Basic Entomology

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Hi, I'm Art Antonelli, Extension Entomologist, and I am the presenter for Basic Entomology. Welcome to, for what some of you, will be your first exposure to training in the world of insects and their relatives, or basic entomology. Hopefully, after you realize how important these creatures are to global health, many of you will experience an attitude change regarding their right to live. In this module or presentation we will elucidate the insects’ role in nature, their relationship with near relatives, how they develop, their anatomical makeup, etiology, adaptations, host relationships, etc. After a brief discussion break we will then discuss pollinator safety.

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The animal world or kingdom Animalia is broken into a number of taxonomic units called phyla. There are about 25 such groups. The phylum we will explore is called the Arthropoda. The Arthropods are divided into another more clearly defined set of units called classes. There are about nine such units and the ones Master Gardeners should be aware of are listed on the screen. They include the insects; the arachnids, which include spiders, mites, ticks, daddy long legs, scorpions, etc.; the diplopods, which is the technical name for millipedes; the chilopods or centipedes (the centipedes and millipedes sort of look alike, but there are sufficient physical differences to legitimately separate them into different classes); the crustaceans, many of which are aquatic or even marine in existence that you need not know for gardening purposes; however, there are two “land lubbers” known as pillbugs and sowbugs, which are sometimes falsely indicted for damaging crops and structures. In actuality they are beneficial recyclers; and finally there is the class Symphyla, which contains a sporadic pest called the garden symphylan or garden centipede, which can cause huge losses to the roots of plants like beans and corn. Fortunately, epidemics are rare.

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These arthropods share several visible features with each other. They have an exoskeleton to which internal muscles attach. The exoskeleton has advantages and limitations. Its design can result in these animals being very powerful, but limits the maximum size that they can achieve. They have jointed appendages and are visibly segmented at some stage of their development and they are bilaterally symmetrical (the same on each side of the body). Collectively these features differentiate them from phyla like the chordates (humans, etc.) which have joined appendages and are also bilaterally symmetrical, but have an endoskeleton rather than an exoskeleton and chordates are not visibly segmented.

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Let’s look at the various classes up close and personal and address the major features that make them what they are. This is a common millipede. Millipedes are blocky and rounded in cross section. They are slow-moving and have two pairs of legs on each abdominal segment (which is the most of the length of the critter) and have only one pair on each thoracic
segment. Their food includes largely decaying vegetative material. Occasionally they are erroneously accused of damaging healthy plants. This happens very rarely.

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This is a centipede. Centipedes are very fast-moving and exclusively predacious in our area. They are rather flat in cross section and have but one pair of legs on each body segment except the head, which has a pair of powerful jaws.

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This is a very notorious member of the arachnid class. It is the venomous black widow spider, which has – ounce for ounce – the poisonous impact of a king cobra. Thank God the payload of this spider is far smaller than the snake. Few people are bitten and when looking into the historical record it shows that greater than 99% of the victims are bitten in outhouses – so now you have your own prevention technology. This spider species does occur on both sides of the state, but is more prevalent in eastern Washington than in western Washington. A word on spider venom – it is generally agreed that there are two types. One type results in a more systemic symptomology, which can be a flu-like reaction such as migraine-like headache, shakes, partial paralysis of the diaphragm and difficulty in breathing, all of which may take a week to subside. This type of envenomation is typical of the black widow. The second type is usually more localized at the bite site and may result in either necrosis or rotting flesh at the bite site or at least a tender reddening and weeping of this sensitive area. This is typical of the brown recluse (not native to Washington) and on rare occasions the invasive hobo spider, which is now widespread in much of the western USA and southwestern Canada.

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Another thing that sometimes happens to spruce, in fact pretty frequently to spruce over here, is not an insect but a pest called spider mites. Spider mites are very common and they can hit just about any type of plant: trees or shrubs or herbaceous perennials, annual vegetables, you name it and spider mites can be a pest. They really like hot and dry environments and so spider mites are much more of a problem on the east side of the state. You can see here this spruce, it’s a Colorado blue spruce, and here is this year’s growth and it’s nice and healthy and blue, but back here we see a lot less of this nice blue color and over time we even see some needles that are more yellow. This is a symptom that while the spider mite infestation isn’t severe, it is ongoing, so this spruce is probably not as healthy as it could be because it’s got these little spider mites that are sucking pests that actually pull the sap out of the tree, so over time they actually reduce the vigor of the tree and in severe cases can actually kill a tree or a shrub. This spruce is probably going to be okay, although it would certainly benefit from having some control. Spider mites are so small that it’s easy just to wash them off of plants, if you’ve got a smaller plant you can hose them off with a spray of water, making sure that you hit the undersides because that’s where they like to collect.

Spider mites, like their name, can actually spin webs. You would maybe get that idea from calling them spider mites. In severe infestations you’ll actually see branches that have webs all around them and if there aren’t any visible spiders, that’s a clue that maybe there are spider mites attacking the plant. Spider mites on deciduous trees and shrubs tend to give sort of a stippling effect and you’ll see other examples of that in this module, but on conifers it’s just
generally kind of a yellowing over time. Where they become a really serious pest for some home owners is on arborvitae. A lot of people have an arborvitae hedge that they clip back year after year and spider mites can turn part of that neatly manicured hedge brown almost over night or at least within a couple of weeks. This is a pretty serious issue for some owners, the ones who keep their hedges in good shape are not likely to want big brown patches and so in that case there are some chemicals they can use, but the best treatment for spider mites is prevention and that’s having a nice healthy plant, washing the leaves off if you suspect spider mites and just keeping a plant healthy by giving it enough water, nutrients and giving it a little bit of air circulation between the branches that way spider mites don’t have protection from rain or wind that might blow them off.

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These are the adult female two-spotted spider mites. Also scattered about the underside of the leaf observed are the eggs of these mites. This is a pest group that can be quite serious not only in gardens but also in greenhouses and in collections of houseplants. They have many dozens of potential hosts and can kill many of these plants quite rapidly. Sidebar – do not move houseplants to outdoor areas and then back inside again. Mites can get around quite easily on the silk strands that they spin which they use like windblown parachutes. Hence plants outdoors have a good chance of being infested before being brought back inside.

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This is one of our terrestrial crustaceans – the pillbug. It is related to the sowbug. The pillbug can roll up into a ball like an armadillo when disturbed. Sowbugs cannot. Both are quite dependent on moisture and both are very useful scavengers of rotting wood and other rotting vegetation.

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Now for the class Insecta. This class is differentiated from all other classes of arthropods by having – at least as adults – 3 distinctive body regions, which are the head, the thorax, and the abdomen. Attached to the thorax are three pairs of legs and in many adult forms one or two pairs of wings. No other arthropod exhibits this arrangement.

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As practicing Master Gardeners you are likely going to be responsible for identifying damaging pests and/or their damage. Keep in mind that there are two basic mouthpart types – chewing and sucking. It is the mouthpart design that results in sometimes highly predictable symptoms. Those pests with chewing mouthparts leave evidence of often very generic leaf gouging that, in the absence of the captured culprit, could be caused by beetles, caterpillars, earwigs, or in some cases even slugs. So without the pest, the Master Gardener should respond with his or her diagnosis as “possible cutworm” or “maybe an earwig”. These “weasel” words will help maintain a profile or professionalism until the culprit is ultimately identified. To achieve this goal, tell the client to go out on a warm evening with a flashlight and hopefully capture the offending insect.
Insects with sucking mouthparts often impart characteristic predictable symptoms such as chlorosis or stippling, leaf distortion, needledrop, or galling. These symptoms are caused often by the toxins in the insect's saliva and are so repeatable that the experienced diagnostician can usually diagnose the problem in the absence of the culprit. When the diagnostician has the luxury of having the actual pest, he or she can use the pest's anatomy and structure to arrive at an identification. This often demands the use of dissecting microscope or at least a good hand lens.

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Another kind of chewing insect is one called the leafminer. This one is often misdiagnosed because the symptom here looks like a leaf spot or a leaf blight because it's brown and discolored on it. But the leafminer is an immature stage of usually sawflies and they mine inside the tissue of the plant as they're feeding. As we take this leaf and pull it apart we see that the reason it was brown is that there's no tissue between the lower layer of the leaf and the upper layer, this is an empty tunnel and these are quite large mining activity of that leaf miner. Let's go look at some where we see the individual tunnels.

So the leafminer is often misdiagnosed because it causes these large blighted areas on top of a leaf and so people will be looking for leaf blight information, when in fact it's a chewing insect. The leafminer, the eggs are laid in the leaf tissue and then as the larvae develop they're mining around and you can see this is a completely empty pocket, so to speak, where there's no tissue there between the lower layer of the leaf and the upper epidermis. There's no evidence here of the leafminer left because it's matured and gone on, but underneath there you might see black spots, which is the frass left over.

Ok, now here's some damage that the leafminer does that's more typical and that is this tunneling symptom. See here that there's a little teeny larva in there and it is tunneling out a section of this leaf. This can eventually become more severe and coalesce into a large blot, but this tunneling of individual leaves is very common and you'll find leafminer damage on spinach and chard, you can find it in lilacs.

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The diagnostician will do this by comparing the pest to previously identified specimens in a regional reference collection or by running it through a dichotomous or forked biological key. These keys are couplets offering either/or choices. If he or she has interpreted the appearance of characters on the pest reflected in the choices given correctly, accurate identification will be achieved.

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As with any living entity, pests are given binomial recognition. That is they have a first and last name – the genus and species. These names are in classical Latin or sometimes Greek, and although they are considered dead languages, they are very much alive in biology. They are important in that they maintain a universal language that sustains a high level of accuracy and gives the scientist an ID tag for a literature search that can lead to a maximum amount of information. The Latin name also aids in avoiding the common name syndrome.
For example, *Aphis pomi* (the green apple aphid) is *Aphis pomi* wherever it is found, but it may not sport that common name in various places around the world.

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Let us now look at how insects grow or develop. Growth is driven by genetic, hormonal, and environmental factors. Whereas we and other chordates demonstrate a more or less progressive growth curve through time, ending in an adult form and size, the insects and their relatives grow incrementally in a staircase fashion. Limited by their exoskeletons, they literally have to split open and molt, huff and puff to grow some before the new exoskeleton hardens. From each molt till the next, the immature stage is called an instar. In other words, when the egg hatches the emerging insect is called a first instar nymph or larva, when this instar molts it's then a second instar nymph or larva, and so forth and so on.

The hormonal involvement in molting is complicated and dramatic. Understanding the process has led to the ability to artificially develop one of the key hormones involved – namely juvenile hormone or J.H. This is the hormone that effectively inhibits molting between stages. When the immature insect's immediate environment is overloaded by this chemical, molting ceases completely and the insect dies before even reaching the reproductive stage. Such chemicals are called insect growth regulator pesticides and have proven very effective in indoor flea control, roach control, and whitefly control, etc.

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Metamorphosis or insect development demonstrates a certain level of dramatic change in each stage in all but the most primitive of insects. In ancient insects like firebrats and silverfish there is no real drama – after each molt you simply get a larger individual that looks like a small adult. In the intermediate insects like aphids, termites, earwigs, etc. you see simple or gradual metamorphosis where the only drama observed is the incremental growth of the wingbuds on each nymphal instar. In higher insects like bees, ants, beetles, moths and flies, etc. you see a more complicated or complete development where drama in change is hugely obvious. In fact, a whole new stage is added to the process.

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If you look at development in a flow chart that reflects egg hatch to adulthood, you would see that primitive insects demonstrate younger or smaller nymphal versions until adulthood is reached. In the intermediate types you would observe nymphal stages that begin to reveal the development of wingpads as they grow; whereas with higher insects you see development that reflects a series of larval molts until a new stage is introduced called the pupa. This is truly a magical stage within which there’s dramatic rearrangement of tissue until the emergence of the adult insect. You will note also that the immature of these advanced forms look nothing like the adult form, whereas the less advanced insects’ immatures look a lot like their adults.
Now let’s look at the various types of insect groups as individuals from the primitive to the advanced. These are firebrats. There are two adults shown. All the other are various stages of nymphs and the only difference between them and the adults is size.

This is an intermediate type of insect. It is a lygus bug, and judging from the advanced stage or growth of wingpads it is probably a late instar nymph.

Here we have a clutch of eggs laid by an advanced form of insect called a looper. They are related to cutworms.

After these eggs hatch, the young caterpillars go through multiple larval instars and cease feeding at this last larval instar, which makes preparation to change into the next stage.

Often, such caterpillars will make a mud or dirt capsule or spin a cocoon within which pupation occurs. After a predetermined period of time….

…the adult moth – in this case a celery looper – emerges to start the cycle over again.

The insect class is a hugely diverse group. To date, the number of species described is just slightly under a million. Experts say that if all microhabitats were thoroughly explored and detailed collections were made – there, very likely would be between 10-30 million species of insects revealed. They truly are the dominant ecological animal life-form on the planet. The really astounding fact is that less than 1% of them are even potentially pestiferous. All the rest are beneficial.

While crop, animal, and structural pests are arguably constant as a threat – many so called pests are in nature quite beneficial. For example, carpenter ants and termites can be pests – but for the most part they can be touted as beneficial re-cyclers of rotting wood. Even the lowly housefly, detested by all, are hugely important to the health of the earth in that the maggots are pioneer creatures rendering rotting vegetation and carrion to the next recyclable level.

Insects inhabit virtually all microhabitats (discrete portions of larger habitats) and perform all
known niches therein. For reference sake, microhabitats are where these animals reside and niches are the jobs they perform there.

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The open ocean is one of the few habitats where insects are not known. It isn’t salt that limits their existence here, because the Great Salt Lakes harbor many insect species. No, it’s the fact that the crustaceans (a geologically older group) got there first and successfully radiated into all available microhabitats and performed all known niches therein. You will, however, find many insect species along the shores, backwaters, and estuaries associated with the ocean.

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Let’s look at a few of these microhabitats and niche existences in the insect world. Here we have a damsel fly nymph whose microhabitat is the reeds or grasses along the shoreline of ponds and lakes, where they sit and wait as ambushers of mosquitoes and other aquatic prey. They, with their larger cousins, the dragonflies, are representative of the predator niche.

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The green lacewing and its larvae live in the plant world and wander about performing a predatory role or niche. This creature is quite popular as a predator for sale and release in the garden. Many herbivores have varying levels of association with their host plants, which we will look at momentarily.

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So, we were talking about the beneficials often around when there is this much of a food source for them. We saw ladybugs on another plant. This is a really interesting one. What we’re looking at here is the stalks that are holding up the eggs of the lacewing. The lacewing is an insect that lays her eggs on these little stalks that hold the egg above the leaf and then what happens when the egg hatches is the aphid lion comes down this stalk and then the aphid lion is an immature…it looks like a tiny little yellow slug and we’ll see a picture of that later, but it crawls down the stalk and the reason that the eggs are laid on stalks is that evidently if they’re all laid on the surface, the aphid lion will go ahead and eat his brethren as well as the food source, the aphid itself.

So, here’s the immature, we call it an aphid lion, it’s the immature stage of that lacewing.

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Here we have a rather disgusting microhabitat/niche arrangement. This is an infested deer mouse that is exhibiting a bot fly larva wriggling out of its endoderm to begin pupation on the ground. The microhabitat here is the skin tissue of the mouse and niche is that of a parasite.

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A very important skill that Master Gardeners will achieve is the understanding of the various
host relationships that insects have evolved. It is a skill that will help them become better and better diagnosticians.

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These relationships can be very tight, focused, or specialized. For example, this mossy rose gall, which is caused by a tiny cynipid wasp, occurs only on domestic roses. It is found on no other plant. Incidentally, the lower gall has been cut open to expose the wasp larva in its cavity. These insects secrete enzymes or other chemicals that induce galls like these and they are often harmless to the plants. A similar wasp causes a small spiny rose gall on the leaves of wild roses and it too occurs on no other plant species.

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Some herbivores such as this cottony camellia scale are found only on a few plant species and they may be quite unrelated. This scale species is found only on camellia, holly and Taxus or yew and two other rare plants. Note the black material on the surface of the holly leaf on the left? This is sooty mold fungus, which is thriving on the honeydew secreted by this scale.

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These are two-spotted spider mites; this herbivore is a generalist and has over 100 different plant species that it will feed upon. There are many insect species that are generalists as well.

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Speaking of generalists – most predators are generalists. They are usually larger or stronger than their prey and kill instantly. Unique predators called parasitoids are more specialized as prey goes and are often smaller than the target prey. Female wasp or fly parasitoids stealthily lay their eggs on, in, or near the host critter. After hatching, the young maggots burrow into the prey animal and begin feeding on the fluids, tissues and organs, taking a week or more to finally kill the host. The insect you see here is a general predator called the doodle bug or ant lion. This creature creates conical pits in sandy soils – burying themselves at the bottom, exposing only the two syringe-like mandibles with which it skewers hapless prey that tumble in and suck them dry like an insect milkshake.

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All life forms have a beginning, middle, and an end – so to speak. This is called the life cycle and it is repeated in populations of species through time. A thorough knowledge of a species life cycle and habits can lead to knowledge useful in predicting population events as well as in making management decisions.

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When you look at the life cycle of a population of animals you will find that it is not static. In stable conditions, there is a more or less gently numerical oscillation around the equilibrium line – seen here as the “E” line in the middle of the graphic. These dips and rises in the population are driven by density dependent or biotic (living) factors and they include natural
enemies, competition, disease and food quantity and quality. The population rises and dips can be dramatic when abiotic or density independent factors occur. Catastrophes like the Mt. St. Helen’s “blow” or extreme aberrations in climate have had devastating impacts on insect populations. Impacts like these can cause localized extinctions or population crashes that occur from late spring frost from which newly hatched or emerged insects have no defenses. Alternately, populations can rise precipitously when humans use broad spectrum insecticides against an herbivorous pest. The application often does not totally suppress the pest, but conversely may cause the total demise of its natural enemies, the result of which will see the pest population surge to the K-line or carrying capacity at which point the pests often eat themselves out of house and home or crash due to an outbreak of a contagious disease brought on by population stress.

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How insect pests over winter can have great bearing on how we might manage them.

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For example – see these black spheres all over this apple twig? They are overwintering eggs of green apple aphids. At this stage they become very vulnerable to delayed dormant oils. The delayed dormant stage is usually when buds just being to swell. This event can vary from one side of the mountains to the next. Many of our aphid pests over winter as eggs on their primary hosts and this makes oil a very useful and almost selective pest management tool.

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The pattern of damage from spruce aphid to spruce goes a little like this: it’s a winter aphid and that’s bad in its own sake because there are no winter predators to speak of. So these things start to activate and multiply as early as October and nice days throughout the winter they’re going to be feeding and injecting toxins with their saliva into last year’s needles. As time goes by, and they’ll do this clear into early April, as time goes by, you’ll see this yellowing first and then reddening, brown out if you want to call it that, and by early April we’ll see pretty much all of this drop off and begin to look like this right here. So, even though they don’t kill out the new buds for the following spring, you still have a tree that looks pretty miserable if you don’t do something about it and the new buds in spring will break, you’ll get new foliage, it will basically just barely keep the tree alive for many, many years, but again, looking shabby.

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Hopefully by now we are beginning to see that insects are a very successful group of animals.

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That they are successful has a lot to do with their many wonderful and sometimes bizarre adaptations. Many of which we can use against them in deciding how to manage them.
If you think heavy snowfall like this limits their survival, you're dead wrong. It actually acts as a thermal blanket that maintains a consistent temperature. More importantly, it prevents the insects hiding in or on the soil from the cold desiccating winds of winter. Desiccation is a huge mortality force due to their small size – they cannot lose even a tiny bit of moisture. If they do they will likely die.

Another adaptation that has evolved in temperate region insects is the production of glycerol in their hemolymph (or blood) when temperatures begin to drop and days get shorter and shorter prior to winter. What is glycerol? It's anti-freeze, one of many things insects did first, way before the dawn of homo sapiens.

Here we have a mosquito larva. Notice the breathing tube at the end? The tube’s end is fringed with hydrophobic hair, which breaks the surface tension at the surface of the water when the larva comes up for air. Many years ago, pest managers devised a mosquito control strategy that used light oil applications to the surface of isolated non-productive ponds. The larvae could not break the surface tension of the oil treated ponds and subsequently drowned.

Many insects have evolved complicated pheromones. These are chemicals that – like hormones – influence an event or behavior. Pheromones are emitted to the outside environment to cause some type of activity to commence. These are male gypsy moths that have become trapped in a sticky trap that was impregnated with female gypsy sex pheromones. These sex-luring pheromones have become important agricultural IPM tools and they have become available in many cases to home gardeners. The benefits of pheromones are three-part: they can detect presence of the pest, indicate impending threshold levels, and they can help accurately time insecticide applications. Other types of pheromones include trail pheromones emitted by ants to assist in food-finding sorties and nest return. There are also alarm pheromones in many stinging hymenopterans such as the African bee, many yellow jackets, etc. This type of pheromone signals the assistance of nest mates to defend an agitated or threatened nest member. The use of these chemicals makes these insects geometrically more dangerous than a single individual would be.

There are a number of insects from different orders that demonstrate some level of social organization. Some of the more advanced of these include termites, bees, ants and stinging wasps. Sometimes this social behavior is capitalized upon in pest management. Toxic baits have been manufactured that ant and yellow jacket workers bring back to their nests to feed their larvae. Once again we can show how we can use insect adaptations against them in pest management schemes.
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This is a mound made by thatching ants. The ants belong to a family of hymenopterans called *Formicidae*. Many of these have functional stingers like fire ants of the south and the harvester ants of eastern Washington. However, some, like the thatching ants have lost their stingers; but they have made up for the loss by evolving a different defense behavior. If any of you have been unfortunate enough to step on one of these mounds, you know what I mean. Accidental or deliberate disruption of this nest material will send hundreds of them to the rescue, often running up the pant legs of the offender while biting repeatedly. They add insult to injury by tipping their abdomens forward and squirting a formaldehyde-like chemical into the bite wound, creating a memorable sting-like sensation. Having pointed this out, it is clear that knowing this threat potential should reveal safety implications – avoidance of these mounds!

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Some social behavior is simply wonderful to watch. These are some leafcutter ants in Central America. They cut leaf material to piece together their nests in the trees. The worker ant in the foreground is titillating one of its younger siblings or larva with its mandibles. When it does so, the larva begins to spin silk from its labial glands and acts like a living sewing machine, stitching the leaf edges together. Note that the other worker to the left is holding the leaf edges together so she can accomplish her task. It’s interesting to point out that this kind of cooperation is often rare in human populations.

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The insect world brings to the front another set of bizarre adaptations that are simply amazing on their own and have little to do with management, except in some cases are heralds of safety and avoidance. The adaptation we are addressing here is that of mimicry, of which there are several types. One of the most common demonstrations of mimicry is that called cryptic mimicry, where the insect blends or resembles something quite different. The insect in the middle of the leaf is a dead leaf mimic. It is a katydid.

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This is a preying mantid mimicking a living leaf. One could ask the question – is this passive or aggressive mimicry? It could be both!

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This is a preying mantid mimicking an orchid in the tropics. Here orchids are a dominant nectar source for many insects so it is highly advantageous to resemble a “fast food joint” if you’re a mantis. The head is in the upper left corner and the predatory forelegs just below. The upturned abdomen is to the right middle of the screen. The second and third pair of legs appear as flower petals on each side of the insect.
This is a hornworm caterpillar that exists in the arboreal forests of the tropics where the food web exhibits a complex mix of predators and herbivores. Insectivorous birds and lizards threaten almost all insects in this microhabitat. This insect has the capacity to instantly mimic a vine snake, which preys upon many of the hornworm’s enemies. When threatened, the insect inflates a sac situated behind its head. When inflated, the sac resembles a perfect snake head complete with scales and even false highlights in the eyes. When this happens, the head of the hornworm is concealed beneath the snout of the phony snake head.

Two other types of mimicry include one elucidated by a Professor Müller where both the mimic and the model are dangerous creatures. This is demonstrated by this eumenid solitary stinging wasp. It mimics a yellow jacket and is just as dangerous. The universal message is that anything (insect) with black and yellow stripes may likely be dangerous. This type of mimicry is called Müllerian mimicry.

The other type was explored and reported by a scientist by the name of Bates. In this type the model is dangerous but the mimic is not. This style is demonstrated in the Viceroy/Monarch butterfly relationship where their ranges overlap and beyond. The Monarch caterpillars feed on milkweeds that possess glycol alkaloids in their tissue. The feeding caterpillars incorporate these chemicals into their tissues and pass them along to the adult form. Any predator that feeds on the adult butterfly will become violently ill (it’s like having a simulated heart attack) – and it remembers. Thus it will never again eat anything resembling a Monarch butterfly again.

The look-alike Viceroy butterfly is perfectly edible but is afforded protection from frequent predation by having the same appearance as the Monarch. This kind of mimicry is called Batesian mimicry.

We will discuss briefly the value of pollinators and the necessity to protect them from accidental or wanton destruction by broad spectrum insecticides. When we look at the value of the honeybee by itself, we find that this single pollinator is responsible for the pollination of over 100 crops – many of which wouldn’t produce at all, were it not for the attention of this pollinator. With this in mind, be aware that the honeybee is constantly fighting threats from disease, tracheal and varroa mite parasites, etc. It does not need to deal with misapplied insecticides too.

To be fair in giving credit to pollinators, we need to herald the pollination value of other bees as well. Bumble bees, which are native bees, are very efficient pollinators and some cropping
industries like cranberries use them almost exclusively for pollination. The growers even build them nesting boxes to encourage their success.

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There are a number of things we can do to eliminate the level of destruction to bees in our yards and gardens. For example, remember the bloom is the source of the problem. Flowers become contaminated after applications and bees die after visiting these blossoms. Take a lesson from the seasoned and experienced orchardist who understands that even though the target fruit tree is not in bloom when the first codling moth cover spray is due, he or she recognizes full well that they must examine the cover crop to see if it is blooming. The plants in bloom in the cover crop may be weed flowers but nevertheless, they must be mowed off before spraying commences because they attract bees. A similar scenario could exist in the landscape. For example, let’s say you had a shrub that was not in bloom and it was planted next to the lawn with a rockery directly behind it and that it had a pest problem needing immediate attention with a broad spectrum spray. Would you go ahead and spray it simply because the shrub was not in bloom? No! Like the orchardist, you would determine if there were dandelion or clover flowers in the lawn near the shrub in question and get rid of them. Remember, any spray applied will drift even a little bit. Additionally, what if there was a blooming heather nearby in the rockery. Would such a spray be a threat here? Yes, heather flowers are hugely attractive to bees so they need to be covered with a colored plastic mulch during the spray operation, then removed after the spray has dried. Attention to details like these will go a long way in protecting bees from the hazards of insecticides.

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Pesticides have varying degrees of impact on bees. As of this recording (2008), few garden fungicides or herbicides have serious consequences to bees. This can be said of garden miticides as well. Indeed, there are a few insecticides that can also be applied to blooming plants with reasonable safety to bees. These would include products like insecticidal soaps, BT formulations, Beauveria bassiana (a fungal insecticide), kaolin clay, lime sulfur, and several others. A surefire guide to how dangerous a particular insecticide is – is the Extension publication – PNW 581 – titled “How to Reduce Bee Poisoning from Pesticides”. While many broad spectrum insecticides do kill bees, they do so immediately. Thus foraging bees do not make it back to the hive. However, there are a few that are slow killers that when contaminated pollen is picked up by the foraging bee, it returns to the hive with it and disseminates it to the rest of the hive – virtually destroying the entire colony. One such garden product is Sevin or Carbaryl. Please disregard the pet implications on this old Sevin label. There are no longer any legal uses of Sevin on pets.

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Some products can be applied to blooming plants in one or two formulations. A good example would be malathion. Malathion dust or wettable powder formulations can never be applied to flowers; however, malathion EC or liquid concentrate formulations can be applied to flowers at night, since these formulations volatilize rather quickly to non toxic levels by the time the bees return the next day. The volatility or dissipation rate of this formulation can be 2-6 hours depending on temperature.
Formulations of insecticides have a descending level of toxicity to bees in general starting with dusts. Dust formulations are the most dangerous to bees when applied to blooms, followed by wettable powder formulations. Liquid concentrates are in general less toxic than WP formulations. Depending on active ingredient, granular formulations are the least toxic to bees because they are normally applied to the soil surface and do not contaminate blooms. If the active ingredient in a granular formulation is a systemic – check with the aforementioned publication to check its status. In any case, the rule of thumb during bloom is if you’re not sure, don’t apply insecticides to flowering plants!