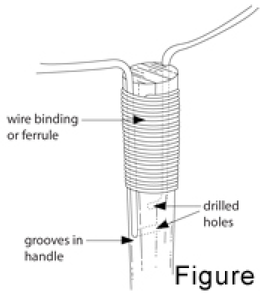

Figure 4

Wrap the joint tightly with fine wire (Figure 4), or better still, fit the handle with a sliding metal sleeve. A short piece of ¾-inch copper or aluminum tubing fits snugly over a dowel rod of that diameter.

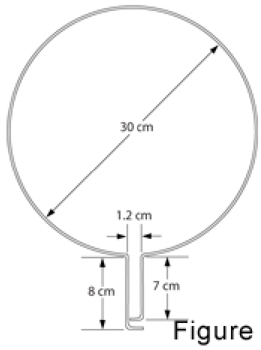

Figure 5

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Handling Insects

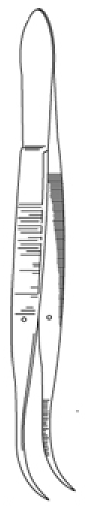
Figure 6

Handling insects properly can protect against possible bites or stings, as well as prevent damage to the fragile specimens. It is best to carry a pair of forceps (specialized tweezers, 4 to 5 inches long, Figure 6) to handle butterflies, moths, and other delicate and small insects. Fine-pointed tips allow you to handle even very tiny insects. To prevent losing or misplacing forceps and to keep them handy, attach them to a loop of string or yarn and wear them around your neck. Handle very small insects with a small paintbrush.

Left to thrash around in a net or killing jar, butterflies and moths often break wing tips or rub the scales from their wings, ruining the specimen. This can be prevented by immobilizing the insect immediately after you catch it. Through the cloth of the insect net, grasp the body of the moth or butterfly with wings up. Squeeze the sides of the thorax quite vigorously with the thumb and forefinger for 2 to 3 seconds. This paralyzes the specimens temporarily so the net can be opened and the specimen lifted out without danger of damage or escape. With a little experience, one learns to apply sufficient pressure to paralyze the insect without squashing it.

Avoid touching the wings of butterflies or moths with fingers unless it is absolutely necessary. Scales that provide the color patterns and the beauty of a moth or butterfly rub off very easily when handled leaving a less-than-perfect specimen for a collection.

Insects collected near home can be killed quickly and safely by transferring them to small bottles or boxes and placing them in a freezer for 1 to 3 hours. In addition to not having to worry about killing jars, one major advantage to this method is that the insects may be stored in a freezer for extended periods of time without the risk of the specimens drying out or decomposing until the collector is ready to mount them.

A killing jar also may be used for killing collected insects. Most collectors like to have at least two such jars – one large enough for butterflies and moths and another for beetles and other small insects.

To make a killing jar at home, select a heavy glass jar (1 pint to 1 quart in size) with a large mouth and a screw cap (Figure 7). Do not use plastic jars. Pour approximately 1 inch of wet plaster of Paris (more for larger jars) into the bottom of the jar. Let it harden, then thoroughly dry the jar in an oven set on warm. After removing it from the oven, saturate the dry plaster of Paris with ethyl acetate (available in many drug stores) and pour off any excess liquid that does not immediately soak in. Put the screw cap on the jar. Place a prominent label on the jar: "POISON – ETHYL ACETATE." The jar is now ready for use. Keep the jar tightly capped when not in use to extend the effectiveness of the ethyl acetate. When the jar loses its killing strength, dry it out and recharge it (re-saturate with ethyl acetate).

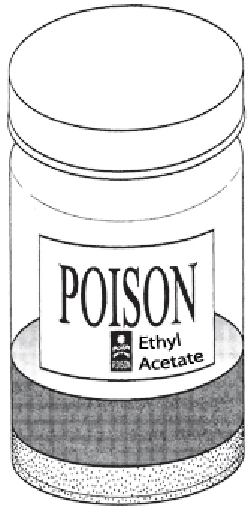

Figure 7

Always keep a piece of clean, crumpled paper toweling or facial tissue in each jar to absorb moisture and keep the specimens from being damaged. An experienced insect collector makes it a habit to mount and label all specimens within a few hours after they are caught. Insects left in the killing jar for more than a day become too soft and, thus, ruined, and those taken out but not soon pinned become too brittle to handle. With experience, a collector will learn to leave specimens in the jar long enough to make sure they are dead, but not long enough to ruin them.

Do not waste time putting damaged or mutilated specimens in the killing jar. Most insects are so plentiful that there is no reason to spend time and energy trying to mount and label less-than-perfect specimens.

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How to Safely Transfer a Captured Stinging Insect From a Net into a Kill Jar

Transfer Stinging Insect From a Net into a Kill Jar

Stinging Insect to Kill Jar from Teaming with Insects on Vimeo.

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Advanced Collecting Equipment

A supply of small plastic or glass containers or vials comes in handy, especially on long collecting trips. Empty pill bottles are good for this purpose. They serve as temporary storage, so that large numbers of specimens can be collected without crowding the killing jars. Soft tissue or cotton placed in these containers cushions delicate specimens and prevents breakage.

After they have died, butterflies, moths, dragonflies, and other large-winged insects are protected best by removing them from the jars and carefully placing each specimen in an individual envelope or in a rectangular piece of paper folded to form a three-cornered envelope (Figure 8). Cut a regular piece of paper approximately twice as long as wide (3 in. X 6 in. is recommended for most butterflies and moths). Fold diagonally as on line (A), approximately 1/2 in. from the upper right to lower left corners. Fold the wings of butterflies and moths above their back to prevent scales from being rubbed off the upper surface of their wings and place inside envelope (B). Fold tabs to close off the open sides of the envelope. The envelope is then locked closed by folding over tabs (C). Write collecting data on the outside of the envelope.

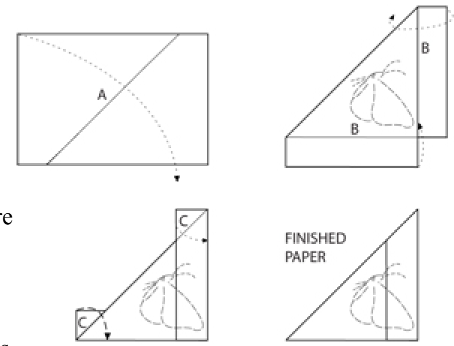

Figure 8

Warm, cloudy, sultry nights in the summer offer the best conditions to collect moths, beetles, and other insects attracted to lights. Many aquatic insects also are attracted to lights near lakes and streams. Visiting porch, street, and landscape lights in the evening can yield many insects that are otherwise difficult to find. You can also use specialized portable lights to attract insects. For example, a gas- or battery-powered camp lantern placed in the middle of a white bed sheet may attract a large number of insects at night. Commercially constructed light traps are available from entomological supply houses, but effective traps also can be made at

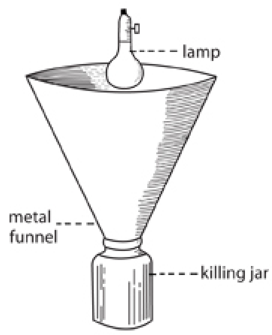

Figure 9

home (Figure 9). Lights afford good collecting throughout the spring, summer, and fall because various species occur at different times during the season.

Some insects are attracted to various food sources. Some can be collected from sweetened baits; others come to protein-based foods. Decaying meat attracts many beetles that can be trapped if the bait is placed in a glass jar or funnel trap (Figure 10) sunk into the soil with the opening flush to the ground surface.

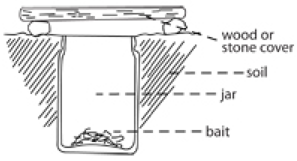

Figure 10

Collecting aquatic insects can be very exciting and productive. First-time aquatic insect collectors are amazed by the number of insects in aquatic systems. Many insects are found by turning over logs and stones on the bottoms of shallow ponds and streams. To collect fast-swimming specimens, it is usually necessary to use some type of net. You can buy specialized aquatic nets, but a large tea strainer is adequate for collecting along the shallow margins of both ponds and streams. For collecting in faster waters of rivers and streams, a specially constructed device called a kick screen (Figure 11A) is the standard piece of equipment. The screen is placed in the current. Rocks immediately upstream from the net are then turned over, and the dislodged insects drift into and are caught on the screen. Commercially constructed, heavy-duty dip nets (Figure 11B) with long, sturdy handles are useful for collecting from deeper waters of lakes and ponds. Never use your aerial or sweep net to collect in the water, as it is easily ruined.

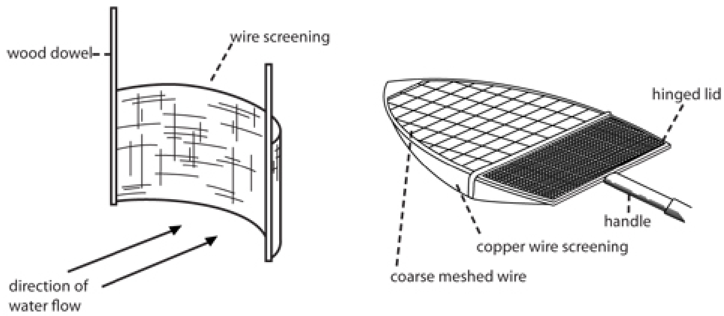

Figure 11

Careful attention is needed to collect insects from leaf litter and soil debris, because some of the specimens are very small and easily overlooked. Some collectors place soil litter on a white cloth or paper to make them easier to see and collect the insects as they attempt to crawl away.

Small trees and shrubs may be jarred or shaken, and the insects collected as they fall into an inverted umbrella or a light-colored beat sheet held under a branch or tree. This method is especially effective for collecting insects that "play possum" when disturbed. Figure 12 provides general guidelines of how to build your own beat sheet.

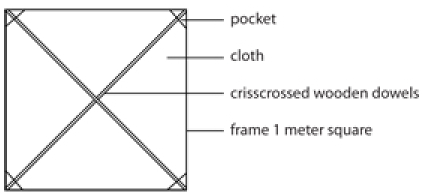

Figure 12

Every insect collector needs a good pocketknife. Pocket knives have a myriad of uses, such as removing bark from trees or borers from fallen logs or stumps; cutting off twigs; opening seeds, galls, fruits and vegetables; or even cutting into sod or soil. A trowel comes in handy to dig in the ground or leaf litter for larvae, pupae, and adult insects living there.

Last but not least, the collector should always carry a pencil and notebook for jotting down the place, date, collector's name and other important facts about the specimens collected. These data are important to include with any insect in a collection.

Many collectors prefer to carry field equipment, such as killing jars, note pads, vials, forceps, and brushes, in a backpack.

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Where to Collect Insects

Although many insects are easily found, certain kinds live in obscure and unusual places. Discovering where, when, and how to search adds greatly to the challenge as well as to the productivity of an insect-collecting trip.

During summer, insects are plentiful on flowers and foliage of growing plants, in and around ponds and streams, beneath decaying logs or the bark of dead trees, around bright lights in the evening, and on the ground among grasses and weeds. Some insects come out only at certain times of the day or night, others only at specific times of the year. Some are found only on or near plants upon which they feed.

The bodies of dead animals often attract many unusual insect specimens (e.g., scavenger beetles) that are not likely to be found elsewhere. The same is true of the droppings of livestock, where specialized insects are apt to be found. With a little experience, the collector soon learns where to look for the less common specimens.

During winter, most insects seek shelter and are found in clumps of grass, beneath the loose bark of trees, under stones and logs, or beneath leaves and soil debris. Many burrow into the ground to pass the winter. Although insects are more difficult to find during the winter, searching for them is nonetheless interesting.

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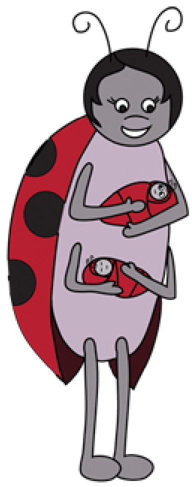
How to Rear Insects



Insect collectors soon become very familiar with the behavior and habitats of insects they collect. They not only know where to look, but also what life stages are apt to be present. When a strange-looking caterpillar, beetle grub, or bug nymph is found, or when an odd-appearing larva is seined from the bottom of a pond, or even a mass of tiny insect eggs is found, it is only natural for the collector to wonder what the insect is and what it might look like as an adult when its life cycle is complete. These questions can be answered by rearing the insects.

To rear insects and observe them as they pass through their various stages of development helps the collector more easily recognize the insects. Rearing insects also adds to the pleasure of collecting and studying them. Some collection or display-box rules mandate that only the adult-stage insect may be included. Rearing an insect from the immature stage to the adult stage is not only educational, but also results in a nice addition to the collection.

Many kinds of rearing cages are used, most of which are constructed of screen to prevent escape of the adults as they emerge. Most insects are easy to rear, if you give them an environment similar to the one in which they were found. For example, to rear a caterpillar found on oak leaves, regularly add fresh oak leaves for it to eat until it pupates. Unless you are familiar with the habits of the insect being reared, it is best to always provide a few inches of soil in the bottom of the rearing cage because many insects need soil in which to transform.

Rear aquatic insects by placing them in an aquarium with the proper environment. As with fish, the water must be properly aerated. Aquaria and air pumps are purchased from pet supply stores. Aquatic insects also need access to the kind of food on which they naturally feed, such as tiny aquatic plants or other organisms.

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Tips on Collecting Insects

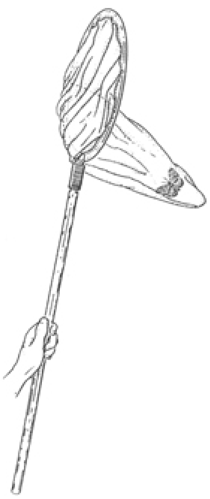

Figure 13

An alert collector finds many insect specimens from very diverse habitats. For example, dragonflies, damselflies, and other aquatic insects are found near water. These, as well as other flying insects, can be captured by netting them in the air. Other insects such as nectar feeders (bees, wasps, butterflies, and others) as well as a myriad of plant feeders are best collected with the net as they rest on plants. These insects are collected by sweeping weeds, grass, or any other foliage with the collecting net — swinging the net back and forth, scraping the foliage with each pass as you walk along. After several vigorous sweeps, grasp the bag with your free hand or flip the net over the wire loop (Figure 13) to prevent escape of the specimens.

Most insects can be simply picked out of the net by hand, with forceps, or with a small brush, and dropped in a collecting container. However, a few, such as bees and wasps, may inflict a painful bite or sting if handled. To kill these and other small flying insects that readily escape the net, first briskly sweep the net through the air to force the insects to the bottom of the net, then place the portion of the net containing the insects in the killing jar. Place the lid on the jar for a few minutes until the insects become lifeless. Once immobilized, they may be safely dumped directly from the net into the killing jar without danger of them stinging or escaping.

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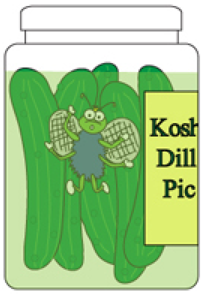
How to Preserve Insects



The next step after collecting insects is to preserve them permanently for future display and study. Insect larvae and soft-bodied and extremely tiny specimens are preserved in liquids. Isopropyl alcohol (70 percent) or equivalent is best. All others are preserved on specially designed insect pins. Large insects are mounted directly on pins, while those too small to be placed on pins are mounted on card points (Figure 14).

The wings of butterflies, moths, and dragonflies are spread to make the specimens more attractive and to aid in identification. All other insects should be dried with legs and antennae adjusted in the most lifelike manner possible.

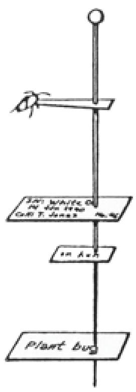


Figure 14

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Pinning Large Insects

Insect pins are available from any dealer of entomological supplies. Do not use common pins, because they rust and soon ruin valuable specimens. Additionally, only insects mounted on proper pins are acceptable in competition. Insect pins come in several sizes, but sizes No. 2 and No. 3 are most useful to the general collector.

Any insect that is large enough to be supported on a pin without breaking or otherwise being distorted is pinned directly through the body. Insert the pin through the body from top to bottom. The proper place of insertion depends upon the type of insect (Figure 15). The following rules are for pinning different types of insects so that the pin is placed firmly through the heavier parts of the body without destroying important identifying characteristics.

1. *Bees, wasps, flies, etc.* — Pin through the thorax between bases of fore wings and slightly to right of middle line (Figure 15A).
2. *True bugs* — Pin through the scutellum, which is the triangular area between the bases of the wings (Figure 15B).
3. *Grasshoppers, crickets, etc.* — Pin through the prothorax or "saddle" slightly to the right of the center line (Figures 15C and 15D).
4. *Beetles* — Pin through the forepart of the right wing cover near the centerline (Figure 15E).
5. *Butterflies, moths, dragonflies, etc.* — Pin through center of thorax between the bases of forewings (Figures 15F and 15G).

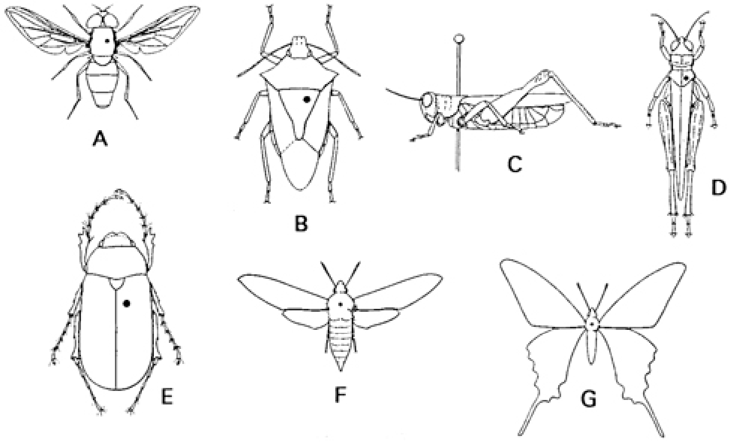

Figure 15

A piece of 1-inch thick Styrofoam is an excellent aid for pinning or mounting specimens. As each specimen is pinned, push the pin into the foam until the insect rests on the surface with approximately one-quarter to one-third of the pin projecting above the insect to facilitate handling of the specimen. Adjust the legs, antennae, and wings to a lifelike position with forceps and hold them in place with extra pins if needed. Allow the specimen to dry in the desired position for 7 to 8 days before moving. To prevent sagging, the abdomens of soft-bodied insects, such as crickets, mantids, or walking sticks, can be further supported with two temporary pins crossed at an angle such that the abdomen rests where the pins cross. Pieces of light cardboard supported on other pins can also serve this purpose. Once dry, the specimen will retain the proper position and the temporary supports can be removed.

Flat sheets of Styrofoam or other porous material also provide a handy place for the temporary holding of pinned specimens while they are labeled, identified, or arranged in display boxes.

Pinning Small Insects

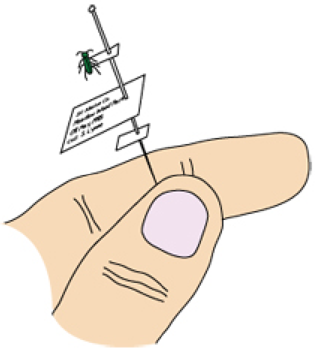

Figure 19 illustrates the card-point method used to mount very small insects. Cut all triangular points to a uniform size, 3/8 to ½ inch long and approximately 1/8 inch wide at the base. Index card paper is a durable and sturdy material to use. A specialized point punch (Figure 19A) can assist in creating a supply of points very quickly. If a punch is available, cut a large supply at one time (Figure 19B), and keep them in a box for future use. This saves time and assures that the card points are uniform. When a point punch is unavailable, a pair of fine pointed scissors will suffice. A series of card points may be cut from the pre-measured template found here.

Mounting insects on card points is not difficult if you follow the correct procedure. Note from Figure 19C that the pin is pushed through the widest part or base of the triangle and the specimen is glued to the point.

First, put the card point on the pin, and place a small amount of white glue or clear fingernail polish on the tip. Use as little adhesive as possible so that body parts will not become unnecessarily covered by glue. Next, lay the specimen to be pointed on its back on the edge of a block or thick book in such a manner that the pin can be turned upside down and the card point pressed lightly against the insect. IT IS VERY IMPORTANT TO ATTACH THE CARD POINT TO THE RIGHT SIDE OF THE SPECIMEN. With a little practice, the specimen can be placed so that it is in the correct position when glued to the point. Slight adjustments can be made once pointed and before the glue dries.

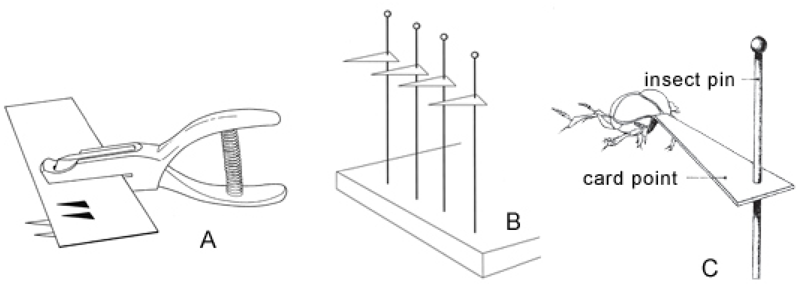

Figure 19

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The Pinning Block

The appearance of a collection is improved vastly if all the specimens are mounted properly and at a uniform height on the pins (Figure 16). This is easily done by using a "pinning block." Such a block is made of wood, plastic, or metal. Metal blocks must be purchased, but the others can be made at home. The wooden block is cut from a soft piece of wood 1 inch square and 4 inches long, or it is built by gluing together four pieces of ¼-inch finishing lath creating steps of ¼, ½ and ¾ inches (Figure 17). Small holes, slightly larger than the insect pins, are drilled through each of the four steps. After an insect is placed on a pin, either the head or the point of the pin is inserted in the desired hole and the specimen adjusted to the proper height (Figure 18). The block also is useful in adjusting labels to a uniform height upon the pins, thus improving the overall appearance of the collection.

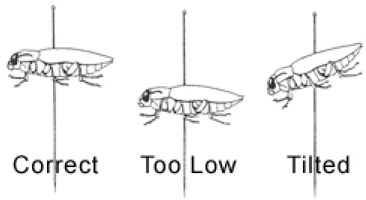

Figure 16

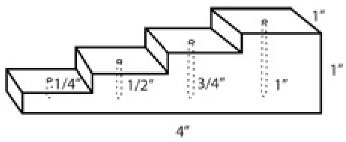

Figure 17

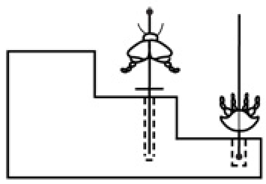

Figure 18

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The Relaxing Chamber

If specimens are allowed to dry out or become brittle, they may shatter when being pinned. Dry specimens can be made soft and pliable again by placing them in a relaxing chamber for 1 or 2 days. To make a relaxing chamber, place 1 to 2 inches of clean sand or sawdust in the bottom of a large, airtight jar. The jar must be large enough to allow small dishes to be placed inside, and must have a screw type or other lid to create airtight conditions inside the bottle. Saturate the sand with clean water and add a few drops of carbolic acid (sold at most drug stores) to prevent mold growth. Place the specimens in shallow, open containers on the bottom of the jar, and fit the lid tightly on the relaxing chamber. Amount of relaxing time needed varies with the size of the insect and how dry it is when first introduced. Retrieve and mount specimens as soon as they are pliable enough to pin easily, but remember that they can be ruined if left in a relaxing jar too long. Relaxing the wings of dry butterflies and moths is essential to allow them to be properly spread.

The relaxing chamber should be used for emergencies, not as a general practice. It is always best to pin specimens within a few hours after collection and avoid the need for relaxing chambers.

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The Spreading Board

All butterflies and moths, and sometimes other insects, are mounted with their wings spread. A spreading board is therefore an important piece of equipment for the insect collector. One board is sufficient for a beginner, but eventually the serious collector will prefer more and different-sized spreading boards to accommodate either large or small insects. Adjustable spreading boards that meet both purposes are available from entomological supply houses. Wooden spreading boards (Figure 20) also can be made at home, using the following materials.

1. Two end blocks, 5½ inches long and 1 inch square.
2. Two soft wood top pieces, 16 inches long, 2½ inches wide and approximately ½ inch thick. These pieces should be planed down to 3/8 inch thick on one edge.
3. One flat strip of corrugated box paper, fiberboard or cork, 14 inches long, 1 inch wide and approximately ½ inch thick.

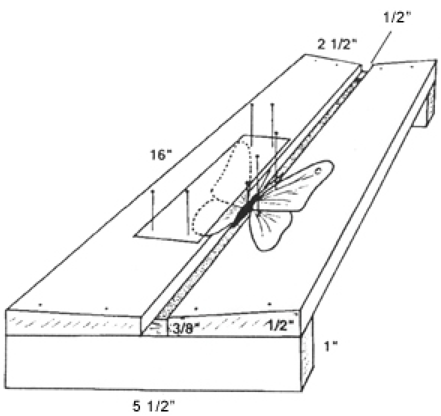

Figure 20

Nail the two top pieces to the end blocks, leaving approximately ½ inch between the thin edges. The cork or corrugated paper then is tacked beneath the top pieces to cover the opening and provide soft material into which insect pins can be inserted.

The top pieces can be sloped by cutting the top sides of the end blocks into shallow "Vs". This permits insect wings to dry in a slightly elevated position and allows for any sag that may occur after the specimen is removed from the board. Spreading boards with level top pieces are acceptable, but insects must remain on such boards longer for complete drying.

A less expensive spreading board is made from Styrofoam. The dense blue insulation-type Styrofoam used in house construction works best. Carve a groove to accommodate the body of the insect into a single block of this material or glue pieces of Styrofoam together to make a board similar in size and shape to the wooden one previously described.

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Spreading the Wings

Before attempting to spread an insect's wings, make sure the insect is fresh or thoroughly relaxed. Pin the specimen in the usual manner and at the usual height on the pin. Insert the pin into the middle slot of the spreading board and push down until the body lies in such a way that the wings are flush with the top pieces of board. Cut several thin strips of paper about ¼ inch wide and 8 to 10 inches long. This paper helps secure the wings without rubbing the scales off or unnecessarily tearing the wings. Slip a paper strip between the wings (if they are upright) and use them to force the wings on one side down into position (Figure 21). Being careful not to tear the wing, pin the ends of the paper down to the board (B). Then, with a fine point or needle inserted behind the heavy front margin of each wing, pull to adjust the front wings until their hind margins form a straight line (right angles to the long axis of the body), and secure by placing additional pins in the paper strips (C). Work the hind wings forward in a similar manner until their leading margins are concealed beneath the front wings (D). Repeat steps for opposite wing (E).

After wings are secured, set the board aside for 10 to 14 days to allow the specimen to dry adequately.

Note: Incorrectly spread wings is the biggest error in beginning entomology collections. Proper spreading takes practice. Poorly spread specimens should be replaced before entering collections in competition.

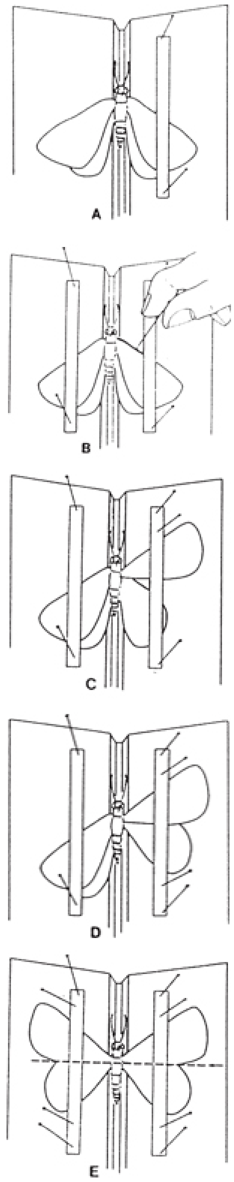

Figure 21