Recognizing Trouble

When you consider everything that can go wrong in a garden you may develop the sinking feeling that your corner of Eden is doomed to disaster. But there's no need to despair—though many garden problems are possible, few are likely to occur. Your plants won't succumb to every affliction, just as you won't suffer every calamity that can occur in an average day.

As you survey your domain for signs of trouble, be discerning: don't let the sight of a solitary bug or a few yellow leaves send you scurrying for the heavy artillery. A healthy garden is alive with insects, fungi, and other organisms. They're everywhere in the air, on the soil, underground, and on plants. The great majority are harmless: of the few million species of insects and related creatures and the approximately 100,000 plant diseases, only a small percentage cause serious problems.

Some creatures even help gardeners by pollinating plants, preying on pests, and breaking down organic matter. In fact, pests aren't responsible for the most garden woes: your troubles can usually be traced to poor growing conditions.

Of course, you will have to do battle with pests and diseases at least occasionally, so it's important to be aware of what's living in your garden—and to recognize the damage these organisms can cause. Your region, climate, plants, soil type, and gardening practices influence the types of trouble you'll encounter. Some problems are minor and can be monitored or entirely ignored, while others are serious enough to require immediate action. The challenge is to decide which of these categories your problem belongs to, and to determine its cause. For example, what if a plant that ordinarily remains vivid green turns a sickly yellow? Something is wrong, but what? Many gardeners blame the most visible creature, but the actual culprit may be microscopic; or the plant may be getting too much water or not enough nitrogen or light. Unless you figure out the underlying cause, you probably won't manage to cure the patient.

This Section will help you assess your garden problems. The following pages offer information on the chief sources of trouble, tips for examining plants, and suggestions for identifying the villain (or at least narrowing the list of suspects) from the evidence collected. You may have to seek expert help in diagnosing some problems, but at least you'll know when that's necessary. And you'll be able to provide your consultant with valuable clues.
Potential Culprits

Most organisms in a home garden are either neutral or beneficial, but some can do serious harm. These troublemakers range from obvious creatures, clearly visible from a distance, to microscopic pests that are usually identified by the damage they do. The major sources of garden problems fall into the four categories reviewed in the following pages: insects and their relatives, larger creatures, plant diseases, and poor growing conditions.

Insects & Their Relatives

If the destruction in your garden is the work of a living creature, chances are that the guilty party is either an insect or one of the pests that look and act much like insects: spider mites (arachnids), slugs and snails (mollusks), pillbugs and sowbugs (crustaceans), millipedes (diplopods), and nematodes (roundworms). These pests invade your property in various ways: they fly, walk, or crawl in, or they're blown in by the wind or brought in on infested plants or soil.

The overwhelming majority of creatures in this group are insects. (Although they're often referred to as "bugs," that term is properly reserved for a specific group of sucking insects.) Insects comprise all those organisms, which, as adults, have six legs, an exoskeleton (a protective outer shell instead of an internal backbone), and three body sections: head, thorax, and abdomen. The head contains the sensory organs, including eyes, antennae, and mouthparts. The legs and wings are attached to the thorax (most adult insects have two pairs of wings; flies have a single pair). The abdomen, usually the longest section, brings up the rear; it contains the respiratory, digestive, and reproductive organs.

A few million insect species inhabit the earth, with beetles accounting for some 40 percent of the total. Of all those insects, a mere one percent are considered pests. Moreover, because many insects change quite radically as they grow, pests are often harmful only at a certain stage of life.

How Insects Grow

Insects develop through the process of metamorphosis, meaning that their form changes as they mature. It's important to know a troublemaker's different stages, so you can recognize the pest before any damage is done.

example:

### Simple Metamorphosis

The harlequin bug is an example of a species that undergoes simple metamorphosis - meaning that the immature form looks pretty much like the adult. It starts out as an egg, then batches into a wingless nymph, which increasingly resembles the adult with each molt.

### Complete Metamorphosis

Species that undergo complete metamorphosis change drastically as they grow. The hornworm, illustrated above, starts life as an egg, then becomes a wingless larva called a caterpillar. After the last molt, it enters a resting stage called a pupa, then emerges as a moth.
A basic knowledge of the life cycle will also tell you when a particular pest is most susceptible to controls.

Almost all insects begin life as an egg, though most aphids and a few unusual insects give birth to live young. The egg hatches into an immature insect called a larva, which grows by molting—periodically shedding its external skeleton. Because the exoskeleton is rigid, it can't expand to keep up with the insect's growth; when it becomes too tight, it splits open and the insect crawls out, having already developed a new, soft shell that will soon harden. Most insects molt a specific number of times during the larval stage.

In simple (incomplete) metamorphosis, the larvae (usually called nymphs) look pretty much like miniature versions of the adults. They molt until they reach maturity, growing larger with each molt. Development of wings, changes in color, and other modifications may occur during growth. For example, spider mites (which undergo simple metamorphosis just as some insects do) start out with six legs and develop two more. Nymphs and adults of the same pest species feed on the same plants and cause the same kind of damage.

In complete metamorphosis, the young insect is a wormlike creature that bears no resemblance to the adult. Moth and butterfly larvae are called caterpillars, beetle larvae are known as grubs, and fly larvae are called maggots. Caterpillars have legs, but maggots and some grubs do not. During the larval stage — the phase that's usually most damaging to gardens — an insect increases in size by molting. When it's ready to mature, it pupates; that is, it enters a transitional, nonfeeding phase during which it encases itself in a protective shell, such as a chrysalis or cocoon.

### Metamorphosis & Mouthparts

If you know what kind of mouthparts a pest has and what type of metamorphosis it undergoes, you’ll have important clues for recognition. Pests experiencing simple metamorphosis look pretty much the same throughout life, while those undergoing complete metamorphosis change dramatically as they mature. The mouthparts determine the type of damage each pest inflicts. (For more on metamorphosis and mouthparts, see “How Insects Grow,” previous page, and “type of Mouthparts”, on page 4.)

<table>
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<tr>
<th>Pest</th>
<th>Metamorphosis</th>
<th>Mouthparts</th>
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<tr>
<td>Aphids, cicadas, leafhoppers, mealybugs, psyllids, scale insects, spider mites, spittle bugs, true bugs, whiteflies</td>
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<td>Crickets, earwigs, grasshoppers, pillbugs, sowbugs</td>
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<td>Thrips</td>
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<td>Ants, beetles, and weevils, caterpillars, sawflies</td>
<td>complete</td>
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<td>Fly larvae</td>
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A pupating insect is known as a pupa. Finally, after undergoing a dramatic transformation, the insect emerges as an adult.

Each stage of development may be lengthy or fleeting — some insects pass through the entire cycle in just days. Adulthood is usually very brief and concentrates on reproduction. Depending on the insect and the climate, there are from one to many generations a year; in mild-winter regions, some insects (such as aphids and whiteflies) reproduce the year around.

Once you understand a particular troublemarker's life cycle, you have the key to managing that pest. You'll find that most creatures have weak points, stages when you can more easily kill them. Entomologists refer to this as "breaking the life cycle." For instance, many insects that undergo complete metamorphosis are vulnerable during pupation, when they can't fly, crawl, or run away. At that point, you may be able to reduce the population by handpicking pupae attached to plants or garden structures, or by tilling the soil to destroy underground pupae or expose them to predators. If the damaging stage of soil-dwelling pest feeds only on a certain host crop, you can starve the creature by rotating the crop (not growing it in the same place year after year).

**Type of Mouthparts**

Most insects and related pests harm plants by feeding on them. The mouthparts — usually chewing or sucking — dictate the kind of damage and provide clues for control. The larval and adult stages of insects that undergo complete metamorphosis often have different feeding patterns: the larvae inflict damage by eating plant tissue, while the adults just lap up or siphon pollen and nectar. In some cases, the adults live only long enough to reproduce and don't feed at all.

**Chewing pests** eat holes in leaves, twigs, stems, flowers, and fruit; some gobble right through and sever the stems. These pests have strong, sideways-moving jaws, and their teeth tear as well as mash. Caterpillars, beetle grubs and adults, sawfly larvae, grasshoppers, and earwigs all chew. A few types of maggots are also chewing pests, but most fly larvae have a pair of hooks they use to rasp or scrape food. Among insect relatives, pillbugs and sowbugs have chewing mouthparts. Slugs and snails, though sometimes described as chewers, actually consume food with a radula — a tooth-encrusted band that shreds food and draws it into the mouth.

Some chewing pests leave distinctive holes or other marks. Root weevil adults make notches in leaf edges. Flea beetle adults munch small, irregular holes, so that foliage looks as if its been riddled with shotgun fire. Many other beetles skeletonize leaves, chewing them to lace.
Insects that chew tunnels in stems and trunks are called borers. They cause plants to yellow, wilt and suddenly lose vigor; branches or stems die back. And unlike most insect pests, borers don’t just disfigure woody plants—they often kill them. Of the numerous types of tree borers, many have characteristic tunneling patterns, allowing experts to identify the cause of damage even if the culprits have already vacated. Other types of borers attack nonwoody plants, such as squash and corn. To recognize borer holes in plant stems, look for excrement at the hole edges and on the ground below; on woody plants, sawdust or sap may also be present.

**Sucking pests** cause leaves, buds, and fruit to discolor, distort, or drop, but they don’t cut away pieces of the plant. Most pests of this type insert a specialized feeding tube (called a stylet) directly into a plant’s vascular tissues, then suck the juices — sometimes transmitting diseases as they feed. Sucking pests include aphids, scale insects, mealybugs, whiteflies, leafhoppers, psyllids, true bugs, spider mites, and thrips. Thrips are unique in rasping or scraping the leaf surface before sucking the juices.

Numerous means of control are possible for most pests, but mouthparts play a role in determining the chemical controls that will be effective. Since chewing and rasping pests ingest plant material, they can be killed with a stomach poison applied before or during feeding. Sucking pests, on the other hand, don’t eat outer surfaces, so poisons that must be ingested along with plant tissue won’t do the trick.

More effective are contact poisons, which kill by asphyxiating or paralyzing the pest when it's directly hit. Or apply a systemic poison—one that's absorbed into a plant, such as Bonide Systemic Granules or Cygon (use only on ornamentals). Both systemic and contact poisons also work on chewing pests that feed on plant surfaces. Once they’re inside a plant, borers are hard to control with poisons; other methods, such as injecting parasitic nematodes into the bore holes, are more efficient.

**Larger Creatures**

Urban sprawl has brought people into direct contact with wildlife. Consequently, many home gardeners now find that the most serious pests aren't insects, but larger creatures such as birds, rabbits, deer, and other fauna. Most of these pests are easy to recognize if you know when and where to look for them, and many highly distinctive damage. Some nibble fruits and vegetables just before harvest, others girdle trees and shrubs by gnawing, and yet others heave plants out of the ground by burrowing. And, even a pet dog or cat can wreak havoc by trampling plants and digging up seedlings.

Doing battle with wild creatures seems to cause gardeners unbounded frustration. When you feel your blood pressure rising, it may help to remember that you're the one infringing on the animals’ territory — they're only doing what comes naturally. However, tolerance and understanding go only so far where some pests are concerned. A single mole or pocket gopher, for example, can move through a garden like a wrecking crew. Trapping to kill may be the best way to resolve this kind of problem, but deterrence is a better solution in many cases. Bird netting, row covers, fencing, tree guards, and repellents are all available weapons in the war against wildlife.

Bonide offers repellents such as Rabbit and Deer, Dog and Cat, Mole Repellent, Goose Repellent and an all-purpose animal repellent. If you do decide that an animal is too troublesome to bear, consider its legal status before taking deadly action. Depending on the area, larger mammals (such as deer, rabbits, squirrels, and raccoons) may be protected except during official open seasons. For information, check with your state game or conservation department.

**Plant Diseases**

Plant diseases are caused by pathogens—primarily fungi, bacteria, and viruses. Unable to manufacture their own food as green plants do, these organisms obtain sustenance from host plants, causing disease in the process. Luckily, most plants are resistant to a wide range of disease organisms, but just about every plant is vulnerable to some ailments.
The presence of a pathogen in your garden doesn't mean that disease is sure to develop. Problems will arise only if the plant is susceptible to the pathogen and if the environment favors development of the disease. For example, if a plant is susceptible to a particular fungus, but soil conditions are unfavorable, the disease won't appear. If the soil conditions are conducive but the plant is resistant, the disease still won't develop. This interrelationship is known as the disease triangle.

As experienced gardeners know, avoiding plant diseases is far easier than trying to cure them. To dodge a disease, you disrupt the disease triangle (this is equivalent to breaking an insect's life cycle by exploiting its vulnerabilities). Since eliminating the pathogen isn't always easy, your best bet is to use resistant plants (if they're available) and to provide growing conditions that discourage the disease. If the pathogen is favored by wet soil, let the ground dry out between waterings; if it needs shade, prune the plant to let in sunshine.

Temperature and humidity are key environmental factors, but you can't do much to control them. As long as the weather is unfavorable, the disease will be slowed or even stopped in its tracks. But the longer the conditions remain ideal for disease development, the more severely your susceptible plants will be affected.

Fungi
The source of about 80 percent of plant diseases, these threadlike organisms develop structures

Fungal structures, such as this orange growth, are often quite conspicuous

that actively penetrate plant tissue—and that are often plainly visible on infected plants. Fungi usually grow through or on the tissue as fine branching filaments (hyphae), which form a mass of strands (mycelium). Fungal growth is usually favored by warm, humid, or moist conditions. Infected plants typically suffer from rotting, stunting, leaf curling, spotting, and wilting.

Many fungi produce tiny reproductive bodies called spores, which spread around the garden by they work. If a spore lands on a suitable host, it germinates when conditions are right, producing a new infection. Some types of reproductive structures can survive for long periods in the soil, even in the absence of a host organism.

Bacteria
Because these single-celled microorganisms generally need high temperatures and moisture to multiply, the diseases they cause are more common in the tropics than elsewhere. Bacterial diseases are relatively uncommon in dry-summer climates (fireblight is a notable exception), although overhead irrigation can create favorable conditions. Common symptoms of bacterial disease include wilting, rotting, and swollen plant tissue (galls). Bacteria often live in a protective ooze they produce in the infected plant.

Unlike fungi, bacteria don't have an active mechanism for penetrating tissues: they enter their victims by slipping through natural openings and wounds. Splashing water is the most common method of transmission, although insects, infected tools and soil,
and gardeners working among plants can also foster the spread of disease.

**Viruses**

Even smaller than bacteria, viruses invade living plant tissue and reproduce inside the cells. They're most commonly spread by sucking insects (especially aphids, leafhoppers, whiteflies, and thrips), but can also be transmitted by infected seeds, tools, and hand contact.

Viruses cause stunting, malformations, and color changes, most often mottling or yellowing. Some attractive plant varieties — striped tulips, for example — owe their variegation to a viral infection. Viruses can be disastrous for commercial growers, but they aren't usually a problem for home gardeners, especially when plant vigor isn't affected.

Since viral growth is linked to that of the host plant, you can't get rid of viruses without damaging or killing the host as well. In theory, you can stop many viral diseases by eliminating every potential carrier insect, but this method of control is impractical. You can, however, keep the disease from spreading by destroying infected plants.

**Poor Growing Conditions**

Though the blame is frequently directed elsewhere, most garden trouble results from stress due to unfavorable growing conditions-including nutrient deficiencies, poor drainage, improper light, temperature extremes, air and water pollutants, fluctuations in soil moisture, chemical damage, and mechanical injury. In fact, adverse conditions are often responsible for common problems such as yellowed leaves and stunted growth, ailments many gardeners automatically attribute to insect pests or plant diseases. These problems are sometimes referred to as environmental diseases to differentiate them from sicknesses in which a pathogen is involved. They're also called physiological disorders.

Stressful growing conditions can be categorized as acute or chronic. Acute stress, brought on by sudden, short-term problems such as an untimely freeze or improper pesticide application, produces immediate damage. Chronic stress, caused by long-term problems such as a nutritional imbalance or insufficient light, causes more gradual damage. In either case, though, the affected plants grow weaker and may even die.

Stress also opens a plant to potentially fatal invasions by pests and diseases. Bark beetles and borers will often strike a tree weakened by poor growing conditions; one that's been gashed by a lawn mower or string trimmer is more susceptible to disease, since the wound offers easy access to pathogens. Crowded or overwatered seedlings are more likely to be killed by damping-off fungi than those raised under more favorable conditions. Pests and diseases may administer the coup de grace in such cases, but they aren't the real source of trouble.

Poor growing conditions often produce symptoms similar to those typical of diseases, but the treatment that's required differs. A hint for telling the two types of problems apart: if the same symptom (such as wilting or yellowing) appears on several adjacent plants, chances are the cause is environmental. Disease damage is usually distributed randomly or limited to a single plant. Unless a disease is obvious, it's usually easier to assume that growing conditions are at fault — and to see if improving them solves the problem.
Here’s a short list of environmental problems often blamed on pests or diseases:

- Cracking or splitting of tomatoes, cherries, and other fruits may occur when the plant receives fluctuating moisture.
- Blossom-end rot on tomatoes (a dark, sunken area on the bottom of the fruit) and brown spots or a brown core inside apples are among the problems due to calcium deficiency. If the soil is too wet or too high in salts, or if the moisture content fluctuates, calcium uptake may be prevented even when the nutrient is present in the soil. (Use Bonide Rot Stop.)
- Catfacing (distortions on the bottom of tomato fruit) results if weather is too cool when the plant is young.
- Misshapen cucumbers and apples can often be attributed to poor pollination due to unfavorable weather or the absence of bees. (Use Bonide Tomato Set.)
- Blasting (premature dropping of buds and flowers) is caused by soil that's overly wet or dry.
- Bleached or dead tissue between leaf veins is a sign of sunburn—a problem that usually afflicts plants exposed to hot sun and given insufficient water.
- Dead tissue at leaf margins may be due to windburn, a common problem when plants growing in dry soil are subjected to dehydrating winds. The same symptom can result if plants receive excess salts from over fertilizing or from lime or other minerals in the soil or irrigation water.
- If trees and shrubs in a big city drop their leaves prematurely and show yellow or purple areas between the veins on older leaves, the culprit could be too much ozone in the air.

When you find what you think is trouble, don't jump to conclusions. Before making a diagnosis, ask yourself what the plant should look like. It may turn out that yellow leaves are normal, or that the shrub you think is stunted isn't supposed to grow more than a foot high. Leaf drop can be natural, too: deciduous plants drop all their leaves at once, while evergreens lose some of their older leaves throughout the year. As is true for deciduous leaves, evergreen leaves sometimes turn brilliant colors before they fall.

Fruit trees normally thin themselves by dropping fruit. Some varieties don't flower or bear fruit at all until several years after planting; others bear a heavy crop one year and little or no fruit the next, while still others produce fruit only when another pollinating variety is present. Certain plant species, such as holly, have separate male and female plants, so find out whether your plant is a male before you fret over a lack of fruit.

Once you decide that something is amiss, make sure you've properly identified the plant. This may help you track down the culprit, since some pests and diseases attack only a single species or a narrow range of plants. Closely related plants are usually attacked by the same organisms—for example, cole crops are susceptible to imported cabbageworms, while members of the rose family are prone to the bacterial disease fireblight. Identifying a plant correctly can also help you eliminate suspects; it may be that some pests eat just about everything but the plant in question.

Many pests and diseases will appear in your garden at the same time each year. Keep track of their comings and goings; you may be surprised by the regularity of their visits. Certain insects can be counted on to show up within a few days of a specific date each year. Some disease organisms make inroads at particular times—during a wet spring, for example. By learning to recognize these habitual offenders, you'll be able to anticipate their arrival and have your defenses ready.

Tracking Down Trouble

You have to see trouble in order to unmask it. Unless you conduct regular patrols of your garden, small problems can mushroom into big ones while you're not looking. Walk among your plants often, using a 10-power hand lens for a close look at small organisms and plant parts. Keep a written record of all the problems you discover, noting the date, symptoms, and any unusual conditions, such as unseasonal weather or a recent pesticide application.
The larval form of the mealybug destroyer (top) bears a striking resemblance to its prey, the mealybug (bottom).

Friend or Foe?
It's important to perform general surveys of your garden at regular intervals. Find out what's sharing your yard with you—and remember that not all insects and other organisms you encounter are harmful. Learn to recognize beneficial creatures and treat them with respect. These helpful organisms are efficient pest-control agents; kill them, and your job becomes more difficult.

Some people view anything that creeps, crawls, or slithers as a pest, but many of these creatures are garden allies. Lizards and salamanders eat insects; garter snakes and turtles devour slugs. Ladybird beetle larvae and lacewing larvae, both of which resemble tiny alligators, feed voraciously on aphids and other pests, as do the wormlike larvae of syrphid flies.

Other types of creatures unjustly maligned include birds, bats — and sometimes, pets. But bats consume huge numbers of insects; and though some birds are a nuisance, many species dine almost entirely on insects, ignoring seedlings and ripe fruit. Even a well-trained cat can provide invaluable aid to gardeners by hunting rodents such as pocket gophers and voles.

Some creatures are potentially harmful, but rarely appear in large enough numbers to cause trouble. The ferocious-looking Jerusalem cricket, which eats potato tubers, doesn't usually pose a serious problem in home gardens. Two insects that are hard to spot because they look like plant parts—katydids (leaf mimics) and walkingsticks (twig mimics)—feed on foliage but usually don't do much damage. Don't wage war on these "pets" until they give you reason to do so.

In other cases, an ally and a pest may look alike, so make sure you've got the identification right before you put out the welcome mat or launch controls. You'll find that ladybird beetles bear a superficial resemblance to several harmful insects: Mexican bean beetles, spotted cucumber beetles, and Colorado potato beetles. Except for its thicker middle, the moth of the destructive peachtree borer looks like the digger wasp, a helpful insect that stocks its burrow with caterpillars and other pests.

Some creatures are capable of doing harm but rarely inflict it. Among them are two master of camouflage: the katydid (left), which looks like a leaf, and the walking stick (right), which resembles a twig.

The wax-coated larvae of the mealybug destroyer bear a remarkable resemblance to their quarry—mealybugs. If it weren't for a wider body and oversize orbs, the big-eyed bug could be mistaken
for the chinch bugs they prey on. The similarity between predatory mites and spider mites ends with their looks: the former are garden allies, the latter enemies. And while it's true that most thrips harm plants, the six-spotted thrips and a few other species are predators.

The different dining preferences of brown garden snails and decollate snails prove that not all snails are bad. Brown garden types ravage plants; decollates eat their brown cousins. If you have both kinds of snails in your garden, make sure you don't kill the wrong ones.

If you dig up a plant and find nodules on the roots, don't panic if the plant is a legume (such as a bean or pea) and you can flick off the growths—those little lumps are nitrogen-fixing nodules, which help the plant convert nitrogen into a usable form. On the other hand, if the plant isn't a legume or if you can't detach the growths, you're probably looking at root galls caused by pest nematodes.

Not all garden creatures are undesirables, and the same holds true for plant diseases. Some pathogens actually help gardeners. Naturally occurring viruses commonly kill pests such as cabbage loopers, imported cabbageworms, codling moths, and armyworms. A viral or fungal disease reduces gypsy moth populations every 10 years or so. Chinch bugs are another troublemaker susceptible to fungal infection. If you see sick looking or dead pests, leave them alone to infect other members of the species.

Examining Plants
Use the following technique to inspect a plant, making notes of your findings as you go. From the accumulated data, you may be able to zero in on the culprit yourself. If you're bad and decide to consult a professional, at least you'll have useful information to convey.

Start your examination at the bottom of the plant, since damaged roots cause many aboveground symptoms. Check the soil at the root zone to find out if it contains adequate moisture: either dig down with a trowel or insert a soil probe. Don't just check the surface, since that dries out first.

Uncover a section of root and follow it to the end to see if it's rotten or infested. Dark and/or smelly roots often indicate soggy soil or root-rotting organisms (healthy roots are usually whitish and don't have a foul odor). Look carefully for any pests. Notice whether the roots are chewed off or damaged in some other way.

Next, check the crown (where the roots meet the stem) for signs of pests or diseases. Peel away any bits of loose or wet bark to see what's underneath. Note any discoloration or unusual odor.

Work your way up the stem and branches, searching for wounds, nicks, holes, and dieback. Wounds at the bases of trees are often caused by lawn mowers or gnawing animals. Holes with sawdust like material at the edges indicate the presence of borers. Check the junctions of branches and stems for anything unusual.

Examine the leaves—especially the undersides, where many pests feed. Note any twisting or curling, stickiness, or abnormalities in leaf color, size, or vigor. Look for spots and holes, too.

If flowers or fruit are present, inspect them for signs of infestation or other damage, such as spotting or malformations. If the plant is supposed to bloom or bear fruit but hasn't, note that.

Check to see whether the symptoms appear over the whole plant or are confined to just one section. Also try to discern whether some of the damage appears fresher than the rest. Generally, the most recent damage is characteristic of the underlying problem; older damage may in part be attributable to secondary pests or disease organisms.

Identifying the Culprit
Since different problems have different remedies, an accurate identification of the troublemaker is essential. The evidence you've gathered from touring the garden and examining ailing plants should help you uncover the scoundrel—or at least close in on it.

Before you attribute blame to an organism, make a final check of growing conditions. Might they be
the source of trouble? Even if harmful organisms are present, they're not necessarily the culprits—they may simply have taken over a stressed plant rather than instigating the problem. If you can improve conditions, do so. If the environment looks good, then focus your attention on pests and diseases.

Fortunately, only a limited number of troublemakers are likely to show up in any garden, so there's no need to go through a mental checklist of every conceivable pest and disease. Consider only those found locally and known to affect the plant in question.

If you've found a pest on the plant, then your task is to put a name to it. Keep in mind, however, that the presence of a pest that could have inflicted the harm doesn't constitute proof that it did do the damage. For example, sowbugs and pillbugs, largely beneficial creatures, often hide in holes chewed by slugs and snails. The most conclusive evidence, of course, is seeing the pest actually feed on the plant. To catch nocturnal pests in the act, you'll have to equip yourself with a flashlight for nighttime surveillance.

If no troublemaker is in evidence (during day or night), the best course is to run through the list of suspects to select the most likely perpetrator. You may already be familiar with some pests and diseases, and you'll learn about others by talking to knowledgeable gardeners in your area. This book offers profiles of over 100 pests and diseases; to narrow the search more rapidly, you can check for the afflicted plant in "Some Common Plantings and Their Pests", then start by investigating the troublemakers listed for that plant. You'll notice that some organisms have distinctive features that make them easy to recognize. Others are usually identified by the damage they do or the telltale signs they leave.

Among the most easily recognized pests are Colorado potato beetles, which sport a polka dot thorax and striped wing covers. You'll know earwigs by the curved pincers at their back ends. Root maggots can be identified by their pointy heads and blunt rears' a magnified look at an aphid reveals two projections at the rear that resemble dual exhaust pipes. If tiny, white mothlike creatures flutter up in a cloud when you touch a plant, you're looking at whiteflies.

The eggs of some pests are just as unmistakable as the creatures themselves. Harlequin bug eggs, for example, look like rows of tiny black and white barrels on leaf surfaces. Slugs and snails lay masses of gelatinous eggs in the soil. Fall cankerworm moths deposit gray, flowerpot-shaped eggs on twigs; imported cabbageworm butterflies lay bullet-shaped, ridged yellow eggs on the undersides of cole crop leaves.

Some symptoms obviously point to certain diseases. Blackened foliage and twigs on a pear tree scream fireblight; puckered leaves on a peach tree indicate peach leaf curl. Light pink slime oozing from lesions on plant parts means anthracnose. Tumor-like growths on the roots or stem near the soil line signify crown gall.

Even if you don't recognize a pest or disease, you may be able to narrow down your choices. For example, a powdery or fuzzy coating on plant parts is a clear sign of fungal disease. Weevils (a type of beetle) have a distinctive long, curved snout. All true bugs, many of which are pests, have a triangular marking on the thorax in the adult stage. An organism's color, shape, size, and favored host plants can also help you home in on the culprit. Weather conditions and time of year may prove significant as well.

You don't need to see some pests to recognize their handiwork. Pocket gophers and moles make distinctive mounds—fan-shaped mounds in the case of gophers, volcano-shaped ones for moles. A mole leaves the hole at the mound's center open, while a gopher plugs its off-center hole (although the opening may be unplugged if the gopher's work was interrupted).

Deep, irregularly spaced holes that slope down at an angle indicate a tree borer, while shallow holes in neat rows are the work of a less damaging creature—the sapsucker (a bird). Leaf miners create winding trails or blotches on leaf surfaces.
Bagworms weave sacks that dangle from tree branches.

Other calling cards include the silvery slime trails on which slugs and snails travel. Fall webworms and tent caterpillars produce webs; webworms work at the ends of branches, tent caterpillars in the forks. Spittlebugs manufacture froth. Plum curculios leave a crescent- or mushroom-shaped scar on fruit. Hornworms are often hard to spot on a plant, but the large pellets of excrement they leave on the ground or foliage beneath skeletonized leaves give them away.

If you see leaves coated with a sticky material or black fungus, or if you notice ants marching along a plant's stem, you know you're dealing with sap-feeding creatures such as aphids, scale insects, mealybugs, whiteflies, leafhoppers, or psyllids. These pests excrete honeydew (undigested plant sap), which in turn attracts ants and promotes the growth of sooty mold.

What If You're Stumped?

Don't expect to figure out every problem yourself. A single symptom may have many possible causes (see the chart below and on the following page); some organisms are difficult to detect, while the presence of others can't be confirmed without laboratory analysis.

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