Africanized Honey Bees

And Related Insects

CONTINUING EDUCATION

PROFESSIONAL DEVELOPMENT COURSE

Technical Learning College

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State Approval Listing Link, check to see if your State accepts or has pre-approved this course. Not all States are listed. Not all courses are listed.

If the course is not accepted for CEU credit, we will give you the course free if you ask your State to accept/approve it for credit and we receive the approval letter. Call your State agency to see if the course is accepted.

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http://www.tlch2o.com/PDF/CEU%20State%20Approvals.pdf

You can obtain a printed version from TLC for an additional $59.95 plus shipping charges.

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Important Information about this Manual (Disclaimer notice)

This CEU course manual has been prepared to educate pesticide applicators and operators in general safety awareness of dealing with the often-complex and various pesticide treatment devices, methods, and applications.

This manual covers general laws, regulations, required procedures, and accepted policies relating to the use of pesticides. It should be noted, however, that the regulation of pesticides and hazardous materials is an ongoing process and subject to change over time. For this reason, a list of resources is provided to assist in obtaining the most up-to-date information on various subjects.

This manual is not a guidance document for applicators or operators who are involved with pesticides. It is not designed to meet the requirements of the United States Environmental Protection Agency or your local State environmental protection agency or health department.

This CEU course manual provides general pesticide safety awareness and should not be used as a basis for pesticide treatment method/device guidance. This document is not a detailed pesticide information resource or a source or remedy for poison control.

Technical Learning College or Technical Learning Consultants, Inc. make no warranty, guarantee or representation as to the absolute correctness or appropriateness of the information in this manual and assumes no responsibility in connection with the implementation of this information. It cannot be assumed that this manual contains all measures and concepts required for specific conditions or circumstances. This document is to be used solely for educational purposes only and is not considered a legal document.

Pesticides are poisonous. Always read and carefully follow all precautions and safety recommendations given on the container label. Store all chemicals in the original labeled containers in a locked cabinet or shed, away from food or feeds, and out of the reach of children, unauthorized persons, pets, and livestock.

Confine chemicals to the property being treated. Avoid drift onto neighboring properties, especially gardens containing fruits and/or vegetables.

Dispose of empty containers carefully. Follow label instructions for disposal. Never reuse containers. Make sure empty containers are not accessible to children or animals.

Never dispose of containers where they may contaminate water supplies or natural waterways.

Do not pour down sink or toilet. Consult your county agricultural commissioner for correct ways of disposing of excess pesticides. Never burn pesticide containers.

Individuals who are responsible for pesticide storage, mixing, and application should obtain and comply with the most recent federal, state, and local regulations relevant to these sites and are urged to consult with the EPA and other appropriate federal, state, and local agencies.

Acknowledgments
Most of the information in this Technical Guide was compiled by Charles L. Cole, Professor and Extension Entomologist, and Millisa A. Rowell, Extension Assistant, Texas Agricultural Extension Service, Riverside Campus, Box 2150, Bryan, Texas 77806-2150. Permission to use their findings for Department of Defense purposes is greatly appreciated. Thanks also to LCDR H. R. Stevenson for additional data used to produce this course. Final writing, editing, review and formatting of this document were the responsibility of Capt. Armando Rosales, USAF, Dr. Richard G. Robbins, DPMIAC/AFPMB, and Dr. Edward S. Evans, Jr., Entomological Sciences Program, USACHPPM.

Watch out, the bees are everywhere they can find something sweet and tasty. Even inside a beer can.

Using the duster to destroy a hive

Bee Prepared

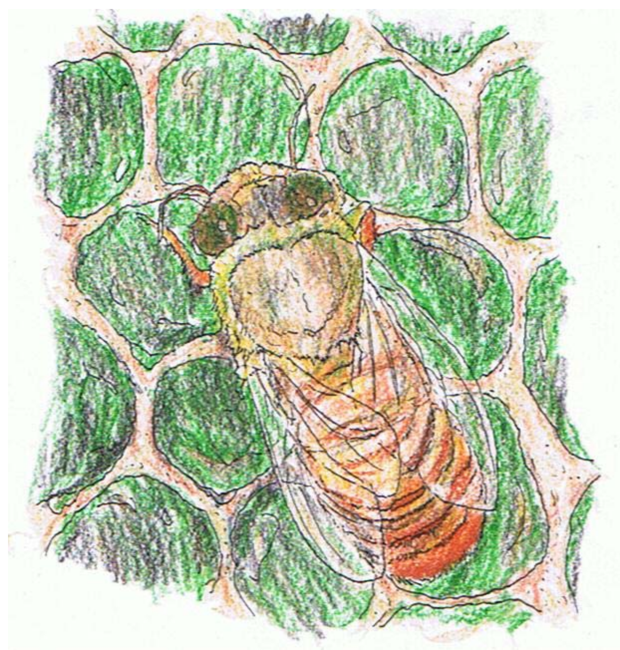
Africanized honey bees (**AHB**)—also called “***killer bees***”—became established in Texas in 1990 and are spreading to other southern states. AHB entered southern California in 1994 and are now established throughout southern California and in the southern end of the San Joaquin Valley. Although its “killer” reputation has been greatly exaggerated, the presence of AHB will increase the chances of people being stung.

Learning about AHB and taking certain precautions can lower the risk of being injured by this new insect in our environment.

The Africanized honey bee is closely related to the European honey bee used in agriculture for crop pollination and honey production. The two types of bees look the same and their behavior is similar in many respects. Neither is likely to sting when gathering nectar and pollen from flowers, but both will sting in defense if provoked. A swarm of bees in flight or briefly at rest seldom bothers people. However, all bees become defensive when they settle and begin producing wax comb and raising young.

Africanized and European Honey Bees

- Look the same.
- Protect their nest and sting in defense.
- Can sting only once.
- Have the same venom.
- Pollinate flowers.
- Produce honey and wax.



Africanized honey bees are less predictable and more defensive than European honey bees. They are more likely to defend a greater area around their nest. They respond faster in greater numbers, although each bee can sting only once.

Africanized Honey Bees

- Respond quickly and sting in large numbers.
- Can sense a threat from people or animals 50 feet or more from nest.
- Sense vibrations from power equipment 100 feet or more from nest.
- Will pursue an enemy 1/4 mile or more.
- Swarm frequently to establish new nests.
- Nest in small cavities and sheltered areas.

AHB nest in many locations where people may encounter them. Nesting sites include: empty boxes, cans, buckets or other containers; old tires; infrequently used vehicles; lumber piles; holes and cavities in fences, trees, or the ground; sheds, garages, and other outbuildings; and low decks or spaces under buildings. *Remove potential nest sites around buildings.*

Be careful wherever bees may be found.

Technical Learning College's Scope and Function

Technical Learning College (**TLC**) offers affordable continuing education for today's working professionals who need to maintain licenses or certifications. TLC holds approximately eighty different governmental approvals for granting of continuing education credit.

TLC's delivery method of continuing education can include traditional types of classroom lectures and distance-based courses or independent study. Most of TLC's distance based or independent study courses are offered in a print based format and you are welcome to examine this material on your computer with no obligation. Our courses are designed to be flexible and for you to finish the material on your leisure.

Students can also receive course materials through the mail. The CEU course or e-manual will contain all your lessons, activities and assignments. Most CEU courses allow students to submit lessons using e-mail or fax, however some courses require students to submit lessons by postal mail. (See the course description for more information). Students have direct contact with their instructor—primarily by e-mail. TLC's CEU courses may use such technologies as the World Wide Web, e-mail, CD-ROMs, videotapes and hard copies (See the course description). Make sure you have access to the necessary equipment before enrolling, i.e., printer, Microsoft Word and/or Adobe Acrobat Reader. Some courses may require proctored exams depending upon your state requirements.

Flexible Learning
At TLC, there are no scheduled online sessions you need contend with, nor are you required to participate in learning teams or groups designed for the "typical" younger campus based student. You will work at your own pace, completing assignments in time frames that work best for you. TLC's method of flexible individualized instruction is designed to provide each student the guidance and support needed for successful course completion.

We will beat any other training competitor's price for the same CEU material or classroom training. Student satisfaction is guaranteed.

Course Structure
TLC's online courses combine the best of online delivery and traditional university textbooks. Online you will find the course syllabus, course content, assignments, and online open book exams. This student friendly course design allows you the most flexibility in choosing when and where you will study.

Classroom of One
TLC Online offers you the best of both worlds. You learn on your own terms, on your own time, but you are never on your own. Once enrolled, you will be assigned a personal Student Service Representative who works with you on an individualized basis throughout your program of study. Course specific faculty members are assigned at the beginning of each course providing the academic support you need to successfully complete each course.

Satisfaction Guaranteed
Our Iron-Clad, Risk-Free Guarantee ensures you will be another satisfied TLC student.

We have many years of experience, dealing with thousands of students. We assure you, our customer satisfaction is second to none. This is one reason we have taught more than 10,000 students.

Our administrative staff is trained to provide outstanding customer service. Part of that training is knowing how to solve most problems on the spot.

TLC Continuing Education Course Material Development
Technical Learning College's (TLC's) continuing education course material development was based upon several factors; extensive academic research, advice from subject matter experts, data analysis, task analysis and training needs assessment process information gathered from other states.

We welcome you to complete the assignment in Word. You can easily find the assignment at www.abctlc.com. Once complete, just simply fax or e-mail the answer key along with the registration page to us and allow two weeks for grading. Once we grade it, we will mail a certificate of completion to you. Call us if you need any help.

2017 Changes to EPA's Farm Worker Protection Standard

In late 2015 the Environmental Protection Agency issued the long awaited revision to the Worker Protection Standard (WPS). Although it is now technically active it will not be enforced until 2017 but the original WPS will still be enforced until the end of 2016. Please keep in mind that the WPS covers both restricted use AND general use pesticides.

This course contains EPA's federal rule requirements. Please be aware that each state implements pesticide regulations that may be more stringent than EPA's regulations and these frequently are changed. Check with your state environmental/pesticide agency for more information.

CEU Course Description

African Honey Bee CEU Training Course

What is the "***Africanized Honey Bee***"? In the 1950's imported bees from Africa being studied in laboratories in Brazil escaped and established colonies in the wild. Since the African bee could hybridize (cross-breed) with local European Honeybees, hybrid or ***"Africanized"*** bees were produced by matings between the escaped bees and honey bees being kept in Brazil. The hybrid bee was more vigorous in some ways, which has allowed it to spread throughout the range where honey bees occur. These hybrids are now found throughout Central America, Mexico and the southern parts of the United States. It is a hybrid bee, with the behavioral characteristics of the imported African honey bee, which is now called the "***Africanized***" honey bee.

Unlike the European honey bee, which has been selectively bred for its gentle nature, the escaped strain of African bees exhibits strongly defensive behaviors against intruders to their hives. This is an appropriate behavior for bees living in open savannahs where large hoofed animals might easily disturb or destroy a hive. Unfortunately, these bees are able to freely hybridize with European honey bees, and produce colonies that sense intruders more quickly, are easily disturbed, and react to threats in large numbers.

Africanized bees have had a great impact on beekeepers who handle bees on a routine basis. Beekeepers have learned the importance of monitoring hive behavior, and regularly "***re-queening***" their hives to insure that the genetic stock (all the offspring!) of a hive are of European honey bee descent.

Prerequisites: None, you will not need any other materials for this course.

Course Procedures for Registration and Support

All of Technical Learning College's correspondence courses have complete registration and support services offered. Delivery of services will include, e-mail, web site, telephone, fax and mail support. TLC will attempt immediate and prompt service.

When a student registers for a distance or correspondence course, he/she is assigned a start date and an end date. It is the student's responsibility to note dates for assignments and keep up with the course work.

If a student falls behind, he/she must contact TLC and request an end date extension in order to complete the course. It is the prerogative of TLC to decide whether to grant the request.

All students will be tracked by an unique number assigned to the student.

Instructions for Written Assignments

The African Honey Bee CEU training course uses a multiple choice answer key. You can write your answers in this manual or type out your own answer sheet. TLC would prefer that you type out and e-mail the examination to TLC, but it is not required.

Feedback Mechanism (examination procedures)

A feedback form is included in the assignment.

Security and Integrity
All students are required to do their own work. Lesson sheets and final exams are not returned to the student to discourage the sharing of answers. If any fraud or deceit is discovered, the student will forfeit all fees and the appropriate agency will be notified.

Grading Criteria
TLC offers the student either pass/fail or a standard letter grading assignment. If TLC is not notified, a pass/fail notice will be issued.

Required Texts
The course will not require any other materials. This course comes complete. You can find the assignment on TLC's website under Assignments.

Pesticide Terms, Abbreviations, and Acronyms
TLC provides a glossary that defines, in non-technical language, commonly used environmental terms appearing in publications and materials. It also explains abbreviations and acronyms used throughout the EPA and other governmental agencies. You can find the glossary in the rear of this manual.

Recordkeeping and Reporting Practices
TLC will keep all student records for a minimum of five years. It is your responsibility to give the completion certificate to the appropriate agencies.

ADA Compliance
TLC will make reasonable accommodations for persons with documented disabilities. Students should notify TLC and their instructors of any special needs.

Course content may vary from this outline to meet the needs of this particular group.

Note to students: Keep a copy of everything that you submit. If your work is lost, you can submit your copy for grading. If you do not receive your certificate of completion or quiz results within two or three weeks after submitting it, please contact your instructor.

Students have 90 days from receipt of this manual to complete it in order to receive Continuing Education Units (**CEUs**) or Professional Development Hours (**PDHs**).

A score of 70% is necessary to pass this course. If any assistance is needed, please email all concerns or call us. If possible, e-mail the final test to info@tlch2o.com or fax (928) 468-0675.

Course Objective: To provide awareness in African honey bee/wasp identification, effective and safe pesticide application and bee/wasp control and/or treatment methods.

Educational Mission
The educational mission of TLC is:

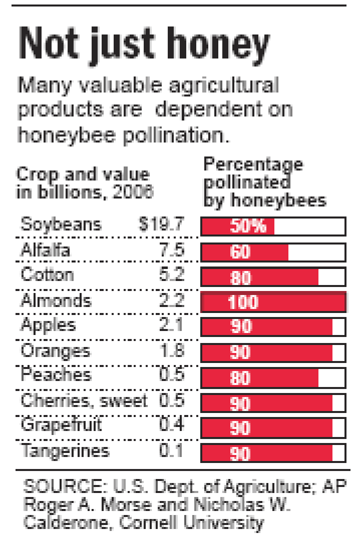
To provide TLC students with comprehensive and ongoing training in the theory and skills needed for the pesticide application field,

To provide TLC students with opportunities to apply and understand the theory and skills needed for pesticide applicator certification,

To provide opportunities for TLC students to learn and practice pesticide applicator skills with members of the community for the purpose of sharing diverse perspectives and experience,

To provide a forum in which students can exchange experiences and ideas related to pesticide applicator education,

To provide a forum for the collection and dissemination of current information related to pesticide applicator education, and to maintain an environment that nurtures academic and personal growth.



TLC
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Chino Valley, AZ 86323
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Aftermath of a chemical treatment.

2017 Changes to EPA's Farm Worker Protection Standard

In late 2015 the Environmental Protection Agency issued the long awaited revision to the Worker Protection Standard (WPS). Although it is now technically active it will not be enforced until 2017 but the original WPS will still be enforced until the end of 2016. Please keep in mind that the WPS covers both restricted use AND general use pesticides.

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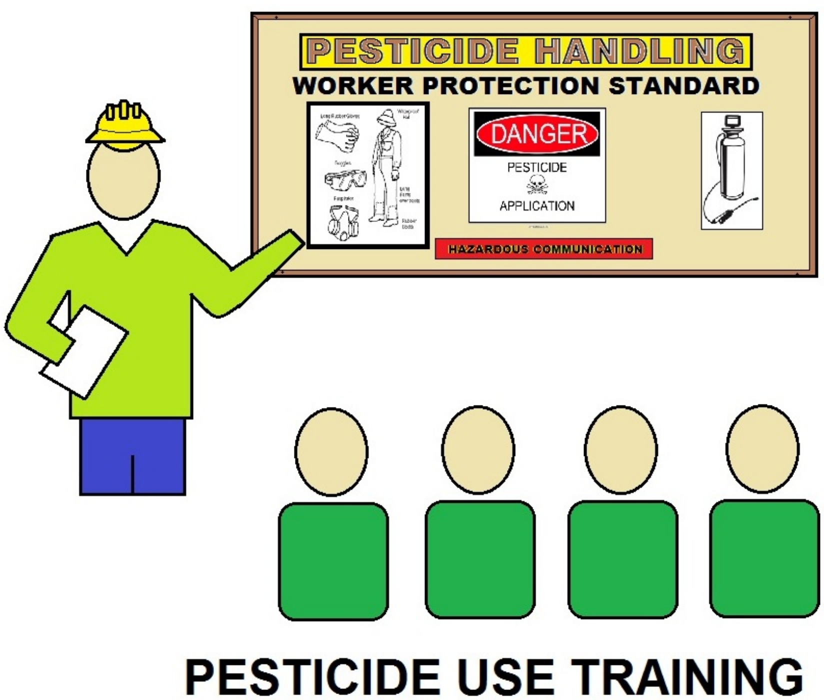

PESTICIDE HANDLING
WORKER PROTECTION STANDARD
DANGER
PESTICIDE
APPLICATION
HAZARDOUS COMMUNICATION
PESTICIDE USE TRAINING

Topic 1 Bee Introduction

In order to adequately protect honey bees from pesticides, there must be a good deal of cooperation between applicators, growers, beekeepers, extension workers and government officials. The key to this cooperation is constant communication fostered by trust on the part of all involved.

It should be realized that protecting honey bees from pesticides is often extremely difficult in spite of the fact that most of these chemicals are not considered hazardous to bees. There are many variables which must be pondered in the decision-making process leading to pesticide use. If those which contribute to honey bee safety are given due consideration, application of pesticides and protection of honey bees are not mutually exclusive. Generally, it is only when decisions are based on insufficient information and/or made without regard to the safety of honey bees that they result in damaging bee colonies.

Since their introduction into the Americas in the late 1950s, Africanized honey bees have received a great deal of attention concerning their impact on human welfare. More often than not, Africanized or "*killer*" bees have been depicted as bloodthirsty beasts out to sterilize their expanding habitat of nearly anything that moves. In reality, research and experience have taught us that Africanized honey bees (AHBs) warrant concern but certainly not hysteria, which may lead to unwise management decisions.

Apis mellifera

What are Africanized bees and their significance? Africanized bees are simply a strain of *Apis mellifera*, the same species introduced from Europe that produces our honey and pollinates many of our plants. An African strain was introduced to South America in an effort to produce a bee better suited to the tropics. Honey bees aren't native to the Americas, and the European bees introduced up to that point were poorly adapted to tropical environments.

African bees were brought to Brazil in 1956 by biologists wanting to create an African/European hybrid that would perform well in the South American climate. But in 1957, measures to contain the colonies were accidentally removed and several swarmed into the countryside.

South America

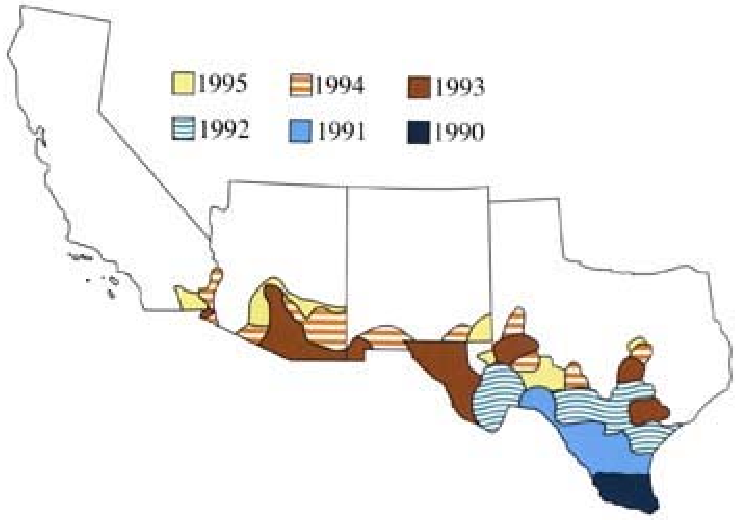
The newly released AHBs survived exceptionally well in South America--so well, in fact, that they quickly displaced existing European strains, even those maintained by commercial beekeepers. But as they spread, problems arose and the differences between the domesticated European bees and AHBs soon became apparent:

- Africanized bees are extremely sensitive to the slightest disturbance, and the hive responds with massive and persistent stinging attacks.
- Africanized bees are difficult to manage and have a strong tendency to leave existing hives (abscond) and settle elsewhere.
- Africanized bees, although better at surviving in the tropics, are poor producers of surplus honey.

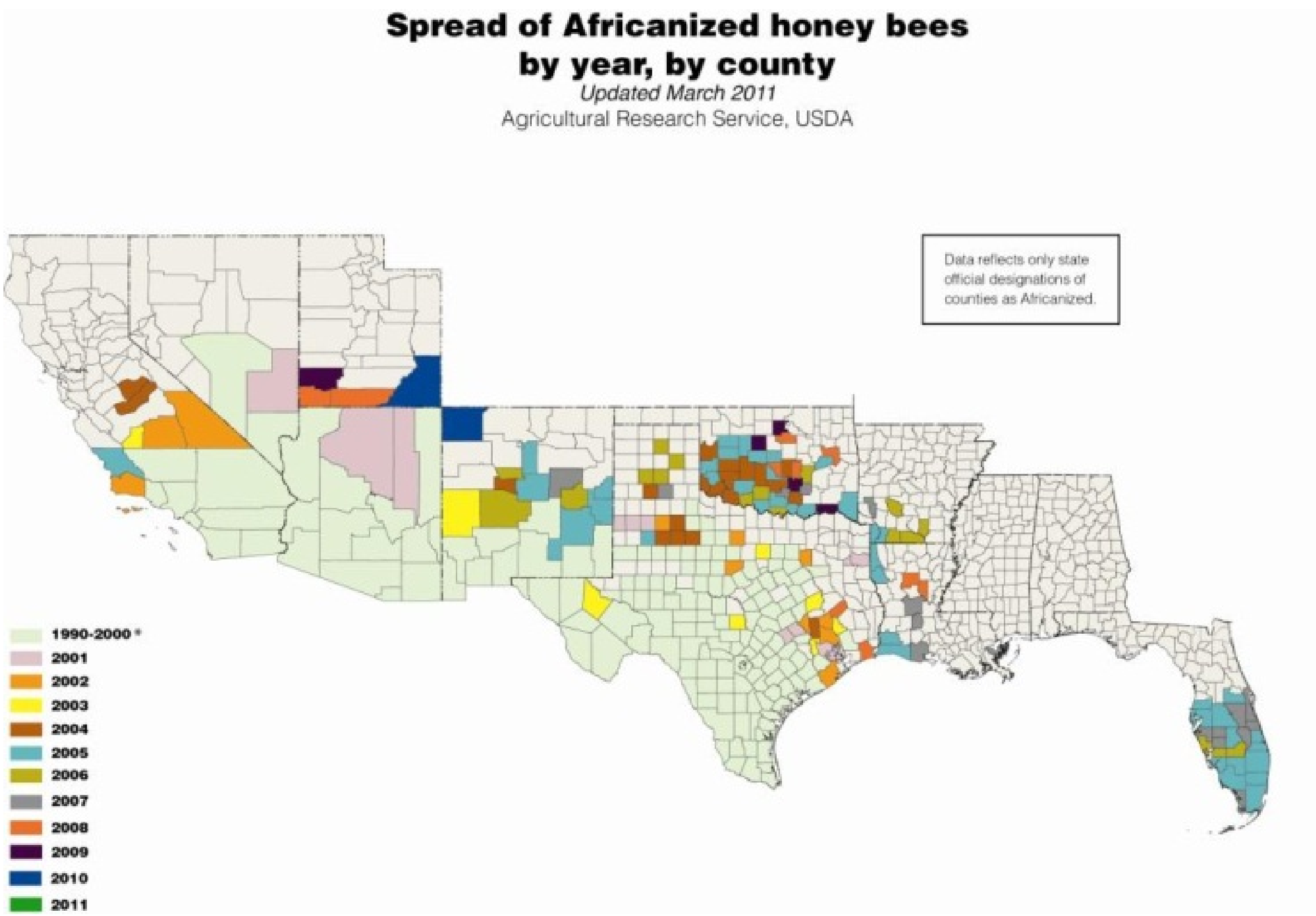
By the time these negative aspects were understood, the Africanized strain had already established a permanent presence in the Americas and soon spread north to Central America, Mexico and, recently, the southern United States.

First Swarm Detected

The first swarm of Africanized bees was detected in the U.S. in October, 1990 when they were captured in a baited trap at the border town of Hidalgo, Texas. AHB colonies were first reported in Arizona and New Mexico in 1993 and in California in October, 1994. Within a year, more than 8,000 square miles of Imperial, Riverside and northeastern San Diego counties were declared officially colonized by Africanized Bees. To date, more than 100 counties in Texas, 6 in New Mexico, 14 in Arizona, 1 in Nevada, and 3 counties in California have reported Africanized honey bees. AHB continue the northward expansion of their territories by swarming, the process by which bee colonies replicate.



Above, range extension of the Africanized honey bee in 1990- 1995



European honey bees are adapted to winter survival, largely because of their ability to collect large honey supplies. Africanized bees, on the other hand, do not overwinter well and respond to food shortages by migrating. European bees make large, permanent colonies whereas Africanized bees make small to large colonies that reproduce (swarm) often. The table outlines some of the differences between the two types of bees.

Fatalities
In May of 1991, Jesus Diaz became the first person to be attacked by AHB in the U.S. while mowing a lawn in the border city of Brownsville, Texas. Diaz suffered 18 stings and was treated at a local hospital.

On July 15, 1993, 82-year-old Lino Lopez became the first person to die in the U.S. from Africanized honey bee stings. He was stung more than 40 times while trying to remove a colony from a wall in an abandoned building on his ranch near Harlingen, Texas.

Arizona's first human fatality from Africanized Bees occurred in October, 1993 when an 88-year-old Apache Junction woman disturbed a large Africanized honey bee colony in an abandoned building on her property and was stung numerous times.

Although such fatalities are alarming, Africanized Bees probably present the greatest danger in the U.S. to American beekeeping and American agriculture in general. AHBs often enter European colonies to mingle and mate with them. Such mating results in more hybrid bees having African genes and tendencies dominating over European ones. An entire colony may suddenly take on aggressive and short-tempered behavior.

Venezuelans
Although AHBs weren't the monsters seen in popular fiction, their aggressive response, coupled with our lack of experience, led to the deaths of hundreds of people and animals. South Americans soon learned to live with the bees.

For example, the highest recorded number of fatalities due to AHB attacks in Venezuela was nearly a hundred people in 1978, but those numbers dropped to twenty by 1985. Beekeepers learned to take proper precautions and Venezuelans became familiar with potential dangers. AHBs are a real and significant threat for those who must live with them, but they can be dealt with as long as the appropriate precautions and control measures are taken.

Summary
Africanized honey bees (*Apis mellifera scutellata*) and European honey bees (*Apis m. mellifera*) are the same species - they look the same, sting in defense of themselves or their nest, can only sting once, and have the same venom.

Africanized honey bees are slightly smaller (but because the bees look so much alike only a laboratory analysis can tell them apart). They also differ in that they respond more quickly and more bees sting, can sense a threat from people or animals 50 feet or more from their nest, sense vibrations from power equipment 100 feet or more from their nest, may pursue a victim 1/4 to 1/2 mile, remain agitated for an hour or more after an attack.

The swarm will try to establish new nests, nest in smaller cavities and sheltered areas, and move their entire colony readily (abscond) if food is scarce. Away from the hive, however, they are no more defensive than other bees or wasps. They will not form large swarms and hunt for you.

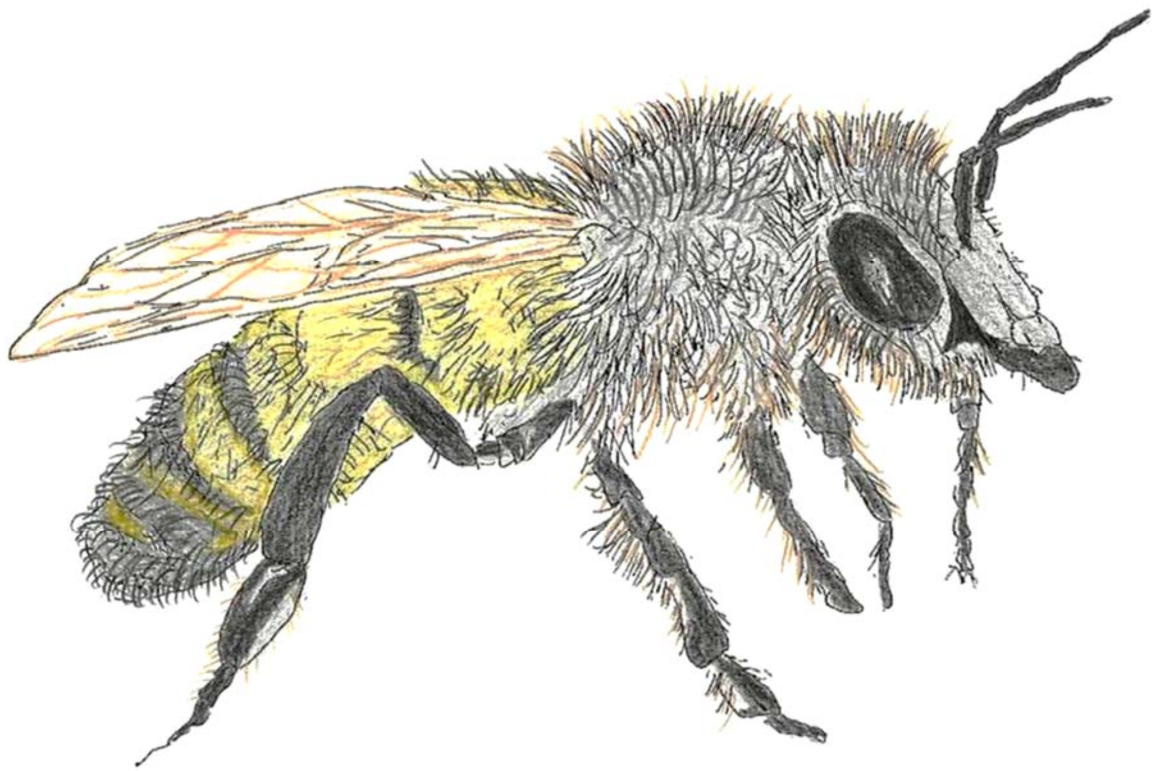
Mayan Indian Bee Hive

The African Bee has almost destroyed the stingless honey bees in Central America. Here and there in the countryside, a more harmonious relationship still exists between man and melliferous insects--harmonious because the native bees of Central America are stingless. One of these is the Royal Mayan bee. These stingless bees are *Melipona beecheii,* known by common names according to region: *la abeja de la miel virgen* (the bee of the virgin honey), *el blanco del pais* (the white countryman), and *el jicote* (the indigenous name).

Most frequently it is called *la blanca estrella* (the white star) or simply *la estrella* (the star). It is slightly smaller than the Africanized honey bee, with a darker abdomen and a fuzzier thorax. *Melipona beecheii* colonies establish themselves in protected enclosures, usually hollow logs. Man has not changed this system; the logs are cut to a manageable size, then carried with the colony still inside to the "bee haver's" house.

The open ends of the trunk are plugged, usually with a wooden block or a piece of pottery, and then sealed with mud. They are then hung from nearby trees or the eaves of buildings. Often houses are completely encircled by these strange, mud-daubed trunks, some long and regular shaped, others bulging like beer barrels, others misshapen like crudely-hacked Congo drums.

The Mayan Honey Bee is about the size of a horsefly and much smaller than the European honey bee.



Honey Bees   Apidae Family of Insects

The Apidae are a large family of bees, comprising the common honey bees, stingless bees (which are also cultured for honey), carpenter bees, orchid bees, cuckoo bees, bumblebees, and various other less well-known groups. The family Apidae presently includes all the genera that were previously classified in the families' Anthophoridae and Ctenoplectridae, and most of these are solitary species, though a few are also cleptoparasites. The four groups that were subfamilies in the old family Apidae are presently ranked as tribes within the subfamily Apinae.

This trend has been taken to its extreme in a few recent classifications that place all the existing bee families together under the name "Apidae" (or, alternatively, the non-Linnaean clade "Anthophila"), but this is not a widely-accepted practice.

The subfamily Apinae contains a diversity of lineages, the majority of which are solitary, and whose nests are simple burrows in the soil. However, honey bees, stingless bees, and bumblebees are colonial (eusocial), though they are sometimes believed to have each developed this independently, and show notable differences in such things as communication between workers and methods of nest construction. Xylocopines (the subfamily which includes carpenter bees) are mostly solitary, though they tend to be gregarious, and some lineages such as the Allodapini contain eusocial species; most members of this subfamily make nests in plant stems or wood. The nomadines are all cleptoparasites in the nests of other bees.

Adults measure ¾-inch long and are fuzzy, with gold and black stripes and transparent wings. Honey bees can often be identified by the balls of yellow pollen they carry on the backs of their legs. Honey bees are an important pollinator of many plants.

Genus Apis

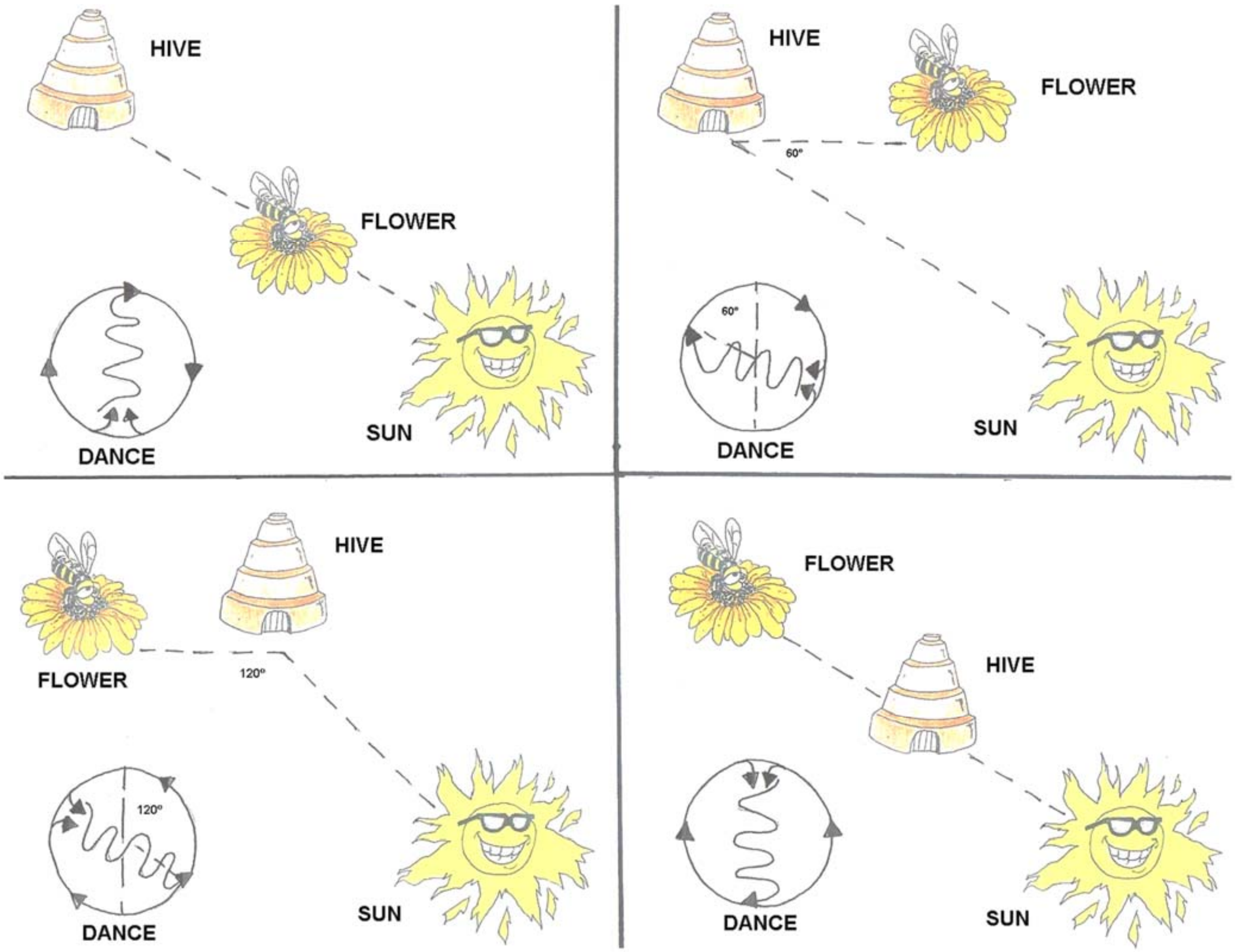
Honey bees (or honeybees) are a subset of bees in the genus Apis, primarily distinguished by the production and storage of honey and the construction of perennial, colonial nests out of wax. Honey bees are the only extant members of the tribe Apini, all in the genus Apis. Currently, there are only seven recognized species of honey bee with a total of 44 subspecies, though historically, anywhere from six to eleven species have been recognized. Honey bees represent only a small fraction of the approximately 20,000 known species of bees. Some other types of related bees produce and store honey, but only members of the genus Apis are true honey bees.

As in a few other types of eusocial bees, a colony generally contains one queen bee, a fertile female; seasonally up to a few thousand drone bees or fertile males; and a large seasonally variable population of sterile female worker bees.

Details vary among the different species of honey bees, but common features include:

1. Eggs are laid singly in a cell in a wax honeycomb, produced and shaped by the worker bees. Using her spermatheca, the queen actually can choose to fertilize the egg she is laying, usually depending on what cell she is laying in. Drones develop from unfertilized eggs and are haploid, while females (queens and worker bees) develop from fertilized eggs and are diploid. Larvae are initially fed with royal jelly produced by worker bees, later switching to honey and pollen. The exception is a larva fed solely on royal jelly, which will develop into a queen bee. The larva undergoes several moltings before spinning a cocoon within the cell, and pupating.
2. Young worker bees clean the hive and feed the larvae. When their royal jelly producing glands begin to atrophy, they begin building comb cells. They progress to other within-colony tasks as they become older, such as receiving nectar and pollen from foragers, and guarding the hive. Later still, a worker takes her first orientation flights and finally leaves the hive and typically spends the remainder of her life as a forager.
3. Worker bees cooperate to find food and use a pattern of "dancing" (known as *the bee dance or waggle dance*) to communicate information regarding resources with each other; this dance varies from species to species, but all living species of *Apis* exhibit some form of the behavior. If the resources are very close to the hive, they may also exhibit a less specific dance commonly known as the "Round Dance".
4. Honey bees also perform tremble dances which recruit receiver bees to collect nectar from returning foragers.
5. Virgin queens go on mating flights away from their home colony, and mate with multiple drones before returning. The drones die in the act of mating.
6. Colonies are established not by solitary queens, as in most bees, but by groups known as "swarms", which consist of a mated queen and a large contingent of worker bees. This group moves *en masse* to a nest site that has been scouted by worker bees beforehand. Once they arrive, they immediately construct a new wax comb and begin to raise new worker brood. This type of nest founding is not seen in any other living bee genus, though there are several groups of Vespid wasps which also found new nests via swarming (sometimes including multiple queens). Also, stingless bees will start new nests with large numbers of worker bees, but the nest is constructed before a queen is escorted to the site, and this worker force is not a true "swarm".

GIANT HONEY BEE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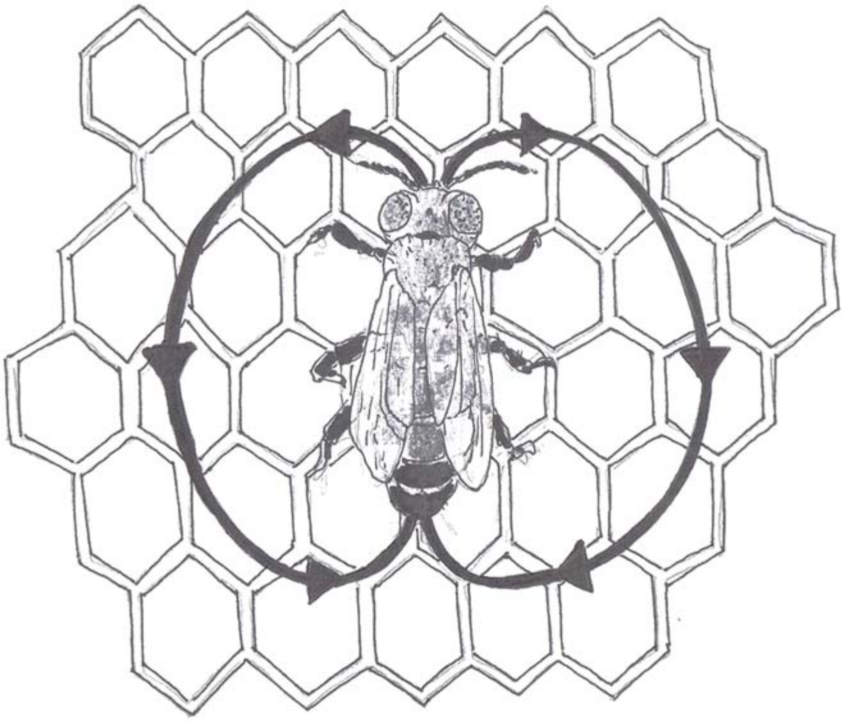
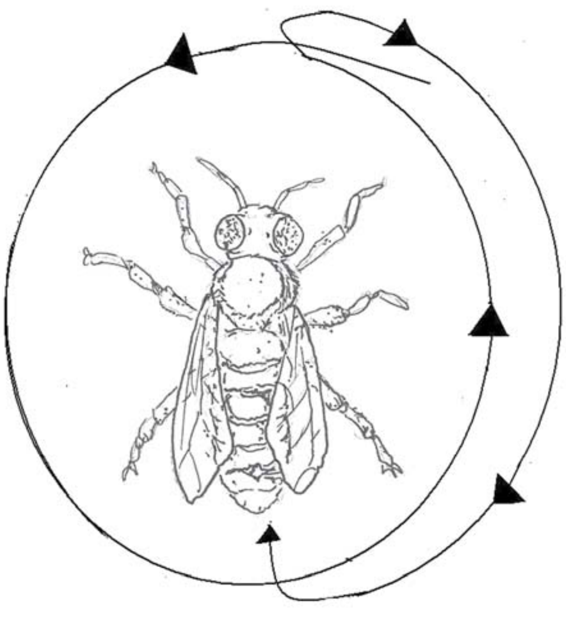
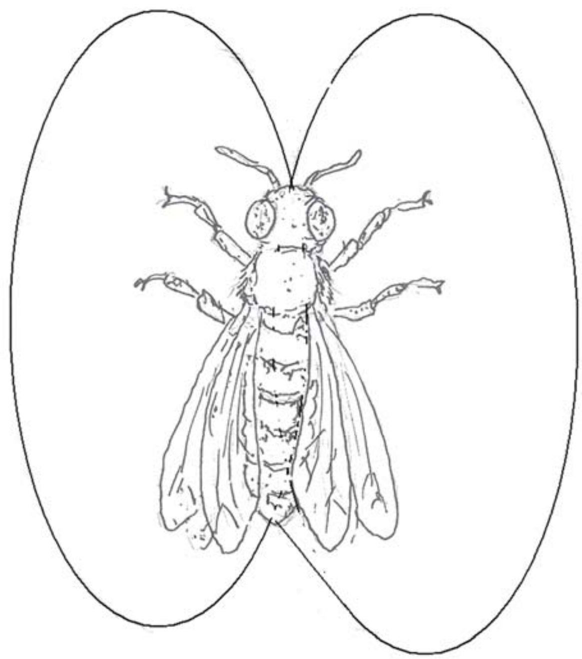


WAGGLE DANCE





Honey Bees Constitute Three Different Clades

Micrapis, Megapis and Apis
Africanized honeybee belongs to Apis. Scientific name: *Apis mellifera scutellata* Lepeletier.

Africanized honey bees, known colloquially as "**killer bees**," are hybrids of the African honey bee, A. m. scutellata, with various European honey bees such as the Italian bee A. m. ligustica and A. m. iberiensis. These bees are far more aggressive than the European subspecies. Small swarms of Africanized bees are capable of taking over European honey beehives by invading the hive and establishing their own queen after killing the European queen.

Micrapis
Apis florea and Apis andreniformis are small honey bees of southern and southeastern Asia. They make very small, exposed nests in trees and shrubs. Their stings are often incapable of penetrating human skin, so the hive and swarms can be handled with minimal protection. Given that A. florea is more widely distributed and A. andreniformis is considerably more aggressive, honey is –- if at all –- usually harvested from the former only. Both the bees were generally identified as *Apis florae*, and most information still relates to this species prior to the 1990s. However, the distinctiveness of the two species *Apis florea* and *Apis andreniformis* was established unequivocally in the 1990s. *Apis florea* is redder and the first abdomen is always red in an old worker (younger workers are paler in color, as is the case in giant honey bees); *Apis andreniformis* is in general darker and the first abdomen segment is totally black in old bees.

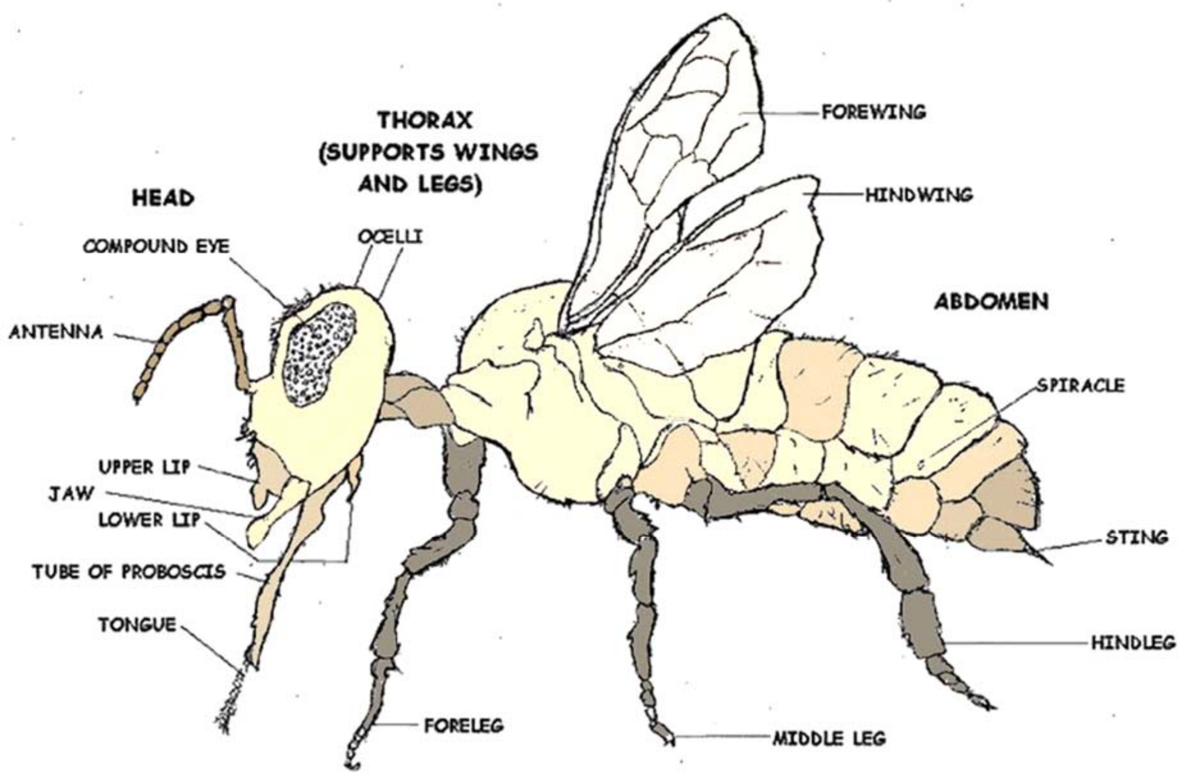
Megapis
There is one recognized species in subgenus Megapis. It usually builds single or a few exposed combs on high tree limbs, on cliffs, and sometimes on buildings. They can be very fierce. Periodically robbed of their honey by human "honey hunters", colonies are easily capable of stinging a human being to death when provoked.

- Apis dorsata, the giant honey bee, is native and widespread across most of South and Southeast Asia.
- Apis dorsata binghami, the Indonesian honey bee, is classified as the Indonesian subspecies of the giant honey bee or a distinct species; in the latter case, A. d. breviligula and/or other lineages would probably also have to be considered species.
- Apis dorsata laboriosa, the Himalayan honey bee, was initially described as a distinct species. Later, it was included in A. dorsata as a subspecies based on the biological species concept, though authors applying a genetic species concept have suggested it should be considered a species. Essentially restricted to the Himalayas, it differs little from the giant honey bee in appearance, but has extensive behavioral adaptations which enable it to nest in the open at high altitudes despite low ambient temperatures. It is the largest living honey bee.

Apis
Africanized honeybee belongs to Apis. Scientific name: *Apis mellifera scutellata* Lepeletier. **Africanized honey bees**, known colloquially as "**killer bees**," are hybrids of the African honey bee, A. m. scutellata, with various European honey bees such as the Italian bee A. m. ligustica and A. m. iberiensis. These bees are far more aggressive than the European subspecies. Small swarms of Africanized bees are capable of taking over European honey beehives by invading the hive and establishing their own queen after killing the European queen. The Africanized honey bee is simply a hybrid honey bee, a result of breeding the European honey bee, *Apis mellifera mellifera*, with the African honey bee, *Apis mellifera scutellata*. The genetic differences in the hybrid Africanized bee make its habits different from those of the domestic European honey bee cultured in the United States.

Africanization

The AHB is the same species of honey bee commonly cultured for honey and wax production and for pollination services. It is a hybrid resulting from crossing a tropical (African) strain and a temperate (European) strain of honey bee. These two strains have been isolated genetically for more than 2,000 years. They have been separated environmentally by more than 70 degrees of latitude and geographically by the Sahara Desert. Each strain has developed its own particular habits.



Anatomy of a Bee

Eastern Species

These are three or four species. The reddish Koschevnikov's bee (Apis koschevnikovi) from Borneo is well distinct; it probably derives from the first colonization of the island by cave-nesting honey bees. Apis cerana, the Eastern honey bee proper, is the traditional honey bee of southern and eastern Asia, kept in hives in a similar fashion to Apis mellifera, though on a much smaller and regionalized scale. It has not been possible yet to resolve its relationship to the Bornean Apis cerana nuluensis and Apis nigrocincta from the Philippines to satisfaction; the most recent hypothesis is that these are indeed distinct species but that A. cerana is still paraphyletic, consisting of several good species.

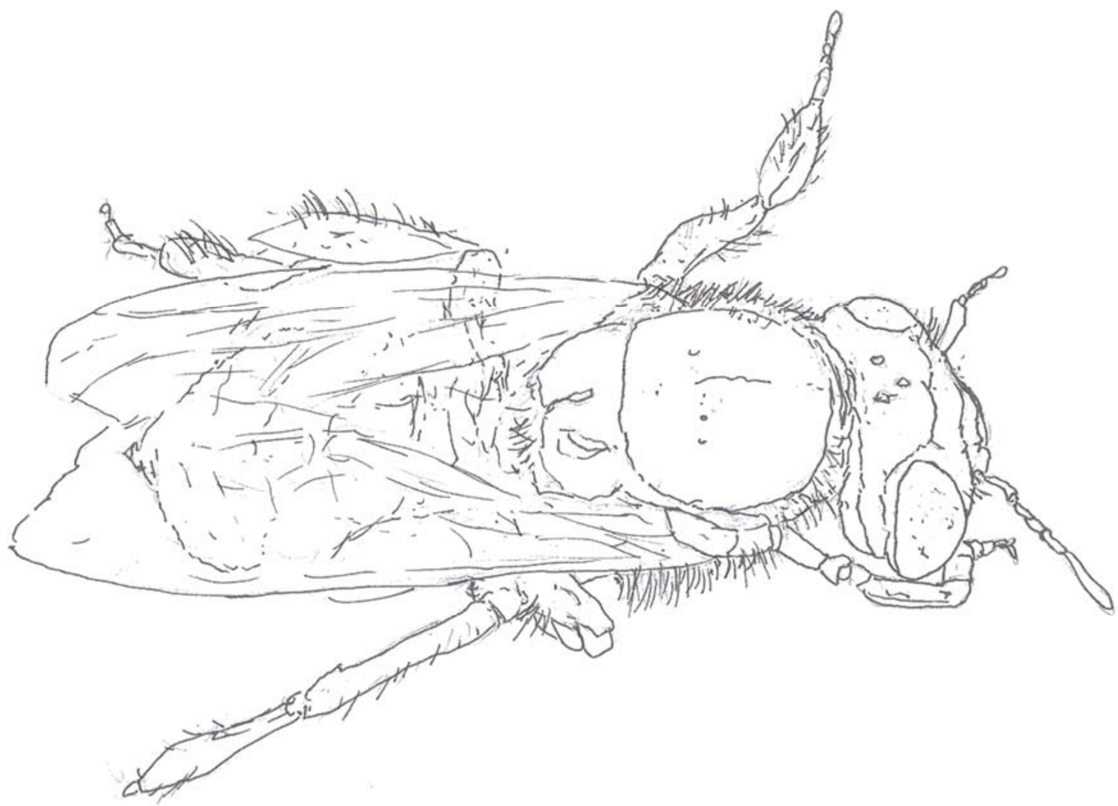
European/Western/Common Honey Bee

Apis mellifera, the most commonly domesticated species, was the third insect to have its genome mapped. It seems to have originated in eastern tropical Africa and spread from there to Northern Europe and eastwards into Asia to the Tien Shan range. It is variously called the European, Western or Common honey bee in different parts of the world. There are many subspecies that have adapted to the local geographic and climatic environment, and in addition, hybrid strains such as the Buckfast bee have been bred. Behavior, color and anatomy can be quite different from one subspecies or even strain to another. Regarding phylogeny, this is the most enigmatic honey bee species. It seems to have diverged from its Eastern relatives only during the Late Miocene.

This would fit the hypothesis that the ancestral stock of cave-nesting honey bees was separated into the Western group of E Africa and the Eastern group of tropical Asia by desertification in the Middle East and adjacent regions, which caused declines of foodplants and trees which provided nest sites, eventually causing gene flow to cease. The diversity of subspecies is probably the product of a largely Early Pleistocene radiation aided by climate and habitat changes during the last ice age.

That the Western honey bee has been intensively managed by humans since many millennia – including hybridization and introductions – has apparently increased the speed of its evolution and confounded the DNA sequence data to a point where little of substance can be said about the exact relationships of many A. mellifera subspecies.

There are no honey bees native to the Americas. In 1622, European colonists brought the dark bee (A. m. mellifera) to the Americas, followed later by Italian bees (A. m. ligustica) and others. Many of the crops that depend on honey bees for pollination have also been imported since colonial times. Escaped swarms (known as "wild" bees, but actually feral) spread rapidly as far as the Great Plains, usually preceding the colonists. Honey bees did not naturally cross the Rocky Mountains; they were carried by ship to California in the early 1850s.



ORCHID BEE

Adult bees measure ¾-inch long and are fuzzy, with gold and black stripes and transparent wings. Honey bees can often be identified by the balls of yellow pollen they carry on the backs of their legs. Bees are an important pollinator of many plants.

Understanding Both AHB and EHB Bee Colony

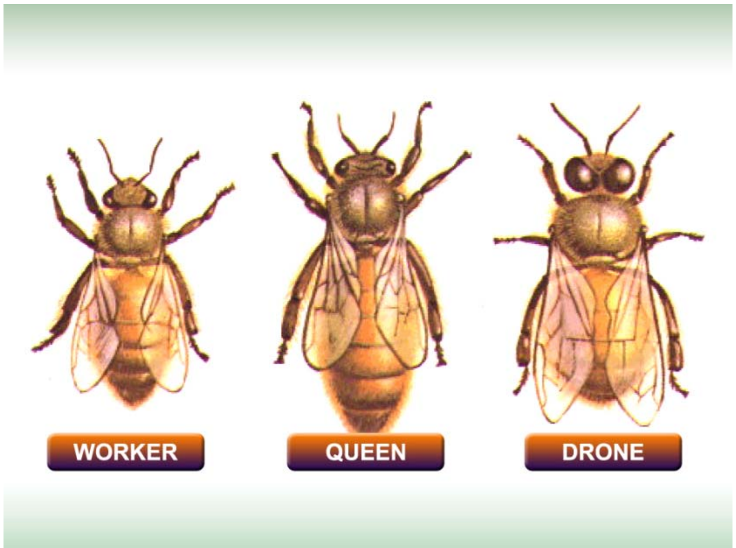
To understand the threat of Africanized honey bees, it is necessary to know something in general about honey bees and their behavior. Honey bees are important beneficial insects and we would be in big trouble if they were all suddenly destroyed. Unless a honey bee colony is in a location that is close to people, pets or farm animals, it should be left alone.

An additional requirement of a colony is a social pattern or organization, probably associated with a “social pheromone.” It causes the bees to collect and store food for later use by other individuals. It causes them to maintain temperature control for community survival when individually all would perish. Individuals within the colony communicate with each other but not with bees of another colony. Certain bees in the colony will sting to repel an intruder, even though the act causes their death. All of these, and perhaps many other organizational activities, probably are caused by pheromones.

There is no known governmental hierarchy giving orders for work to be done, but a definite effect on the colony is observed when the queen disappears. This effect seems to be associated with a complex material produced by the queen that we refer to as “queen substance.” There also is evidence that the worker bees from 10 to 15 days old, who have largely completed their nursing and household duties but have not begun to forage, control the “governmental” structure. Just what controls them has not been determined. These and many other factors make an organized colony out of the many thousands of individuals.

Biology and Habits of the Honey Bee

The honey bee undergoes complete metamorphosis, passing through four stages: egg, larva, pupa, and adult. Bees develop into three different castes: workers, queens, and drones.



Developmental time and longevity vary with each caste and among races. When honey bees emerge as adults, they continue to develop. At first their body is soft, but the cuticle hardens in about 12-24 hours. During the next few days, glands and reproductive organs (in the queens and drones) develop and mature.

Drones produce semen in about 12 days and queens begin to lay eggs about three days after mating. In a typical colony there will be only one laying queen, about 100 – 300 drones, and about 20,000 - 60,000 workers.

Virgin Queens

When mature, virgin queens take a mating flight and mate with 10-15 drones. In about three days the queen begins to lay eggs. A queen may lay as many as 1,500 eggs in a single day and around 200,000 eggs in a year. The queen controls whether or not the eggs are fertilized, using sperm stored in her spermatheca. Fertilized eggs develop into females (workers) and unfertilized eggs develop into males (drones). About 99 percent of the eggs laid by a queen are fertilized and develop into workers.

The Domicile

The AHB swarms much more frequently than other honey bees. A colony is a group of bees with comb and brood. The colony may either be managed (white hive boxes maintained by professional beekeepers) or wild (feral). A group of bees that are in the process of leaving their parent colony and starting a nest in a new location is called a "swarm." Usually a new queen is reared to stay with the parent colony and the old queen flies off with the swarm. Scout bees often locate potential nest sites prior to swarming, but the swarm may spend a day or two clustered in impressive, hanging clumps on branches or in other temporary locations until the bees settle on a new nesting site. If they can't find a suitable location, the bees may fly several miles and cluster again.

When the swarm emerges from its domicile and settles in a cluster on a tree, certain “scout bees” communicate to it the availability of other domiciles. At least some of these domiciles may have been located by the scout bees before the swarm emerged. The various scouts perform their dances on the cluster to indicate the direction, distance, and desirability of the domiciles. Eventually, the cluster becomes united in its approval of a particular site. Then the swarm moves in a swirling mass of flying bees to it. Agreement always is unanimous.

When a swarm or combless package is placed in a box, allowed to fly, and supplied with abundant food, it builds comb. With a laying queen present, the first comb is “worker” in design, with about 25 cells per square inch. As the population of bees grows larger, and after there is a considerable amount of worker comb built, comb containing larger cells is constructed. This comb, termed storage comb by Langstroth, is used for rearing drones. We have found that bees store their first honey all across the top of the combs, utilizing both drone and worker cells.

The space between honey storage combs is much more uniform than between brood combs. The space left between capped honey cells is usually one-fourth inch or even less – room enough for one layer of bees to move.

As the colony ages, the combs that were first used for rearing worker bees may be converted to honey storage comb; areas damaged in any way are rebuilt. These changes usually affect the bee space and result in combs being joined together with “brace” comb. Strains of bees show genetic variation in building these brace combs. All these cells are horizontal or nearly so; vertical cells are used for rearing queens. Why horizontal cells are used for the rearing of brood and for honey and pollen storage, whereas vertical cells are built only for queen production, is unknown.

As Africanized bees expand into temperate areas, their tropical adaptations are less advantageous. Cold weather seems to limit both their defensiveness and overwintering capacity. Africanized bees are more defensive in warm tropical regions and less so in cooler zones. In South America the bees do not overwinter south of 34 degrees S latitude, which corresponds roughly to Atlanta, Georgia. (Please note, however, that Africanized bees are found north of this latitude in the American West.)

In areas where their ranges overlap, African- and European-derived bees interbreed, causing “hybrid zones” where bees share African and European traits. In Argentina, Africanized bees dominate in the northern semitropical regions but European bees dominate in the southern temperate areas; the area in between (*ca*. 32-34 degrees latitude) is a hybrid zone where bees have varying degrees of African or European traits. A similar pattern may occur in the United States, with African traits dominating in southern regions.

Flight Behavior

When several thousand bees and a queen are placed in new surroundings – which happens when the swarm enters its new domicile or a package of bees is installed, or a colony is moved to a new location – normal flight of some workers from the entrance may occur within minutes. If flowering plants are available, bees may be returning to the hive with pollen within an hour. Bees transferred by air from Hawaii to Louisiana and released at 11:30 a.m. were returning to the new location with pollen loads within an hour. Package bee buyers in the Northern States have noticed similar patterns in bees shipped from the South.

Bee Housecleaning
Certain waste material accumulates in a normal colony. Adult bees and immature forms may die. Wax scales, cappings from the cells of emerging bees, particles of pollen, and crystallized bits of honey drop to the floor of the hive. Intruders, such as wax moths, bees from other colonies, and predators, are killed and fall to the floor. Worker bees remove this debris from the hive.

The cleaning behavior of some strains of bees, associated with removal of larvae and pupae that have died of American foulbrood, is genetically controlled by two genes. This discovery is important not only because it might help in developing bees resistant to diseases, but also in indicating that other behavior characteristics of bees can be genetically modified to suit special needs.

Known Pheromone Activity
Chemicals that bees and other insects produce that influence, or direct, behavior of other bees are broadly called pheromones. In honey bees these chemicals are produced by the queen, workers, and probably drones. This is an interesting and new area for bee research, as this list represents just a beginning. Research has indicated the existence of many other pheromones, which are as yet undocumented. If interested in this topic, consult the technical work listed in Gary (1974).

Pheromonal bee behavior activity patterns are easily observable. Nassanoff or scent gland activity is best seen when a swarm is hived. When the bees first enter the new domicile, some bees stand near the entrance and fan. At the same time, they turn the abdominal tip downward to expose a small, wet, white material on top of the end of the abdomen. This seems to affect the other bees, for within several minutes all will have entered the new hive. When bees find a new source of food, they also mark it with the same chemical.

Colony Odor
Colony odor refers to the odor of one colony. Because each colony odor is different, colonies cannot be combined into one hive without the bees fighting and killing one another. This odor probably results from a combination of endogenous (pheromone or pheromone-like) materials and exogenous (food) materials in each hive and seems to be recognizably different for every colony. When colonies are to be combined, the beekeeper usually places a newspaper between the two sets of bees. By the time the bees have eaten through and disposed of the newspaper, their odors have intermingled and become indistinguishable. During heavy honey flows, differences between colonies seem to disappear, or be submerged by the scent of nectar, and colonies can be united without difficulty.

One of the most interesting and complex pheromones, originally termed "queen substance," is now believed to be a complex of different chemical pheromone compounds which stimulate a large number of complex behavior responses. Its presence in virgin queens in flight attracts the drone for mating from an unknown distance. Its presence in virgin and mated queens prevents the ovaries of the worker bee within the hive from developing and the worker bees from building queen cells. It keeps swarming bees near the queen. Its decrease is a cause of swarm preparation or supersedure. Queen substance is produced in glands in the queen's head. The alarm or sting pheromone also may be a complex of pheromones. When a bee stings, other bees in the immediate vicinity also try to sting in the same place. Smoke blown onto the area seems to neutralize this effect.

Colony Morale
"Colony morale" generally refers to the well-being of the colony. If the morale is good, the bees are doing what is desired of them, including increasing the colony population, making honey, and pollinating flowers. Many factors affect colony morale. For example, if the queen is removed from a colony during a honey flow, the daily weight gains immediately decrease, although the bee population for the next 3 weeks is unaltered. Also, when a colony is preparing to swarm, the bees practically stop gathering pollen and nectar. Improper manipulations or external environment also affects colony morale. A colony has good morale when the maximum number of bees are making the maximum number of flights to gather nectar and pollen.

The Performance of Colonies
Genetically, we found that some bees produce more honey than others, but we do not know why. The individual bee may collect more because of its own genetic inheritance. The colony may store more honey because of the queen's inherited ability to lay more eggs, resulting in a greater total population of bees in the hive, or because the bees are inherently longer lived.

We can affect the bee's environment in conjunction with its inheritance, and our aim is to have good-quality bees and maintain the best colony morale possible. A beekeeper's disturbance of the colony during the honey flow results in a marked decrease in the amount of honey stored for that day and even the following day. Colonies of bees should not be needlessly disturbed; however, some manipulation associated with many aspects of management is necessary.

Bee behavior toward different plants varies greatly. Some plants are particularly attractive for nectar or pollen; others are not. Strains of bees can be genetically selected to visit certain plants, and plants can be selected to be more attractive to bees. Attractive nectar or pollen, or both, can be important in ensuring pollination of bee-pollinated crops. Nectar and pollen availability in plants can be accidentally eliminated by breeding. When this occurs, there is a loss of a potential honey crop, but more important can be the loss of a seed or fruit crop because the plant no longer attracts pollinators. If plants such as soybeans, which cover enormous acreages, could be made more attractive to bees, honey and possibly soybean yields could be greatly increased.

A behavior characteristic of honey bees limits their effectiveness in pollinating some crops. Individual bees usually confine their foraging area in a series of trips to the field to a relatively small area such as a single fruit tree. On the other hand, the foraging area of a colony may comprise several square miles; honey bees flying 2.5 miles in all directions from a single hive have access to 12,500 acres. This characteristic and the fact that honey bees distribute themselves well over the area within flight range are important in locating and harvesting available nectar and pollen.

Control of Foraging
A major crop pollination goal is to control foraging bees and get them to more effectively visit and pollinate crops; conversely, we would like to repel them from areas where there is danger from insecticides or where they endanger people. Work with other insects – both social and nonsocial – indicates that this might be accomplished someday by chemical and physical means. There is considerable evidence that different plant species produce varying attractant compounds associated with their nectar and pollen.

Bees are highly attracted to the scent of recently extracted honeycomb and to the scent of honey being extracted or heated. Obviously, chemical scents of certain flowers and to some extent scents incorporated in the collected honey are attractive to bees or associated with available food. Some pollens also contain chemical compounds that stimulate collection response in bees. Isolation and identification of these bee-attractive compounds and the application of the attractant to plant areas or altering attractants through plant breeding are an area of research of potential importance to crop pollination.

Research should not be confined to chemicals alone, but should be shared equally with various physical factors that can possibly attract or repel bees. In other entomological fields, research on physical methods of controlling insects is receiving intensive investigation. Different insects respond in differing ways; they are attracted to certain light wavelengths and repelled by others. Night-flying moths are repelled or go into defensive maneuvers because of bat sonar signals, whereas crickets and other members of their insect group can be collected by reproducing certain stridulations.

Other Methods of Bee Communication

There are other methods of bee communication besides the one involving chemical pheromones. The best known is the "dance" of the returned forager bee so well elucidated by von Frisch and his many students, particularly M. Lindaner.

This dance is so precise that it tells other bees not only in which direction to go but also how far to fly in search of food. This was the first non-human language to be interpreted. The experiments on bee communication by dances were done with dishes of sugar water and not under true foraging conditions of bees collecting nectar from plants. When a returning forager comes back to the hive after finding a highly attractive 100-acre field of sweet clover, does she direct bees to the spot she was working or to the whole field? The last word in dance communication of bees certainly has not yet been written.

Even the most uninitiated are familiar with the soft quiet hum of bees collecting nectar and pollen on their foraging trips. In the hive itself, there are many more bee noises or sounds which are much more subtle. Experienced beekeepers recognize a difference in sound between a colony with a queen and one without. Individual queens and even worker bees emit squeaky sounds called "piping" and "quacking."

The bee literature is full of many explanations of the causes and meanings of these sounds. Since these sounds and other hive sounds are now under careful scientific scrutiny, it is really premature to say definitely that they have certain defined meanings. This field of interest may produce useful information in the future.

According to von Frisch, when a bee returns from a foraging trip and dances, she also communicates the kind of "plant" or "flower" on which she was foraging by releasing the perfume of the flower through nectar regurgitation or from nectar aroma on body hairs. Again, most of these experiments were done with dishes of sugar water impregnated with essential oils or plant extracts. These experiments have prompted other experiments that were designed to train bees to work desired crops for pollination. These experiments were unsuccessful. The reason for the failures may well be that the bee language code has not been completely translated. We are still unable to "talk" effectively to the bees and "tell" them what we want done.

Von Frisch also discovered that bees recognize and are guided to flowers by different colors but are unable to communicate these colors. He also showed that the bee's eyes are receptive to polarized light and that polarization of the light from the sky aids the bee's navigation. How light of different wave lengths or intensity affects what goes on inside a hive is being studied.

Age Levels of Bees Correlated With Work Habits

The honey bee is adaptable to many environments. Honey bees that were native only to Europe, Asia, and Africa have adapted well to all but the polar regions of the world. Part of this adaptability lies in the capacity of the individual bee to "sense" what must be done, then to perform the necessary duty. Typically an EHB hive will swarm once every 12 months. However, the AHB may swarm as often as every six weeks and can produce a couple of separate swarms each time. This is important for you to know, because if the AHB swarms more often, the likelihood of your encountering an AHB swarm increases significantly.

Regardless of myths to the contrary, Africanized honey bees do not fly out in angry swarms to randomly attack unlucky victims. However, the AHB can become highly defensive in order to protect their hive, or home. Again, it is now better to consistently exercise caution with respect to all bee activity. So keep your distance from any swarm of bees.

The AHB is far less selective about what it calls home. The AHB will occupy a much smaller space than the EHB. Known AHB nesting locations include water meter boxes, metal utility poles, cement blocks, junk piles, and house eaves. Other potential nesting sites include overturned flower pots, old tires, mobile home skirts, and abandoned structures. Holes in the ground and tree limbs, mail boxes, even an empty soda pop, could be viewed as "home" to the AHB.

The Africanized honey bee is extremely protective of their hive and brood. The AHB's definition of their "home turf" is also much larger than the European honey bee. So, try to allow ample physical distance between the hive. At least 100 feet, or the width of a four-lane highway, is a good distance. The best advice is that if you see a bee hive, start moving away immediately.

Under normal conditions, all ages of bees are in the hive and, in general, the bee's age determines its daily activity. In response to special needs of the colony, however, bees are capable of altering the division of labor according to age. Young bees feed larvae, build comb, and ripen nectar into honey in a rather definite sequence. After about 3 weeks, they become field bees. If many field bees are killed by pesticides, young bees go to the field at a younger age to get necessary chores accomplished.

Africanized and European Honey Bees

- Look the same.
- Protect their nest and sting in defense.
- Can sting only once.
- Have the same venom.
- Pollinate flowers.
- Produce honey and wax.

Africanized honey bees are less predictable and more defensive than European honey bees. They are more likely to defend a greater area around their nest. They respond faster in greater numbers, although each bee can sting only once.

Africanized Honey Bees

- Respond quickly and sting in large numbers.
- Can sense a threat from people or animals 50 feet or more from nest.
- Sense vibrations from power equipment 100 feet or more from nest.
- Will pursue an enemy 1/4 mile or more.
- Swarm frequently to establish new nests.
- Nest in small cavities and sheltered areas.

AHB nest in many locations where people may encounter them. Nesting sites include: empty boxes, cans, buckets or other containers; old tires; infrequently used vehicles; lumber piles; holes and cavities in fences, trees, or the ground; sheds, garages, and other outbuildings; and low decks or spaces under buildings. *Remove potential nest sites around buildings.*

Karl Ritter von Frisch

Karl Ritter von Frisch (20 November 1886 – 12 June 1982) was an Austrian ethologist who received the Nobel Prize in Physiology or Medicine in 1973, along with Nikolaas Tinbergen and Konrad Lorenz. His work centered on investigations of the sensory perceptions of the honey bee and he was one of the first to translate the meaning of the waggle dance. His theory was disputed by other scientists and greeted with skepticism at the time. Only recently was it definitively proved to be an accurate theoretical analysis.

Bee Perception
Sense of smell: Frisch discovered that bees can distinguish various blossoming plants by their scent, and that each bee is "flower constant". Surprisingly, their sensitivity to a "sweet" taste is only slightly stronger than in humans. He thought it possible that a bee's spatial sense of smell arises from the firm coupling of its olfactory sense with its tactile sense.

Optical perception:
Frisch was to first to demonstrate that honey bees had color vision, which he accomplished by using classical conditioning. He trained bees to feed on a dish of sugar water set on a colored card. He then set the colored card in the middle of a set of gray-toned cards. If the bees see the colored card as a shade of gray, then they will confuse the blue card with at least one of the gray-toned cards; bees arriving to feed will visit more than one card in the array. On the other hand, if they have color vision, then the bees visit only the blue card, as it is visually distinct from the other cards. A bee's color perception is comparable to that of humans, but with a shift away from the red toward the ultraviolet part of the spectrum. For that reason bees cannot distinguish red from black (colorless), but they can distinguish the colors white, yellow, blue and violet.

Color pigments which reflect UV radiation expand the spectrum of colors which can be differentiated. For example, several blossoms which may appear to humans to be of the same yellow color will appear to bees as having different colors (multicolored patterns) because of their different proportions of ultraviolet.

Powers of orientation:
Frisch's investigation of a bee's powers of orientation were significant. He discovered that bees can recognize the desired compass direction in three different ways: by the sun, by the polarization pattern of the blue sky, and by the earth's magnetic field, whereby the sun is used as the main compass, with the alternatives reserved for the conditions arising under cloudy skies or within a dark beehive.

Polarization pattern:
Light scattered in a blue sky forms a characteristic pattern of partially polarized light which is dependent on the position of the sun and invisible to human eyes. With a UV receptor in each of the lens units of a compound eye, and a UV filter oriented differently in each of these units, a bee is able to detect this polarization pattern. A small piece of blue sky is enough for a bee to recognize the pattern changes occurring over the course of a day. This provides not only directional but also temporal information.

Variations in the daytime position of the sun: Karl von Frisch proved that variations in the position of the sun over the course of a day provided bees with an orientation tool. They use this capability to obtain information about the progression of the day deep inside a dark beehive comparable to what is known from the position of the sun.

This makes it possible for the bees to convey always up-to-date directional information during their waggle dance, without having to make a comparison with the sun during long dance phases. This provides them not only with alternative directional information, but also with additional temporal information.

Internal clock
Bees have an internal clock with three different synchronization or timekeeping mechanisms. If a bee knows the direction to a feeding place found during a morning excursion, it can also find the same location, as well as the precise time at which this source provides food, in the afternoon, based on the position of the sun.

Horizontal orientation of the honeycomb: Based on the magnetic field, the alignment of the plane of a honeycomb under construction (e.g., the new honeycomb of a swarm) will be the same as that of the home hive of the swarm, according to Karl von Frisch. By experiment, even deformed combs bent into a circle can be produced.

Sensing the vertical:
The vertical alignment of the honeycomb is attributed by Karl von Frisch to the ability of bees to identify what is vertical with the help of their head used as a pendulum together with a ring of sensory cells in the neck.

"Dialects"
The linguistic findings described above were based on Karl von Frisch’s work primarily with the Carnica variety of bees. Investigations with other varieties led to the discovery that language elements were variety-specific, so that how distance and direction information is relayed varies greatly

Dances as language
Knowledge about feeding places can be relayed from bee to bee. The means of communication is a special dance of which there are two forms:
Round dance

The “round dance” provides the information that there is a feeding place in the vicinity of the beehive at a distance between 50 and 100 meters, without the particular direction being given. By means of close contact among the bees it also supplies information about the type of food (blossom scent).

The foraging bee...begins to perform a kind of “round dance”. On the part of the comb where she is sitting she starts whirling around in a narrow circle, constantly changing her direction, turning now right, now left, dancing clockwise and anti-clockwise, in quick succession, describing between one and two circles in each direction. This dance is performed among the thickest bustle of the hive. What makes it so particularly striking and attractive is the way it infects the surrounding bees; those sitting next to the dancer start tripping after her, always trying to keep their outstretched feelers on close contact with the tip of her abdomen....They take part in each of her maneuverings so that the dancer herself, in her mad wheeling movements, appears to carry behind her a perpetual comet’s tail of bees.

The Waggle Dance
The "waggle dance" is used to relay information about more distant food sources. In order to do this, the dancing bee moves forward a certain distance on the vertically hanging honeycomb in the hive, then traces a half circle to return to her starting point, whereupon the dance begins again. On the straight stretch, the bee “waggles” with her posterior. The direction of the straight stretch contains the information about the direction of the food source, the angle between the straight stretch and the vertical being precisely the angle which the direction of flight has to the position of the sun. The distance to the food source is relayed by the speed of the dance, in other words, by the number of times the straight stretch is traversed per unit of time.

The other bees take in the information by keeping in close contact with the dancing bee and reconstructing its movements. They also receive information via their sense of smell about what is to be found at the food source (type of food, pollen, propolis, water) as well as its specific characteristics. The orientation functions so well that the bees can find a food source with the help of the waggle dance even if there are hindrances they must detour around like an intervening mountain.

As to a sense of hearing, Karl von Frisch could not identify this perceptive faculty, but it was assumed that vibrations could be sensed and used for communication during the waggle dance. Confirmation was later provided by Dr. Jürgen Tautz, a bee researcher at Würzburg University's Biocenter. Dr. Tautz co-authored a paper on "Immune-Related Proteins Induced in the Hemolymph After Aseptic and Septic Injury Differ in Honey Bee Worker Larvae and Adults" in Insect Biochemstry and Physiology 69:155–167 (2008).

Prof. Dr. Jürgen Tautz Information

Research interests:
Our group has its research focus on fundamentals of honeybee biology and specifically onto principles of disease resistance in honeybees. Honeybees are ecologically and economically most relevant insects. In order to understand how honeybees prevent and fight diseases we use a wide scope of technologies. We have introduced a new technology (RFID=Radio frequency identification) into the behavioral biology of insects, which now allows a lifelong-recoding of behavioral data for individual bees

This technology will allow in future to link a complete data set on identified honeybee individuals with biochemical and genetics details on the same animals aiming at an understanding how the bee-controlled environmental conditions inside the nest may be used by the bees to fight diseases. We use methods from animal physiology and behavioral biology and to study physical and cognitive abilities in healthy and infected bees. Histological and biochemical methods help to survey the hemolymph ("blood") of healthy and infected individuals.

PC modeling of colony efficiency is an important tool for the integration of detailed experimental results.
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"Dialects"
The linguistic findings described above were based on Karl von Frisch's work primarily with the Carnica variety of bees. Investigations with other varieties led to the discovery that language elements were variety-specific, so that how distance and direction information is relayed varies greatly.

Other work
Frisch's honey bee work included the study of the pheromones that are emitted by the queen bee and her daughters, which maintain the hive's very complex social order. Outside the hive, the pheromones cause the male bees, or drones, to become attracted to a queen and mate with it. Inside the hive, the drones are not affected by the odor.

Commonly found public notice.

Africanized honey bees (*Apis mellifera scutellata*) and European honey bees (*Apis m. mellifera*) are the same species - they look the same, sting in defense of themselves or their nest, can only sting once, and have the same venom. Africanized honey bees are slightly smaller (but because the bees look so much alike only a laboratory analysis can tell them apart).

They also differ in that they respond more quickly and more bees sting, can sense a threat from people or animals 50 feet or more from their nest, sense vibrations from power equipment 100 feet or more from their nest, may pursue a victim 1/4 to 1/2 mile, remain agitated for an hour or more after an attack, swarm frequently to establish new nests, nest in smaller cavities and sheltered areas, and move their entire colony readily (abscond) if food is scarce.

Away from the hive, however, they are no more defensive than other bees or wasps. They will not form large swarms and hunt for you.

Behavior Activities of Bees

The Drones
The time of day that drones fly in search of a mate depends on many factors, such as the geographic location, day length, and temperature. Drones usually fly from the hive in large numbers between 11 a.m. and 4:30 p.m. Morning or early afternoon flights may last 2 or 3 hours. Later flights are shorter. When out of the hive, drones congregate in “mating areas,” which may serve to attract virgin queens. These areas usually are less than 100 feet from the ground and seem to be associated with land terrain.

The Queen
The virgin queen becomes sexually mature about 5 days after emergence. She is relatively quiet in the morning and most active in the afternoon. She may begin her mating flights 5 or 6 days after emergence and go on a number of flights over several days. Mating with 8 to 12 drones will stock her spermatheca with 6 million to 7 million sperm. She will begin to lay eggs in 2 to 5 days and may continue for years. A young, fully mated queen rarely lays drone eggs before she is several months old. After that time, she controls the sex of the offspring by laying either fertilized or non-fertilized eggs.

Worker bees occasionally kill their queen. More frequently, they will kill a newly introduced or virgin queen. To do this, 15 or 20 worker bees collect about her in a tight ball until she starves. Generally, it has been thought that bees “balled” strange or introduced queens because they did not have the proper “colony” odor. The reason for balling is probably more complicated than that, because bees occasionally will ball their own queen. Even if the ball is broken up, the queen seldom survives and the stimulus is powerful enough that the bees taking part in the queen balling are sometimes subsequently balled by other bees.

The first bee laws in the United States were enacted in 1883 to establish methods for control of bee diseases. Today, 49 States provide apiary inspection services for disease abatement. Bee diseases cause considerable expense to the States for the cost of maintaining apiary inspection service, as well as considerable losses to the beekeepers for the cost of colonies damaged or destroyed and for the drugs fed to prevent bee diseases. In addition, far greater losses result from reduction in honey and beeswax production and insufficient bees for pollination. It is apparent, therefore, that both beginning and advanced beekeepers should learn to recognize and control bee diseases.

Cause of Stinging Bees or Temper
The term “temper” of bees refers to their inclination to sting. Many factors influence the temper of bees, and it is a difficult subject to study. Environment of the hive and manipulation by an individual beekeeper certainly influence temper responses of bees. Temper is probably influenced tremendously by the genetics or inheritance of the bee as well as the environment. The Brazilian or Africanized bee is thought to be more genetically prone to sting than bees in the United States.

Temper of bees commonly has been controlled with smoke. Just why and how smoke affects bees is unknown, even though it has been used by beekeepers worldwide for hundreds of years. Furthermore, instructing beginners and novices exactly when and how to use smoke on bees is almost impossible. It is something that is learned from experience.

The following brief instruction might help beekeepers with limited experience: Smoke the entrance gently enough to force guard bees inside, raise cover, smoke gently. Smoke bees only when they fly up from combs toward hands and face. Move slowly and deliberately. Break propolis seals between hive bodies and frames slowly and evenly.

Don’t jar or bump combs and bees. During cold weather, propolis joints snap when pried apart unless care is taken. If combs are kept clean of propolis and burr and brace comb and if care is taken not to crush bees when moving combs and supers, they can be kept quite gentle.

Great care should be exercised in the placement of colonies of bees so that they cannot become a nuisance to friends and neighbors. Bees visiting nearby fishponds, swimming pools, and stock-watering troughs can be a real nuisance as well as dangerous to people and animals. Springtime flight of bees voiding feces and spotting laundry hanging on a line or a new car is irritating. Good public relations are important for beekeepers. Talk to your neighbors about the importance of bees in the community and country at large. Help them to understand that your bees and others are responsible for important pollination and share some honey with them occasionally.

A Worker bee with a collection of pollen.

Bee Identification

1. Bees Have 2 Sets of Wings

In other words, bees have four single wings - two on each side of the body. Note that flies only have one pair of wings – one wing on each side of the body. Wasps also have two sets of wings.

2. Behavior/Body Movements

The way an insect moves can help you identify a species. For example, many flies – including the hover fly Volucella Bombylans, (which can be mistaken for a bumblebee, along with some other hover fly species), often engages in an activity that makes it quite easy to spot. It extends its fore legs out in front of itself and appears to be briskly rubbing its feet together. This behavior is commonly seen in houseflies, as a further example.

3. Check The Eyes!

Take a good look at the eyes! The eyes of hover flies are comparatively large - as can be seen from the image above - and note the shape.

4. Pollen Carrying

A number of insects may be seen gathering nectar, including the bee fly, which is a fly, not a bee!
Bees carry pollen in different ways – some solitary bees carry it on the underside of the abdomen.
However, if you spot an insect with pollen baskets on the hind legs, these are bees. Only the females carry pollen.

Habit Information

The honey bee undergoes complete metamorphosis, passing through four stages: egg, larva, pupa, and adult. Bees develop into three different castes: workers, queens, and drones.

Developmental time and longevity vary with each caste and among races. When honey bees emerge as adults, they continue to develop. At first their body is soft, but the cuticle hardens in about 12-24 hours. During the next few days, glands and reproductive organs (in the queens and drones) develop and mature.

Drones produce semen in about 12 days and queens begin to lay eggs about three days after mating. In a typical colony there will be only one laying queen, about 100 – 300 drones, and about 20,000 - 60,000 workers.

Virgin Queens
When mature, virgin queens take a mating flight and mate with 10-15 drones. In about three days the queen begins to lay eggs. A queen may lay as many as 1,500 eggs in a single day and around 200,000 eggs in a year. The queen controls whether or not the eggs are fertilized, using sperm stored in her spermatheca. Fertilized eggs develop into females (workers) and unfertilized eggs develop into males (drones). About 99 percent of the eggs laid by a queen are fertilized and develop into workers.

Swarming
Swarming is the natural means of honey bee dispersion. A new honey bee colony is established after a swarm leaves an established colony to seek a new location. A swarm consists of the old queen and about half the bees from the old colony.

The swarm flies from a few to several hundred yards and lands on a low-hanging tree limb or other structure. From there, scout bees seek out a suitable area to establish a new colony. Swarms may stay in their temporary location from a few hours to a few days. It is during this time that bee swarms may be hived by beekeepers and managed for honey and wax production.

Absconding
Absconding is a behavioral trait of all honey bees. It is much more common in the AHB than in the EHB. Absconding occurs when all the adult bees, including the queen, workers and drones, leave the old nest and relocate to a new site.

Absconding is usually the result of a severe disturbance, such as predator activity, flooding, starvation, or other major stress. Absconding bees may travel 30-50 miles before finding a suitable nest site. Long flights may have to be interrupted several times to forage for food.

Food Gathering
Worker bees forage for nectar, pollen, propolis, and water. They bring these raw materials back to the colony for use or storage. Nectar is converted from sucrose, a complex sugar, into fructose and glucose, simple sugars, by enzyme activity in the bee's "*honey stomach*." Then it is dehydrated from 60 to 65 percent water to the 17 to 20 percent water found in ripe honey.

Worker bees also forage for propolis, often called "*bee glue*." Propolis is a mixture of tree resins and bee wax. It is used to secure and seal cracks and crevices within the colony. Water is collected by foragers and has three important functions in the colony: to dilute thick honey, to maintain the desired humidity in the hive, and to maintain the proper temperature.

Defensive Behavior
Stinging is a defensive behavior. Virtually all defensive behavior is in the immediate vicinity of the hive. Away from the hive, bees literally have to be forced to sting. Swarming bees are rarely defensive and do not sting unless provoked. However, "*hunger swarms*" or absconding bees are usually very defensive and are frequently the cause of stinging incidents.

A bee's stinger is barbed so that when it stings, the stinger, poison sac, surrounding muscles and nerves are torn from its body. Thus, a bee can sting only once, after which it soon dies.

After the bee has departed, the stinger will continue to pump venom until it dries up. An alarm pheromone (odor) is also released that will attract other bees to the area and prompt an aggressive response, thus increasing the chances of additional stinging. The alarm pheromone response is one of the biggest factors in the AHB's excessive stinging characteristic.

Stimuli that have a tendency to increase the defensive behavior of bees include sudden and rapid movements, jarring or bumping hives or frames, vibrations and noise such as operating lawn mowers or tractors, odors (both good and bad), and dark colors. Bees are also more defensive in cooler, cloudy weather.

Several basic differences exist between the activities and habits of temperate honey bees (European strains) and tropical honey bees (the Africanized strain).

The Africanization of the Honey Bee
The Africanized honey bee is simply a hybrid honey bee, a result of breeding the European honey bee, *Apis mellifera mellifera*, with the African honey bee, *Apis mellifera scutellata*. The genetic differences in the hybrid Africanized bee make its habits different from those of the domestic European honey bee cultured in the United States.

Africanization
The AHB is the same species of honey bee commonly cultured for honey and wax production and for pollination services. It is a hybrid resulting from crossing a tropical (African) strain and a temperate (European) strain of honey bee.

These two strains have been isolated genetically for more than 2,000 years. They have been separated environmentally by more than 70 degrees of latitude and geographically by the Sahara Desert. Each strain has developed its own particular habits.

Honey Bee Breeding
For more than 300 years honey bees have been bred in the Americas. Honey bee breeding programs have used genetic material from all over the world, including Africa, but have concentrated mostly on European strains. Desired characteristics include winter hardiness, tendency not to swarm, gentleness, low drone production, and other valuable traits.

The African strain of the honey bee is a tropical bee and has been selected by nature more than by man. African bee strains tend to be more defensive, swarm more often, and don't conform as well to our "*American*" bee management practices.

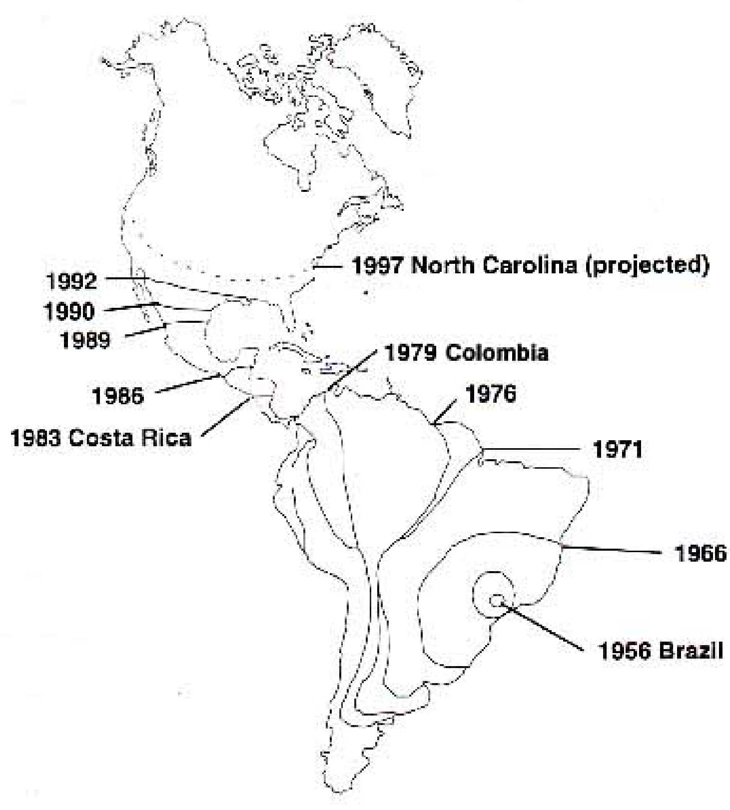
Brazilian Bee Breeding Program

In 1956, a Brazilian researcher went to Africa in search of new genetic material for the Brazilian bee breeding program. Temperate bees do not adapt well to conditions in Brazil, so researchers were looking for a bee that would survive and be more productive in Brazil's tropical climate. A total of 170 African queens were collected and sent to Brazil. Of these, 48 survived the trip and were introduced into colonies at the research station in São Paulo.

In 1957, queen excluders were accidentally removed from the entrances of 26 colonies. These colonies soon swarmed and established feral colonies in the area. The breeding program continued into the 1970s, with African bees and hybrid queens being widely distributed among beekeepers in southern Brazil. Brazilian scientists recognized the problems with the AHB and proposed management practices that would alleviate them. A survey of beekeepers showed that some had quit the business due to difficulties in managing these bees. Among beekeepers remaining in business, there was a preference for the AHB because of its high productivity.

Once released into nature, the AHB spread throughout Brazil by swarming and absconding. It moved south to about 32 degrees latitude. It continued its spread northward, through Central America and Mexico at 200-300 miles a year, reaching Panama in 1980, Mexico in 1985, and the United States in 1990 (Figure 1).

Figure 1. Actual and Projected Range of the Africanized Honey Bee (after Winston, 1992).



In advance of the natural spread of the AHB, numerous "***man-assisted***" swarms were detected in the United States. The man-assisted AHB swarms occurred as early as 1979 and as far north as Baltimore, MD, and Strong Point, NY. Upon detection, these swarms were eliminated, thus preventing the establishment of the AHB in the United States at that time.

Killer Bee

The name "*Killer Bee*" evolved in a unique way. It was first used in 1965 by Time Magazine when recapping a press release from the Brazilian military, which at the time was trying to discredit certain scientists by reporting all stinging incidents, including those from wasps, as due to the AHB. The name caught on and has been used in at least four movies in the United States, including one called "*The Swarm*." Newspapers, television, and radio have used the name in headlines and in bold print.

This has created not only an awareness of the bee but in some instances near hysteria. Mike Allsopp, with the Agricultural Research Council in South Africa, wrote "*In my opinion the entire AHB saga is one dominated by paranoia and misinformation*." Mark Winston, Professor of Biological Sciences at Simon Fraser University and author of Killer Bees, The Africanized Honey Bee in the Americas, in referring to the printed media, books and movies, has written "There is no pretense of accuracy, and imagination has taken over to bring us wildly exaggerated horror stories that play on our innate fear of stinging insects."

Ironically, the paranoia created by misinformation and exaggeration could mask some real problems associated not only with the AHB but also with the EHB, wasps, and other stinging insects.

Guard Bees

Differences between Africanized and European Bees

European honey bees are adapted to seasonal availability of food; Africanized bees are adapted to the tropics, where food is more available year-round. European honey bees make large, fairly permanent colonies; Africanized bees make smaller colonies that reproduce (swarm) often. The table outlines some differences between the two bee types.

European bees usually nest in hollow trees or in wall voids of houses. Africanized bees nest in these places and in unusual places, such as old tires, tin cans, other trash and old underground mouse nests. These types of nest sites increase the chance of human encounters with Africanized bees, especially in urban settings.

Trait	**Africanized**	**European**
open, exposed nests	common	rare
colony population	smaller	larger
colony honey supplies	smaller	larger
tendency to abandon nest	often	rarely
swarming rate	greater	lesser
stinging behavior	intense	moderate
body size	smaller	larger
development time for young	shorter	longer
adult life span	shorter	longer
commercial honey production	poorer	better
commercial pollination	poorer	better

Potential Range of Africanized Bees in the United States
As Africanized bees expand into temperate areas, their tropical adaptations are less advantageous.

For example, experimental Africanized colonies in Germany had higher winter death rates than did European colonies or European X Africanized hybrid colonies. In temperate zones, African- and European-derived bees interbreed with higher frequency, causing "*hybrid zones*," where bees share African and European traits.

In Argentina, Africanized bees dominate in the northern semitropical regions, but European bees dominate in the southern temperate area; in-between, there are hybrid zones where bees have varying degrees of African or European traits. A similar pattern may occur in the United States, with African traits dominating in extreme southern regions.

Mayan bee hives with religious sacrifices and drinking water set especially for the bees. Mayans are master bee keepers.

Understanding Africanized Honey Bees

To understand the threat of Africanized honey bees, it is necessary to know something in general about honey bees and their behavior. Honey bees are important beneficial insects and we would be in big trouble if they were all suddenly destroyed. Unless a honey bee colony is in a location that is close to people, pets or farm animals, it should be left alone.

AHBs were brought to Brazil in the 1950's for testing as possible alternative pollinators and honey producers because of their reputation of being hardy in tropical environments. At the time, their defensive nature and ability to reproduce in greater numbers was not well understood. Some were accidentally released and have spread throughout South and Central America, Mexico and the southern US. Both European and Africanized queens are responsible for reproduction in their colonies. Their drones mate with the queens, while the workers, which are sterile females, collect nectar and pollen and defend the colony. The Africanized honey bee is simply a hybrid honey bee, a result of breeding the European honey bee, *Apis mellifera mellifera*, with the African honey bee, *Apis mellifera scutellata*. The genetic differences in the hybrid Africanized bee make its habits different from those of the domestic European honey bee cultured in the United States.

Barbed Stingers
European and Africanized workers have barbed stingers. When either type of bee stings a human, it leaves both the stinger and tiny, attached venom sac. This causes the bee to die soon after. If you are stung, simply scrape the stinger out to remove it.

AHB Venom
The venom of an AHB is no more poisonous than that of their European counterparts. However, they are more defensive if provoked. The stinging response of AHBs is 10 times greater than that of European honey bees. Vibrations from motors, such as a power lawn mower or weed whacker, particularly seem to disturb them. When provoked, the bees will wander as far as a quarter mile from their nest to chase an intruder.

However, individual AHBs on foraging trips for nectar and pollen are no more likely to sting than our European honey bees - they are not wanton killers.

Africanized honey bees tend to colonize large areas and swarm excessively. Also, the bees will leave the colony completely and move to a new location when conditions in the environment do not suit them - a special trait known as "absconding." Africanized honey bees may abscond on flights of several miles.

The behavior- not the appearance - of the AHB is different from the EHB in four major ways:

- ✓ The AHB swarms much more frequently than other honey bees. A colony is a group of bees with comb and brood. The colony may either be managed (white hive boxes maintained by professional beekeepers) or wild (feral).
- ✓ A group of bees that are in the process of leaving their parent colony and starting a nest in a new location is called a "swarm." Usually a new queen is reared to stay with the parent colony and the old queen flies off with the swarm. Scout bees often locate potential nest sites prior to swarming, but the swarm may spend a day or two clustered in impressive, hanging clumps on branches or in other temporary locations until the bees settle on a new nesting site. If they can't find a suitable location, the bees may fly several miles and cluster again.

EHB Hive will Swarm
Typically an EHB hive will swarm once every 12 months. However, the AHB may swarm as often as every six weeks and can produce a couple of separate swarms each time. This is important for you to know, because if the AHB swarms more often, the likelihood of your encountering an AHB swarm increases significantly. Regardless of myths to the contrary, Africanized honey bees do not fly out in angry swarms to randomly attack unlucky victims.

However, the AHB can become highly defensive in order to protect their hive, or home. Again, it is now better to consistently exercise caution with respect to all bee activity. So keep your distance from any swarm of bees.

The AHB is far less selective about what it calls home. The AHB will occupy a much smaller space than the EHB. Known AHB nesting locations include water meter boxes, metal utility poles, cement blocks, junk piles, and house eaves. Other potential nesting sites include overturned flower pots, old tires, mobile home skirts, and abandoned structures. Holes in the ground and tree limbs, mail boxes, even an empty soda pop, can could be viewed as "home" to the AHB.

Home Turf

The Africanized honey bee is extremely protective of their hive and brood. The AHB's definition of their "home turf" is also much larger than the European honey bee. So, try to allow ample physical distance between the hive. At least 100 feet, or the width of a four-lane highway, is a good distance. The best advice is that if you see a bee hive, start moving away immediately.

Impact on Pollination and Honey

European honey bees that interbreed with AHBs may become harder to manage as pollinators and may produce less honey. This is an important consideration when each year honey bees add at least $10 billion to the value of more than 90 crops in this country. They also produce about $150 million worth of honey each year.

The African bee issue and the disappearance of managed honey bees are unrelated as far as most experts are concerned. This means that eradicating one wild honey bee nest in Florida does nothing to hurt honey bee populations overall. In fact, there can be as many as 100-200 bee colonies per square mile in areas where African bees occur. Removing 1 colony does very little to the overall population of wild bees. It's simply a public safety issue.

What is a Honey Bee?

- ✓ Honey bees are not native to the North America.
- ✓ Honey bees currently pollinate about 90 agricultural crops (accounting for 80% of the pollination in the US): ~ $10 billion pollination business, $150 million honey industry.
- ✓ Bees forage over large expanses of area: 8,000-25,000 acres.
- ✓ US honey bees originated in Europe (European honey bees = EHB) and were brought to the US to pollinate insect-pollinated crops originating in Old World countries.
- ✓ EHB (Apis mellifera mellifera) were also imported in the 1660-1700s to make candles used by emerging churches.
- ✓ Honey bees are not likely to sting when foraging for nectar and pollen in the back yard.
- ✓ Honey bees are not likely to sting when swarming (looking for a new home).
- ✓ Honey bees are most docile when carrying out their daily chores.
- ✓ Honey bees are most likely to sting when their home (the hive) is threatened or they are accidentally crushed.
- ✓ Honey bees swarm (move in large numbers to establish new hives) in spring and fall and are most likely to be aggressive in those seasons.
- ✓ Honey bees sting to protect their hive but each bee can sting only once, and then it dies.
- ✓ Stings are usually not serious unless there are an large number of them or you are systemically allergic to the venom.

What is an Africanized Honey Bee?

- ✓ In 1957, honey bees (Apis mellifera scutellata) were imported from Africa to Brazil African bees escaped and became feral (wild).
- ✓ As feral African bees mated with EHBs they produced a hybrid called an "Africanized honey bee" (AHB).
- ✓ AHBs look like European bees to the eye.
- ✓ They are, on average, slightly smaller than EHBs, but can only be separated by molecular techniques or morphometric computer analysis.
- ✓ Since 1990, only 8 fatalities in the US have been caused by honey bees, as compared to 78 killed by dogs. The chances of being killed by honey bees are less than the chances of being hit by lightning.
- ✓ Africanized honey bees are less fussy in their choice of nesting sites: building nests in the ground, in tree cavities, in the walls of a home, and where ever they find a small hole through which to enter.
- ✓ Africanized honey bees will "abscond" (leave a location when conditions are not suitable) more often than European honey bees.
- ✓ The impulse to sting in AHBs is 10 X greater than that of European honey bees, and attacks last longer and involve more bees.
- ✓ AHBs have been known to follow victims as much as a 1/4 of a mile from the hive whereas EHBs will pursue only about 50 yards.
- ✓ AHB venon is same chemical found in EHBs.
- ✓ AHB have been moving north from S. Am at a rate of 100-300 mi/yr.
- ✓ Once disturbed AHBs may remain aggressive for as long as 24 hours.
- ✓ The "killer bee" reputation of AHBs is highly exaggerated, AHB do not hunt for people to attack and they do not attack unless they feel threatened.

What Causes an AHB Stinging Incident?

- ✓ Load noise.
- ✓ Vibrations of equipment, lawn mowers, moving vehicles etc., even up to 100' or more from a hive.
- ✓ Pedestrian activity up to 50' from the hive: the hive does not have to be touched to provoke AHBs.
- ✓ Animal breath attracts bees to the face. Animals (e.g. horses) that cannot breath through their mouths are vulnerable to suffocation if stings cause swelling of the nasal passages.
- ✓ Smaller pets and small children are more impacted. On average, 8-10stings/# body weight can be lethal. (80# child =800 stings; 200# adult = 2000 stings). 100 stings is considered to be potentially life threatening.
- ✓ AHBs are attracted to hair, dark colors, new mown grass, citrus-scented candles and perfume

How to Prevent a Stinging Incident?

Bees need two basic things to colonize your property: water and a place to build a hive. Prevent access to these where possible.

- ✓ Repair dripping leaks in and around the yard and in irrigation systems.
- ✓ Be alert for the presence of colonizing bees around the home.
- ✓ Listen for bees in walls and abandoned building before approaching.
- ✓ Patrol yards periodically to look for signs of bee colonies. Colonies can set up residence in as little as 24-48 hours.
- ✓ Prevent bees from colonizing the yard or home: fill cracks in the house, remove refuse(bees can establish in discarded cans), discard used tires, plug holes in open pipes and swing sets, move abandoned vehicles, check stock tanks and irrigation pump housings.
- ✓ Properly cover chimney openings.
- ✓ Place screens over drains, attic vents, irrigation control boxes etc.
- ✓ Close and lock doors to sheds and out buildings.
- ✓ Education is central to the issue. South Americans have lived with AHB for decades with a minimum of impact. Teach children and others respect for, and avoidance of,honeybees.

Who is Most Vulnerable?
Those that are allergic to bee stings. Only about ~1% of the population has a systemic allergy to bee stings. Symptoms: within 20 min tongue or throat swell, hives may develop, dizziness may occur and there may be difficulty breathing or loss of consciousness.

- ✓ Pets which are tied so they cannot exit the area.

What To Do When a Stinging Incident Occurs?
Remember that "ACE" is the best action (Alert, Cover, Exit)

Alert = Warn others in the area to flee

Cover = cover your head, pull a shirt over your face. Stings to the head and neck are more dangerous than those to the body.

Exit the area. Get into a car or a house immediately. If bees follow, tolerating those stings is preferable to trying to swat bees away from an open doorway.

- ✓ Stingers are left in the skin by the bees after an attack and continue to deliver venom (for up to 10 min.) due to attached pulsating muscles of the stinger. When the situation has stabilized, remove the stingers as quickly as possible by scraping, do not remove with forceps.
- ✓ Above all, stay calm. Fear can cause accidents if bees get in cars or clothing.
- ✓ If you observe a serious stinging incident call 911.
- ✓ Bee attacks can disorient and if you attempt to aid an attack victim protect yourself first then shout them toward you and lead them to safety.
- ✓ If a pet is involved seek veterinary attention for your pet.
- ✓ If you are seriously stung seek medical attention.
- ✓ If you are allergic carry a bee sting kit prescribed by your personal physician.
- ✓

What not to do

- ✓ Don't tie or pen animals near bee hives as they will have nowhere to go if stung.
- ✓ Do not try to remove bee hives yourself if you find them. Fire departments, bee keepers and pest management operators are best equipped to remove bee colonies.
- ✓ Do not try to fog or spray colonies with insects bombs or sprays.
- ✓ Do not swat at bees. Swatting bees causes the release of an alarm signal and only increases the intensity of an attack by stimulating other bees to attack.
- ✓ Do not count on insect repellents and sprayed on the skin to deter bees.
- ✓ Do not provoke bees by spraying the hive with a garden hose.
- ✓ Don't place certain veterinary salves and creams on your pet. Some are made with bees wax and can increase the severity of AHB attacks to pets and livestock. Check with your vet before using salves and creams.
- ✓ Don't use meat tenderizer on bee-sting wounds, as this could lead to a secondary infection.
- ✓ Do not hike with your dog off-leash, if the dog encounters a hive and provoke the bees it may bring the attackers back to you.

Characteristics of the AHB Summary

A number of specific behavioral characteristics have been identified in the AHB.

Aggressive Hive Defense and Stinging

Although the AHB does not attack unprovoked, it is very defensive of its colony. When compared to the EHB, it is much easier to provoke. The AHB responds quicker and in larger numbers when its colony is threatened. Also, once provoked, the AHB remains agitated for a longer period of time than does the EHB. Disturbing an AHB colony may result in 6-10 times as many stings as European bees inflict. This phenomenon is attributed to the AHB's more acute sensitivity and response to the "*alarm pheromone*," a chemical odor that is released after stinging is initiated.

Excessive Swarming

The AHB will swarm more frequently than the EHB. Typically, an EHB colony swarms once every year or two; an AHB colony may swarm 4-8 times a year. Generally, an AHB swarm is much smaller than an EHB swarm; some aren't much larger than a coffee cup.

Swarming reduces the number of bees in a colony, thus reducing the work force, resulting in diminished honey production. Management practices directed at reducing swarming, such as dividing large colonies into smaller colonies and frequent harvesting of honey, add costs for beekeepers.

Excessive Absconding

While absconding is rare in the EHB, it's rather common with the AHB. Absconding not only results in loss of a managed colony but adds to the feral population competing with managed bees for nectar and pollen.

Selection of Nesting Site

EHBs are very particular in selecting nesting sites. They prefer hollow trees, wall voids or other cavities (about 10 gallons in size) well above the ground that are clean and dry. The AHB will nest almost anyplace that is protected from the weather. Selected sites are often much smaller, closer to the ground, and may not be as protected from the elements. This lack of selectivity is thought by some to be due to greater competition resulting from the larger number of AHB swarms.

Reproductive Capacity
Compared with the EHB, the AHB devotes a greater percentage of its nest to brood production and less to honey storage. Because the developmental period of the AHB is shorter than that of the EHB, it's able to produce more bees in less time.

Number of Feral Colonies
In areas where the AHB has become established, a noticeable increase in the number of feral honey bee colonies occurs. This is generally thought to be the result of higher reproductive capacity, increased swarming rate, and tendency to abscond. However, in much of the area where the AHB is now established, feral colonies were extremely rare, probably because the EHBs were not adapted to the tropical climate. This marked increase of feral colonies may not be as great in an area where feral bees are common.

Robbing
Robbing is a type of foraging behavior where bees take honey from other bee colonies. This often occurs when nectar is scarce or unavailable, or when some colonies are weak and others are strong. Robbing weakens colonies and may spread diseases and parasites.

Winter Survival
Since the AHB is tropical in nature, it may not be able to regulate its body temperature as efficiently as the EHB. Studies indicate that the AHB does not form as efficient a cluster during cold weather as the EHB.

Colony Takeover
Many researchers have reported that AHB swarms often take over EHB colonies, particularly colonies which do not have functional queens. However, EHB swarms will do the same. The importance of such takeovers is questionable. Work by researchers at the University of Georgia suggests that hive takeovers are a minor problem.

Mating Advantage
An AHB colony produces more drones than an EHB colony of equal size. In areas where the AHB has become established, the EHB queens appear to mate with AHB drones at a much higher frequency than with EHB drones. Similar behavior in areas where large numbers of EHB colonies are maintained is being studied.

Identification
Identifying the different races of honey bees and their hybrids is very difficult. The characteristics used for identification differ only slightly and overlap considerably among individuals. Accurate identification is not only difficult but time-consuming and expensive.

Rapid and accurate identification of AHB and EHB strains is very important for monitoring the presence and spread of bees through an area. This element is essential in implementing regulatory and management actions involving AHBs. Several techniques have been used to identify AHB, though none are 100 percent effective.

They include:

1. **Morphometrics:** This technique utilizes precise measurements of specific body parts. Computer-assisted measurements are made of 25 characters on 10 bees. An average is determined and used to distinguish the EHB from the AHB. Variations of this technique include the Fast Africanized Bee Identification System (FABIS), in which only three characters are measured. The FABIS II technique uses seven measurements.

2. **ELISA Procedure for AHB Proteins:** The ELISA procedure for identifying the AHB uses electrophoresis and isoelectric focusing to identify specific proteins unique to the AHB. About 90 percent of all AHB contain at least one of these proteins. A sample of three bees can provide an accuracy of 99.9 percent.

3. **DNA Analysis:** DNA contains the molecular code for genetically inherited characters. Bee DNA can be extracted and used to identify the AHB.

4. **Other Sources:** Other techniques for identifying different strains of the honey bee include cuticular hydrocarbons, flow cytometry, and the use of a portable audiometer.

Monitoring the Natural Dispersion of the AHB with Pheromone Traps
The northward movement of the AHB has been monitored through South and Central America and through Mexico, into Texas and other areas of the U.S. By examining samples of bees taken from pheromone traps, from feral swarms, and from feral colonies, scientists have been able to trace the movement of the AHB. At present, two national agencies monitor AHB populations in the U.S.:

1. The Animal and Plant Health Inspection Service (APHIS), of the USDA.

2. The Agricultural Research Service (ARS), of the USDA.

Social insects: Insects that live in a family society, with parents and offspring sharing a common dwelling place and exhibiting some degree of mutual cooperation; e.g., honey bees, ants, termites.

Carl Hayden Bee Research Center

The Carl Hayden Bee Research Center is the USDA-ARS laboratory for the identification of African honey bee samples. Identifications are made using morphometrics - a system of measuring morphological characteristics to determine honey bee type. The CHBRC laboratory analyzes samples nationwide in an effort to provide vital information on the migration of Africanized honey bees.

Sending honey bee samples for Morphometric analysis:
1. Samples will first be analyzed using FABIS (Fast Africanized Bee Identification System). This is a preliminary procedure to determine honey bee type. If the sample has been identified as African using the FABIS method, a full morphometrics analysis may be performed.

2. Please send a sample of 30 to 50 bees in a tightly sealed jar or vial with enough alcohol (ethanol) to cover all of the bees.

3. If you have questions, please contact Mona Chambers by phone at the number given below or from our email contact page. Otherwise, send your samples to:
Mona Chambers
Carl Hayden Bee Research Center
2000 E. Allen Rd.
Tucson, AZ 85719
Phone: (520) 670-6380 ext. 105

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Topic 1 Bee Introduction Post Quiz
Answers at rear of Glossary
Fill-In-the-blank

Summary
1. Africanized honey bees (*Apis mellifera scutellata*) and European honey bees (*Apis m. mellifera*) are the same species - they look the same, sting in defense of themselves or their nest, can only sting once, and have the same ______________.

Genus Apis
2. Honey bees (or honeybees) are a subset of bees in the genus_______________, primarily distinguished by the production and storage of honey and the construction of perennial, colonial nests out of wax. Honey bees are the only extant members of the tribe Apini, all in the genus Apis.

Micrapis
3. Apis florea and Apis andreniformis are small honey bees of southern and southeastern Asia. They make very small, exposed nests in trees and shrubs. Their stings are ______________of penetrating human skin, so the hive and swarms can be handled with minimal protection.

European/Western/Common Honey Bee
4. Apis mellifera, the most commonly domesticated species, was the third insect to have its genome mapped. It seems to have originated in ______________and spread from there to Northern Europe and eastwards into Asia to the Tien Shan range.

Age Levels of Bees Correlated With Work Habits
5. The honey bee is adaptable to_______________.

6. The Africanized honey bee is extremely protective of their hive and brood. The AHB's definition of their "home turf" is also much larger than the European honey bee. So, try to allow ample physical distance between the hive. At least______________, or the width of a four-lane highway, is a good distance. The best advice is that if you see a bee hive, start moving away immediately.

The Waggle Dance
7. The "__________________" is used to relay information about more distant food sources. In order to do this, the dancing bee moves forward a certain distance on the vertically hanging honeycomb in the hive, then traces a half circle to return to her starting point, whereupon the dance begins again.

Absconding
8. Absconding is a behavioral trait of____________. It is much more common in the AHB than in the EHB. Absconding occurs when all the adult bees, including the queen, workers and drones, leave the old nest and relocate to a new site.

Defensive Behavior
9. Stinging is a defensive behavior. Virtually all defensive behavior is in the immediate vicinity of the hive. Away from the hive, bees literally have to be forced to sting. Swarming bees are rarely defensive and do not sting unless provoked. However, "________________" or absconding bees are usually very defensive and are frequently the cause of stinging incidents.

Africanization

10. The AHB is the same species of honey bee commonly cultured for honey and wax production and for pollination services. It is a _______________resulting from crossing a tropical (African) strain and a temperate (European) strain of honey bee.

Topic 2 Bees and Related Bee-Like Insects

Halictid Bees - Family Halictidae

Order Hymenoptera / Suborder Apocrita -- abeilles, ants, bees, fourmis, guêpes véritables, narrow-waisted hymenopterans, true wasps. Infraorder Aculeata / Superfamily Apoidea -- bees / Family Halictidae -- halictid bees, sweat bees.

Agapostemon splendens

Sweat bee is the common name for any bees that are attracted to the salt in human perspiration. Sweat bees, which are important native pollinators in the Northern Hemisphere, where there are about 1,000 species.

Mostly seen hovering bushes and flowers. In its strict application, the name refers to members of the Halictidae, a large family of bees that are common in most of the world except Australia and Southeast Asia, where they are only a minor faunistic element. In the USA, the common species are black, brown, red, or metallic green, and sometimes with yellow markings, and usually 1/4 to 1/2 inch (4-10 mm) in size. Their attraction to sweat makes them a nuisance, as they will sting if squeezed or squashed against one's flesh. Their sting is only rated a 1.0 on the Schmidt Sting Pain Index, which is relatively harmless. However, individuals with allergies to any kind of insect should seek immediate medical attention. Pest control is not recommended due to their beneficial nature in pollination.

As with many common names, however, the term "sweat bee" is applied colloquially to different insects in different continents, despite its technical restriction to halictids. Thus, in Africa and parts of Southeast Asia, the colloquial name is used to refer to what are technically known as Stingless Bees, which are typically in the genus Trigona and its relatives (family Apidae), and also have the habit of taking up salt from human perspiration. The Western honey bee, Apis mellifera also occasionally laps human perspiration, as will other bees upon occasion.

Identifying characteristics for the family Halictidae include:
As in other families of the superfamily Apoidea, members of the family Halictidae have:

- ✓ a collar-like pronotum without projections that reach the tegulae,
- ✓ body hairs that are branched or plumose, and
- ✓ first segment of the metatarsus often enlarged and flattened.
- ✓ 1 sub-antennal suture (andrenid bees have 2).
- ✓ Front wing with basal vein strongly arched.

- ✓ Hind wing with jugal lobe longer than the sub-median cell.
- ✓ Thorax of some species metallic green like the chrysidid wasps, but halictids lack the sculptured cuticle and the ability to curl.

In many species, the tongue is long and pointed, adapted for probing into flowers. All bees are covered with hair, to which pollen sticks when flowers are visited; most female bees have apparatus for gathering this pollen; it is combed into a special basket or brush located on the hind legs. Males do not collect pollen and lack these structures. There are a few species, especially the parasitic bees that have no pollen baskets.

Green Bee, Family Halictidae

Most bees are solitary -- each female constructing a nesting tunnel underground or in plant materials. She stocks the brood cells with pollen and nectar for the larvae to eat after hatching.

Honey bees and bumblebees, however, are social insects -- They live in colonies consisting of a fertile queen, sterile female worker bees, and male bees (drones). These are the only bees known to produce honey, and they are the only bees which will sting readily in defense of their colonies.

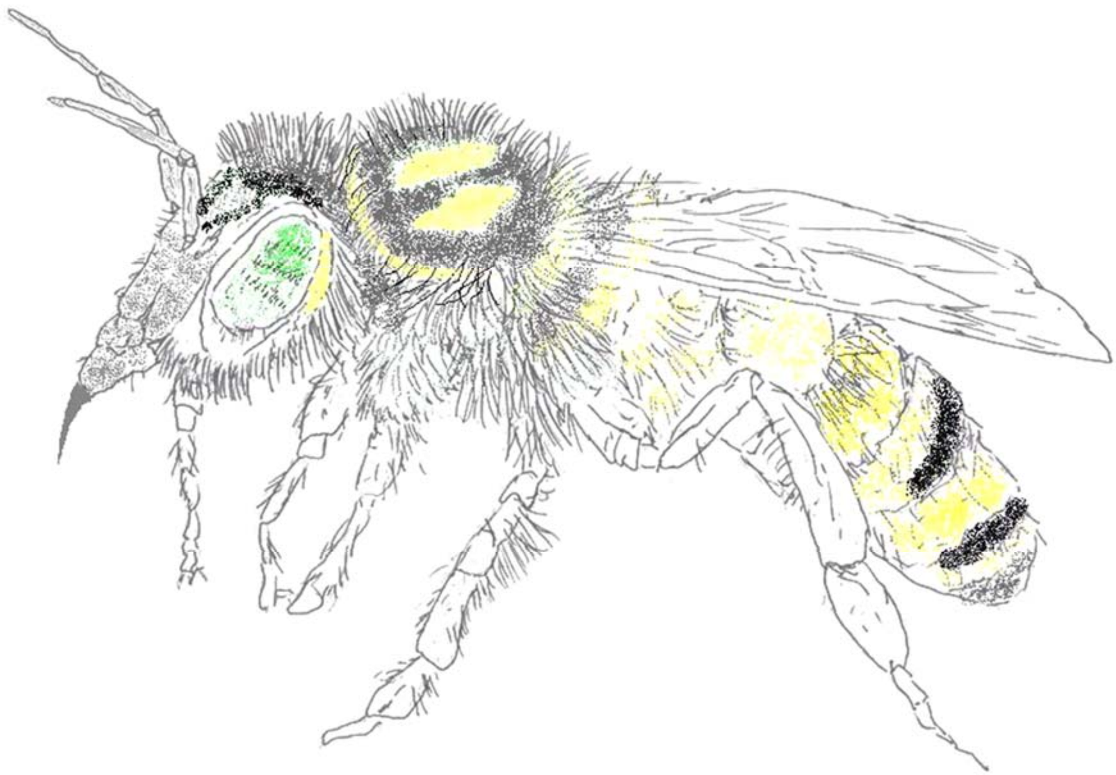
MASON BEE

Mason Bee
Smaller than a honeybee, mason bees resemble house flies more than honey bees. They are deep blue-black in color and have no stripes. Mason bees are native to North America. They are active pollinators between cherry blossom and apple blossom season, and then die out by summer. Attract mason bees by providing them a home. Drill holes exactly 5/16-inch in diameter into wooden blocks and mount the blocks by cherry blossom season facing morning sun.

Species of the genus include the orchard mason bee, Osmia lignaria, the blueberry bee, O. ribifloris, and the hornfaced bee, O. cornifrons. The former two are native to the Americas and the latter to Japan, although O. lignaria and O. cornifrons have been moved from their native ranges for commercial purposes. The Red mason bee, Osmia rufa, is found across the European continent.

There are over 300 species across the Northern Hemisphere, and more than 130 species of mason bees in North America; most occur in the temperate regions, and are active from spring through late summer.

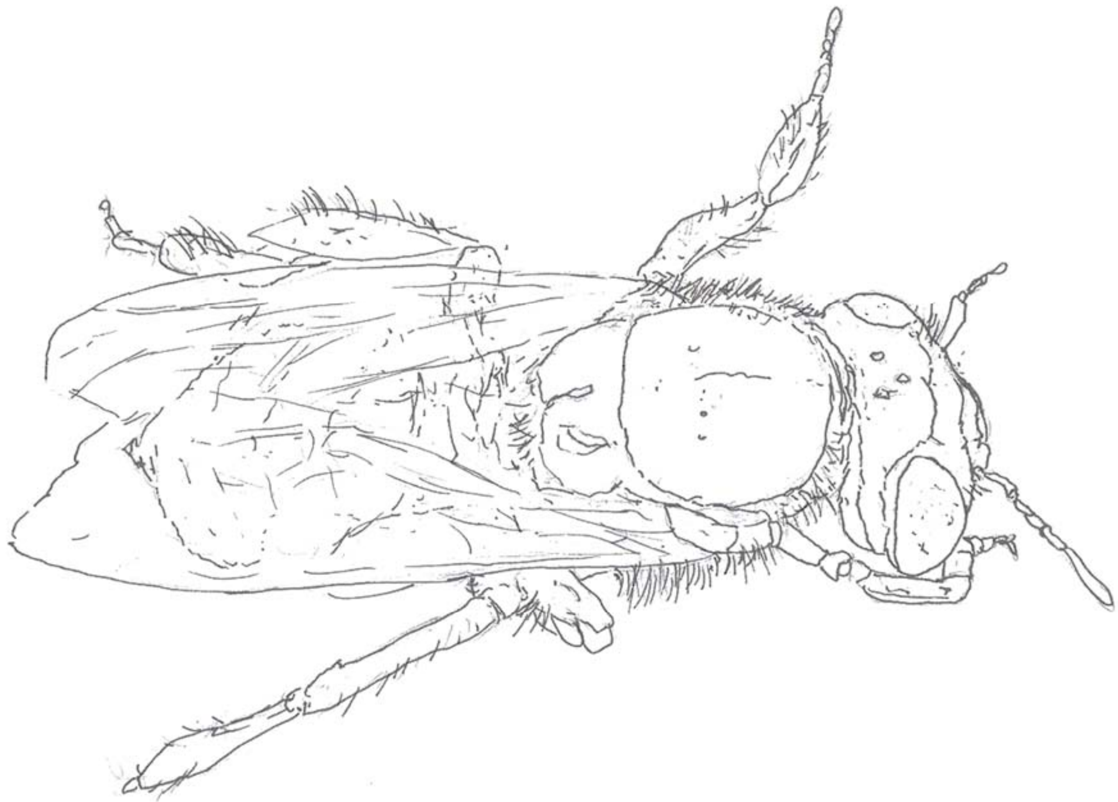
Osmia species are usually metallic green or blue, though many are blackish. Most have black ventral scopae which are difficult to notice unless laden with pollen. They have arolia between their claws unlike Megachile or Anthidium species.



Orchard Bee Not to be confused with Orchid Bee See Mason Bee

Osmia lignaria, commonly known as the **orchard mason bee** or **blue orchard bee**, is a megachilid bee that makes nests in reeds and natural holes, creating individual cells for their brood that are separated by mud dividers. They are unlike carpenter bees in that they cannot drill holes in wood. *O. lignaria* is a common species used for early spring fruit bloom in Japan, Canada, and the United States, though a number of species of other *Osmia* are cultured for use in pollination.

Orchard mason bees, like all mason bees, are very shy and will only sting if the bee believes it is in serious danger. It will not attack to defend itself. The stinger itself is actually an egg guide.



ORCHID BEE

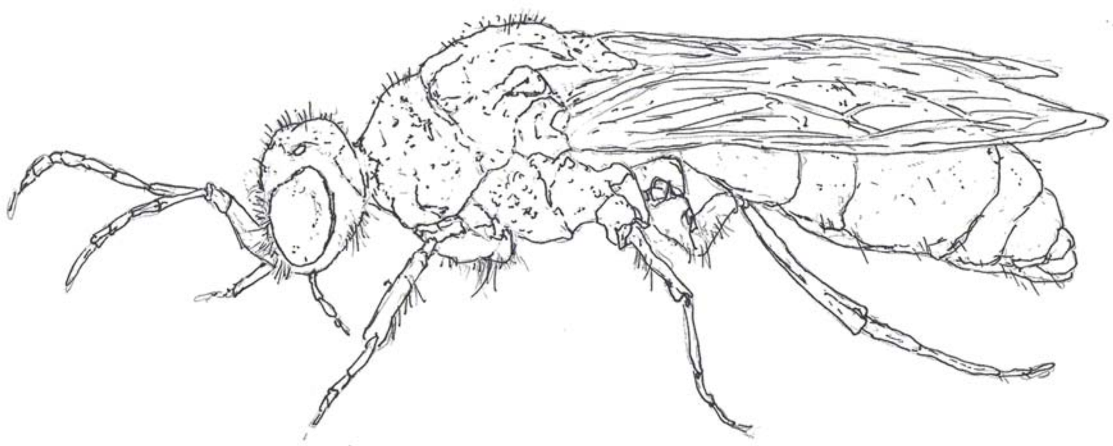
Orchid Bee Not to be confused with Orchard Bee
Male orchid bees have uniquely modified legs which are used to collect and store different volatile compounds (often esters) throughout their lives, primarily from orchids in the sub-tribes Stanhopeinae and Catasetinae, where all species are exclusively pollinated by euglossine males. These orchids do not produce nectar, and hide the pollen on a single anther under an anther cap; they are not visited by females. The whole pollinarium becomes attached to the male as it leaves the flower. Several flowers from other plant families are also visited by the bees: *Spathiphyllum* and *Anthurium* (Araceae), *Drymonia* and *Gloxinia* (Gesneriaceae), *Cyphomandra* (Solanaceae), and *Dalechampia* (Euphorbiaceae) contain one or more species that attract male euglossines.

The chemicals are picked up using special brushes on the forelegs, transferred from there by rubbing the brushes against combs on the middle legs, and finally these combs are pressed into grooves on the dorsal edge of the hind legs, squeezing the chemicals past the waxy hairs which block the opening of the groove, and into a sponge-like cavity inside the hind tibia.

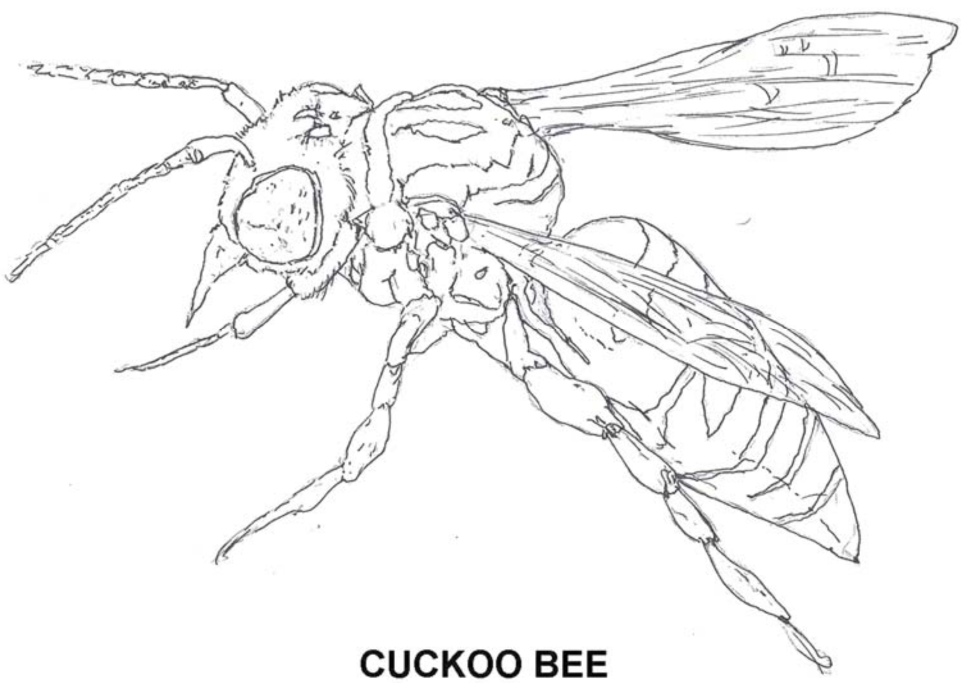
The accumulated "fragrances" are evidently released by the males at their display sites in the forest understory, where matings are known to take place. Although the accumulated volatiles have long been believed to serve as a signal to females, female attraction to male odors has never been demonstrated in behavioral experiments. The behavior of volatile collection is essentially unique in the animal kingdom. Single synthetic compounds are commonly used as bait to attract and collect males for study, and include many familiar flavorings and odors considered appealing to humans (e.g., methyl salicylate, eugenol, cineole, benzyl acetate, methyl benzoate, methyl cinnamate), and others which are not (e.g., skatole).

Neotropical orchids themselves often exhibit elaborate adaptations involving highly specific placement of pollen packets (pollinia) on the bodies of the male orchid bees; the specificity of their placement ensures that cross-pollination only occurs between orchids of the same species.

Different orchid bee males are attracted to different chemicals, so there is also some specificity regarding which orchid bees visit which types of orchid. Not all orchids utilize euglossines as pollen vectors, of course; among the other types of insects exploited are other types of bees, wasps, flies, ants, and moths. The male *Eufriesea purpurata* is highly unusual in actively collecting the insecticide DDT in huge amounts from houses in Brazil, without suffering any harm from it.



BLUE ORCHID BEE



CUCKOO BEE

Cuckoo Bee
Cuckoo Bees are parasites, in that the female cuckoo bee lays her eggs in the nest of other bees, primarily digger bees and Andrenids. Cuckoos are also said to be kleptoparasites, stealing honey and pollen collected by others. Cuckoo bees lack any pollen-transporting apparatus (the scopa). Look for cuckoo bees flying low over the ground and foliage, hunting for foraging and nesting potential victims.

There is also a family of cuckoo wasps which lay their eggs in the nests of potter and mud dauber wasps; many types of wasps in various families have evolved similar habits. These insects are normally referred to as "kleptoparasites," rather than "brood parasites." The distinction is that the term "brood parasite" is generally restricted to cases where the immature parasite is fed directly by the adult of the host, and raised as the host's offspring (as is common in cuckoo birds). Such cases are virtually unknown in bees and wasps, which tend to provide all of the food for the larva before the egg is laid; in only a few exceptional cases (such as parasitic bumblebees) will a bee or wasp female actively feed a larva that is not her own species. The difference is only in the nature of the interaction by which the transfer of resources occurs (tricking a host into handing over food rather than stealing it by force or stealth), which is why brood parasitism is considered a special form of kleptoparasitism.

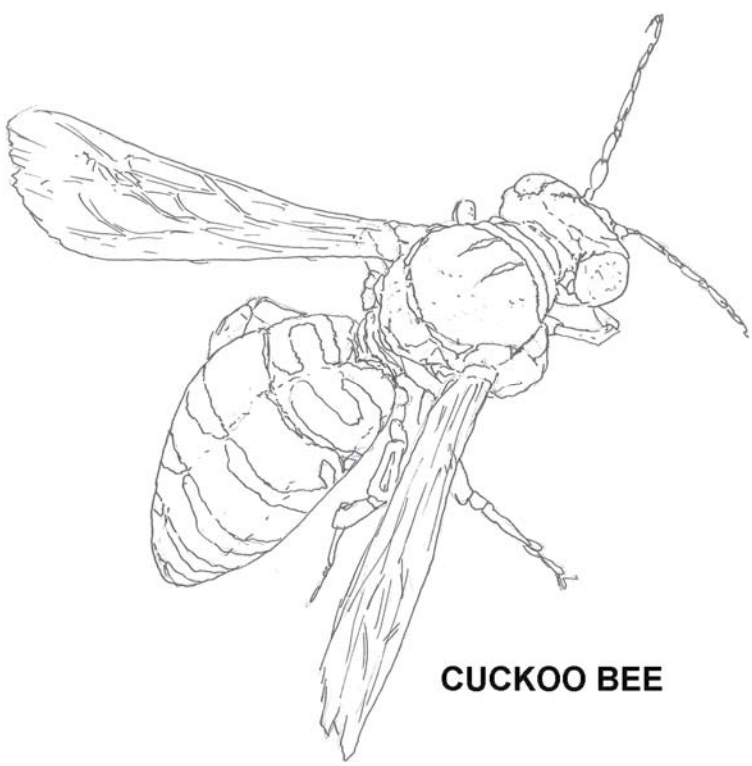
The term **cuckoo bee** is used for a variety of different bee lineages which have evolved the kleptoparasitic habit of laying their eggs in the nests of other bees, reminiscent of the behavior of cuckoo birds. The name is technically best applied to the apid subfamily Nomadinae. Females of cuckoo bees can be easily recognized in almost all cases, as they lack pollen collecting structures (the scopa) and do not construct their own nests.

They often have reduced body hair, abnormally thick and/or heavily sculptured exoskeleton, and saber-like mandibles, though this is not universally true, and other less visible changes are common, as well. They typically enter the nests of pollen-collecting species, and lay their eggs in cells provisioned by the host bee. When the cuckoo bee larva hatches it consumes the host larva's pollen ball, and, if the female cleptoparasite has not already done so, kills and eats the host larva.

In a few cases where the hosts are social species (e.g., the subgenus *Psithyrus* of the genus *Bombus*, which are parasitic bumble bees that infiltrate nests of non-parasitic species of *Bombus*), the cleptoparasite remains in the host nest and lays many eggs, sometimes even killing the host queen and replacing her - such species are often called **social parasites**, though a few of them are also what are referred to as "brood parasites."

Many cuckoo bees are closely related to their hosts, and may bear similarities in appearance reflecting this relationship. This common pattern gave rise to the ecological principle known as "Emery's Rule". Others parasitize bees in different families, like *Townsendiella*, a nomadine apid, one species of which is a cleptoparasite of the melittid genus *Hesperapis*, while the other species in the same genus attack halictid bees.

The number of times cleptoparasitic behavior has independently evolved within the bees is remarkable; C. D. Michener (2000) lists 16 lineages in which parasitism of social species has evolved (mostly in the family Apidae), and 31 lineages parasitizing solitary hosts (mostly in Apidae, Megachilidae, and Halictidae), collectively representing several thousand species, and therefore a very large proportion of overall bee diversity. There are no cuckoo bees in the families' Andrenidae, Melittidae, or Stenotritidae, and possibly the Colletidae (there are only unconfirmed suspicions that one group of Hawaiian hylaeine species may be parasitic).



CUCKOO BEE

Carpenter Bees
Male carpenter bees are solid black, they also cannot sting. The females are tan in color and sting quite well. Carpenter bees are sometimes mistaken for bumblebees, however carpenter bees are shiny with less hair. Their flight is faster than a bumblebee’s, and is also a more jerky flight, very similar to a hummingbird.

Carpenter bees are solitary bees burrowing holes the size of a dime or penny into wood patio covers, eaves, and other places. Average size is one inch in length.

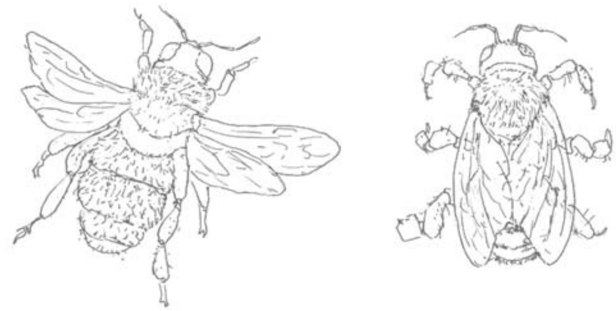
Mining Bees
Several of the more distinctive mining bees are from the large family Andreninae. These fascinating little bees are sexually dimorphic and many species are quite difficult to identify. Often the smaller honeybees are mining bees. They are not to be confused with ‘Digger Bees’, although most species of both types of bees make their nests underground. They actually belong to different families of bees: Andrena belonging to the family ‘Andrenidae' whilst digger bees (actually the genus 'Anthophorini') are part of the ‘Apidae' family, along with bumblebees and honey bees.

Mason Bee

This example of a mason bee is approximately a quarter size of a normal honey bee. There are several species and several color variations. This mason bee looks very similar to a honeybee. Some people call these creatures, “Tiny Honeybees”.

Bumble Bee or Carpenter Bee?

When encountering black, almost round bees buzzing around their home most people do not know the difference between the bumble bee and carpenter bee. There are two basic things to note that should quickly let you know which bee you are seeing: location and activity of the bee and certain physical characteristics of the bee.



BUMBLE BEE   CARPENTER BEE

Carpenter bees are most often noticed while they are building and tending to their nests which are simple, round openings in wood structures. If you see a bee that is boring out a perfectly round hole in wood, it is a carpenter bee. Bumble bees have a fuzzy abdomen and the Carpenter Bee has a shiny abdomen.

General Bumble Bee Information
The "Bumble Bee" is a big, hairy, black and yellow bee whose size can range from 3/4 inch to 1 1/2 inch. This insect is often mistaken for a carpenter bee, which closely resembles the bumble bee in appearance. Carpenter bees have a shiny and smooth abdomen as opposed to the fuzzy abdomen seen on a bumble bee. There are over 200 types of Bumble bees in the world. Fifty different types can be found in North America. Each different species will have its own preference to types of nectar and prefers different flowers.

The bumble bee is an important, beneficial insect. They pollinate plants and flowers as they forage for food. To gardeners, it is a welcome sight to see these large, flying insects carrying large loads of pollen, flying into and around their flower beds and gardens. While busy searching for food (and at the same time, pollinating plants) bumble bees are rarely a problem when in close proximity to humans. They will actually (in most cases) go out of their way to avoid human contact. Bumble bees will, however, defend themselves if they sense that they are cornered and cannot escape. Most of the time they will fly away from danger but will sting if they are under duress.

Bumble bees have very few predators in nature. Skunks are their largest and most destructive predator. Skunks are omnivores that will eat insects, rodents, reptiles, small mammals, worms, eggs, fish, fruit, and plants. When they locate a bumble bee nest, skunks help themselves to bee larvae and adult insects. They ignore the pain of bee stings to get to their preferred foods.

Queen Bumble Bee
The queen bumble bee comes out of hibernation every spring to find a new spot to build her nest and start a new colony. The queen bee is fertilized the previous season and has managed to live through the winter months. The same nesting spots (from previous seasons) are rarely used. A suitable place for nesting is usually on the ground, beneath a flat object. An old mouse hole or similar hole in the ground is preferred if it is underneath an old tarp, flat stone or man-made objects such as a deck. The hole chosen by the queen bee is first padded by pieces of vegetation such as dry grass or moss.

It is in this padded underground hole that the fertilized queen bumble bee lays her eggs and begins collecting nectar for her soon to hatch grubs. Once the grubs emerge from their eggs, the queen bumble bee spins a protective silk cocoon for each grub. It is from this first batch of larvae that 5 to 20 daughters emerge. These daughters of the queen bumble bee are workers who immediately start working on building the colony.

The queen bee will continue to lay eggs for the remainder of the summer season. The workers work tirelessly to build the colony, collect nectar for the young and also to provide protection for the colony. The first batch (or hatching) of bumble bee workers are smaller than their sisters who will emerge later on when the colony grows larger and healthier.

The queen bee uses her energy to begin the nest and this energy (as well as time) is spread thin as she is the sole worker for the new colony. As the colony grows, the eggs and larvae are given more attention and food simply because there are many workers that share the work load. It is at this point in time that larger bumble bees are seen.

Bumble bees are often first noticed (in the area of the nest) when this activity of guarding the nest and pollen collecting begins. The worker bees are focused only on their job and will not go out of their way to sting people. It is only if people get too close to their nest or threaten them that bumble bees will sting. Bumble bees do not die after stinging, as do some other stinging insects.

Towards late summer, the queen will start to produce drones and young queens. The young queens are fertilized by the drones, and then fly off to hibernate. Hibernation usually takes place in dry protected areas such as loose bark. The colony's remaining drones and workers stay in the colony and die during the winter season. The young queens start new colonies in the spring of the year. As mentioned above, bumble bees do not use the same nest, though they may nest in an area close by the original bee nest.

Bumble Bee Control
Bumble bees are very important, beneficial insects that pollinate plants and flowers. Their activity in gardens is desirable, but allowing them to nest in areas where children and pets frequent or where you garden is not desirable.

When adults, children or pets frequent an area where bumble bees have made their nests, the beneficial bumble bee can become a pest. A disturbed nest is an unhappy and angry nest! Although skunks can tolerate a bee's sting (or multiple stings) while collecting food, other animals cannot tolerate the sting. Dogs are often on the receiving end of angry bee stings. A dog's curiosity can get it into trouble with stinging insects. While investigating the activity of a nest, dogs usually get stung on their face; most of the time their snout and nose are easy targets for the bees. When the dog investigates the sounds and activities of a bumble bee nest they are usually attacked on facial areas, resulting in painful stings accompanied by large swelling at the site of the sting. The size of the swelling can be alarming, simply because there is very little muscle or fat on most dogs' face and muzzle area. To prevent bees from becoming a stinging pest, take action to remove possible nesting sites that would put a new colony in close proximity with children and adults that frequent certain parts of the property.

The most important element of wasp and bee control is to *destroy the nest*. Aerosol “wasp and hornet” sprays can be used to knock down bees/wasps around the nest. Small amounts of pesticides (dust and wettable powder formulations work well) applied into the nests of carpenter bees and cicada killers provide good control. Nests of mud daubers also can be treated this way or by simply scraping them off structures. To prevent re-infestation, finishes (paint, etc.) can be applied to unfinished wood to discourage carpenter bees.

In some cases, attempting to destroy a nest becomes a greater health risk than simply tolerating and avoiding it. But nests, especially those of social species, should be destroyed if they are close enough to humans to pose a stinging threat. The nests of honey bees, bumble bees, yellowjackets and hornets should always be approached with caution, preferably at night when most of the workers are present but reluctant to fly. Try not to *carry* a light, as wasps and bees may fly toward it. Instead, set the light aside or cover it with red cellophane (insects cannot see red light). If there is direct access to the nest, a fast-acting dust or wettable powder formulation can be applied. If possible, inject the material into the nest. If you must approach these nests during daytime, a quick knockdown aerosol can be used to keep the bees/wasps at bay, while you treat the nest as above. Heavy clothing or a “bee suit” can be worn for added protection.

Sometimes, yellowjacket and honey bee nests occur in voids such as vents, attics, crawlspaces or hollow walls. Destroying nests in these locations can be difficult, often requiring the services of pest management professionals. Honey bee nests contain honey that must be removed after the bees are eliminated because it will rot and attract secondary pests. Also, be mindful that nests may be located several feet away from the point at which the bees/wasps are entering the structure. Simply applying pesticides into the entrance holes may not be sufficient. It may be necessary to drill into the structure to enable injection of pesticides directly into the nest.

Entrance holes should never be plugged, even after treatment, because the bees/wasps will look for other ways to get out of the nest and have been known to chew their way into living quarters, endangering persons inside. Also, use extreme caution when performing bee/wasp control from a ladder.

Another special case occurs when large numbers of yellowjackets forage in public areas such as parks, schools and zoos. Attracted to human food, especially meats and sweet liquids, wherever it is being prepared, eaten or discarded, yellowjackets pose an increased threat to humans. Control is often difficult. When located in wooded areas, the nests can be difficult if not impossible to find and treat. Yellowjacket baits and traps can kill large numbers, but there can be a lot more where they came from and the problem may continue. Other types of pesticide applications for control of yellowjackets in outdoor recreation areas are rarely effective. Consequently, management of yellowjackets should focus on prevention, such as keeping food enclosed. Tight-fitting lids should be kept on outdoor trash containers and they should be moved away from people. In the end, not eating in infested outdoor areas may be the only sure way to avoid being stung.

NOTE: When pesticides are used, it is the applicator's legal responsibility to read and follow directions on the product label. Not following label directions, even if they conflict with information provided herein, is a violation of federal law.

2017 Changes to EPA's Farm Worker Protection Standard

In late 2015 the Environmental Protection Agency issued the long awaited revision to the Worker Protection Standard (WPS). Although it is now technically active it will not be enforced until 2017 but the original WPS will still be enforced until the end of 2016. Please keep in mind that the WPS covers both restricted use AND general use pesticides.

This course contains EPA's federal rule requirements. Please be aware that each state implements pesticide regulations that may be more stringent than EPA's regulations and these frequently are changed. Check with your state environmental/pesticide agency for more information.

Comparison to Honey Bees
Modern European Bee Hive and Related Information

There are two basic types of modern or movable hive in common use, the "Langstroth hive" (including all the size variants) which has enclosed frames to hold the comb and the top-bar or Kenya-hives which, as the name implies, have only a top-bar to support the comb. These hives are typified by removable frames which allow the apiarist to inspect for diseases and parasites. Movable frames also allow the beekeeper to more easily split the hive to make new colonies.

Langstroth hives
Langstroth frame of honeycomb with honey in the upper left and pollen in most of the rest of the cells named for their inventor, Rev. Lorenzo Langstroth, these hives are not the only hives of this style, but they are the most common. Langstroth presented his design in 1860 and it has become the standard style hive for 75% of the world's beekeeping. This class of hives includes other styles differing mainly in size and number of frames used. Types include Smith, Segeberger Beute (German), Frankenbeute (German), Normalmass (German), Langstroth hive, Modified Commercial and Modified Dadant, \plus regional variations such as the British Modified National Hive.

Langstroth hive make use of the discovery of bee space, a characteristic of Western honey bees which causes them to propolize small spaces (less than 1/4 inch), gluing wooden parts together and to fill larger spaces (more than about 3/8 inch) with wax comb but to hold the intermediate space open for traffic channels for the bees.

His cleverly designed hive makes use of this bee space so that frames are neither glued together nor jammed up with burr comb - comb joining adjacent frames. Langstroth hives make use of standardized sizes of hive bodies (rectangular boxes without tops or bottoms placed one on top of another) and frames to ensure that parts are interchangeable and that the frames will remain relatively easy to remove, inspect, and replace without killing the bees. Langstroth hive bodies are rectangular wooden or styrofoam boxes that can be stacked to expand the usable space for the bees. Inside the boxes, frames are hung in parallel. The minimum size of the hive is dependent on outside air temperature and potential food sources in the winter months. The colder the winter, the larger the winter cluster and food stores need to be. In the regions with severe winter weather, a basketball shaped cluster typically survives in a "double-deep" box. In temperate and equatorial regions, a winter cluster will survive in a single box or in a nuc (short for nucleus colony).

Langstroth frames are thin rectangular structures made of wood or plastic and which have a wax or plastic foundation on which the bees draw out the comb. The frames hold the beeswax honeycomb formed by the bees. Ten frames side-to-side will fill the hive body and leave the right amount of bee space between each frame and between the end frames and the hive body.

Langstroth frames are often reinforced with wire which makes it possible to extract honey in centrifuges which spin the honey out of the frames. The empty frames can be returned to the beehive for use next season. Since bees are estimated to use as much food to make one kilogram of beeswax as they would to make eight kilograms of honey, the ability to reuse comb can significantly increase honey production.

The top-bar or Kenya-hives were developed as a lower-cost alternative to the standard Langstroth hives and equipment. They are used by some devotees in the US, but are much more popular, due to their simplicity and low cost, in developing countries. Top-bar hives also have movable frames and make use of the concept of bee space.

The top-bar hive gets its name because the frames of the hive have only a top bar, not sides or a bottom bar. The beekeeper does not provide a foundation (or provides only a fractional foundation) for the bees to build from. The bees build the comb so it hangs down from the top bar. The hive body is often shaped as an inverted trapezoid in order to reduce the tendency of bees to attach the comb to the hive-body walls. Unlike the Langstroth design, a top-bar hive is generally expanded horizontally, not vertically. The top-bar design is a single, much longer box with all the frames hanging in parallel.

Unlike the Langstroth hive, the honey cannot be extracted by centrifuging because a top-bar frame does not have reinforced foundation or a full frame. Because the bees have to rebuild the comb after each harvest, a top-bar hive will yield more beeswax but less honey.

However, like the Langstroth hive, the bees can be induced to store the honey separately from the areas where they are raising the brood so that bees are less likely to be killed when harvesting from a top-bar hive than when harvesting from a skep or other traditional hive design.

Bee Pollen

Bee pollen is the male seed of a flower blossom which has been gathered by the bees and to which special elements from the bees has been added. The honeybee collects pollen and mixes it with its own digestive enzymes. One pollen granule contains from one hundred thousand to five million pollen spores each capable of reproducing its entire species.

Bee pollen is often referred to as nature's most complete food. Human consumption of bee pollen is praised in the Bible, other religious books, and ancient Chinese and Egyptian texts. Research studies document the therapeutic efficacy and safety of bee pollen. Clinical tests show that orally ingested bee pollen particles are rapidly and easily absorbed--they pass directly from the stomach into the blood stream. Within two hours after ingestion, bee pollen is found in the blood, in cerebral spinal fluids, and in the urine.

Propolis is a wax-like, resinous substance that bees collect from tree buds, or other botanical sources, and use as a sealant for unwanted open spaces in the hive. Propolis is used for small gaps (approximately 1/4"/6.35 mm or less), while larger spaces are usually filled with beeswax. Its color varies from green to reddish brown depending of its botanical source; the most common being dark brown.

For centuries, beekeepers assumed that bees sealed the beehive with propolis to protect the colony from the elements, such as rain and cold winter drafts.

However, 20th Century research has revealed that bees not only survive, but also thrive, with increased ventilation during the winter months throughout most temperate regions of the world.

Propolis is now believed to:
1. reinforce the structural stability of the hive
2. reduce vibration
3. make the hive more defensible by sealing alternate entrances
4. prevent diseases and parasites from entering the hive
5. prevent putrefaction within the hive.

Bees usually carry waste out of and away from the hive. However if a small lizard or mouse, for example, found its way into the hive and died there, bees could be unable to carry it out through the hive entrance. In that case, they would attempt instead to seal the carcass in propolis, essentially mummifying it and making it odorless and harmless.

Composition of Propolis
The composition of propolis will vary from hive to hive, district to district, and from season to season. Normally it is dark brown in color, but it can be found in green, red, black and white hues, depending on the sources of resin found in the particular hive area. Bees are opportunists, and will gather what they need from available sources.

Occasionally bees will even gather various caulking compounds of human manufacture, when the usual sources are more difficult to obtain. Therefore, various potential medicinal properties may be present in one hive's propolis and absent from another. The properties of the propolis depend on the exact plant sources used by an individual hive, and the distributors of propolis products cannot control such factors. This may account for the many and varied claims regarding its potential medicinal properties and the difficulty in replicating previous scientific studies investigating these claims). Even propolis samples taken from within a single colony can vary, making controlled clinical tests virtually impossible.

The source of propolis varies in a major way with latitude. In temperate climates bees collect resins from trees, mostly poplars and to lesser extent conifers. The biological role of propolis in trees is to seal wounds and defend against bacteria, fungi and insects. In tropical regions, bees gather propolis from flowers, especially Clusia, that have adapted propolis to attract pollinators. The chemical composition of temperate propolis and tropical propolis are different. Poplar propolis is rich in flavanoids. Clusia propolis contains polyprenylated benzophenones.

"Typical" propolis has approximately 50 constituents, primarily resins and vegetable balsams (50%), waxes (30%), essential oils (10%), and pollen (5%). Propolis is sticky at and above room temperature. At lower temperatures it becomes hard and very brittle. "Sinapic acid, isoferulic acid, caffeic acid and chrysin were isolated from the alcoholic extraction of propolis and identified by spectrometric methods. The first three compounds were shown with inhibitive effect of against Staphylococcus aureus, while chrysin was ineffective."

How Bees Make Honey
Honeybees use nectar to make honey. Nectar is almost 80% water with some complex sugars. In fact, if you have ever pulled a honeysuckle blossom out of its stem, nectar is the clear liquid that drops from the end of the blossom. In North America, bees get nectar from flowers like clovers, dandelions, berry bushes and fruit tree blossoms. They use their long, tube-like tongues like straws to suck the nectar out of the flowers and they store it in their "honey stomachs".

Bees actually have two stomachs, their honey stomach which they use like a nectar backpack and their regular stomach. The honey stomach holds almost 70 mg of nectar and when full, it weighs almost as much as the bee does. Honeybees must visit between 100 and 1500 flowers in order to fill their honey stomachs.

The honeybees return to the hive and pass the nectar onto other worker bees. These bees suck the nectar from the honeybee's stomach through their mouths. These "house bees" "chew" the nectar for about half an hour. During this time, enzymes are breaking the complex sugars in the nectar into simple sugars so that it is both more digestible for the bees and less likely to be attacked by bacteria while it is stored within the hive. The bees then spread the nectar throughout the honeycombs where water evaporates from it, making it a thicker syrup. The bees make the nectar dry even faster by fanning it with their wings.

Once the honey is gooey enough, the bees seal off the cell of the honeycomb with a plug of wax. The honey is stored until it is eaten. In one year, a colony of bees eats between 120 and 200 pounds of honey.

Carbohydrate Element
Nectar and honey form the energy (or carbohydrate) element of the bees' diet while pollen forms the proteinaceous part of their diet. Both pollen and nectar are essential to normal colony growth. Without nectar the colony has no energy with which to perform its normal tasks and without pollen young bees cannot be reared.

Honey Bee Behaviors
Absconding is another of those honey bee behaviors that isn't completely understood, but we can draw some conclusions based on repeated observations. Usually at least one of the following conditions exists in a hive before a colony absconds in the fall:

- There is a severe nectar dearth resulting in a shortage of stored food.
- The hive has been heavily invaded by predators such as ants, yellow jackets, wax moths, or small hive beetles.
- There has been excessive disturbance from interlopers such as skunks or beekeepers.
- The hive is extremely hot due to the weather or severe overcrowding

In general, the environmental conditions in the hive became too stressful for the bees. Somehow they sensed they had little chance of surviving in the present circumstances and decided to leave.

Much like swarming, absconding is a process. Preparations are made well in advance of “moving day.” Usually the queen ceases to lay eggs and slims down in preparation for flying, foraging stops, scouts begin searching for a new home, and honey stores are used up. By the time a beekeeper discovers an empty hive there is usually nothing left but wax comb. Comb left clean and neat usually indicates the bees left due to a nectar dearth and impending starvation. Comb that is shredded and irregular may have been damaged by robbing bees or yellow jackets. Comb ruined by small hive beetles or wax moths is often completely destroyed and full off feces and cocoons.

A fall absconding honey bee colony has virtually no chance of surviving the winter. The bees have no comb, no honey, no nectar source, no pollen source, and no time. They left their home because they didn’t know what else to do.

If you can catch such a colony, you may be able to save them by heavy feeding of honey, syrup, and pollen. But don’t put them back where they came from unless you can determine what was wrong and correct it. Otherwise, they will simply abscond again.

Colony Collapse Disorder:
Adult bees are gone, but honey, pollen and some brood remain behind. The difference in absconding and CCD is that the honey, pollen and brood are left behind Sometimes the queen and a handful of bees are left in the hive. Opportunists (SHB and wax moths) seem slower to take over when CCD is the cause of the dead hive.

Prevention of Absconding
Where bees abscond frequently it is an indication that food, probably nectar is limited within the environment. Feeding bees is common in temperate bees; perhaps where the bees have collected insufficient honey or perhaps where too much honey has been harvested from a colony. In these cases the feeding of refined white sugar (sucrose) will enable to bees to survive a long period of dearth. Raw, unrefined brown sugar or molasses is NOT suitable for feeding bees as they lack the enzymes to deal with the complex sugars that remain in the unrefined sugar and will die of dysentery.

The writer has however, tried pulping the sugar from sugar cane and feeding the resulting jelly like substance. This appeared to be acceptable to the bees. However, it went moldy very quickly so needed replenishing frequently. There was no long term experimentation or feedback from this method to indicate how it affected honey bee survival.

Feeding Pollen
Feeding pollen is also practiced in areas where pollen is limited. This is most likely to be in the monoculture agricultural landscapes that are associated with large-scale industrialized farming. There are many places in the world where there is plenty of forage, both nectar and pollen. The level of bee absconding and ease of colonization is probably an indicator of the richness and health of the environment (for the people who live there as well as the bees). Feeding pollen is normally practiced at the start of the colony build up period. This is the time when protein demands will be highest as the bees are rearing large numbers of young brood. If the colony build up seems unusual and there are no signs of pollen in the colony then it is possible that supplementary pollen feeding may be helpful. If beekeepers believe either pollen or nectar shortage is affecting the bees, the first line of investigation should be the availability of enough suitable tree species and the implementation of a planting program if possible.

It is possible, but usually not feasible to feed bees sugar to reduce their propensity to abscond. However, in most places where beekeeping is being used as a poverty alleviation tool it is not an affordable technique. It is probably better that the beekeepers use the sugar for their household needs rather than for the bees. It is not practical in fixed comb hives. Feeding must be done within the confines of the hive if it is not to cause a frenzy of bees robbing and possibly killing the smaller colonies and taking their food. Sugar feeding, where it is practiced, is usually done in the evening when there is less chance of disrupting other colonies in the area. Special feeding equipment is also needed.

New Colonies
New colonies which settle too late in the season will not make it, and are best combined with others. Colonies should always be kept as big as possible. Colonies should be harvested modestly, according to the expected season after the harvesting, and smaller colonies should not be harvested at all. In a decreasing season, empty combs should be removed when the colony is still strong. Hives should have a volume, according to vegetational nectar flow, between 80 and 150 liters. Traditional hives should have an opening at the back side, for inspection and harvesting, far from the brood, which is positioned near the bee entrance. Hives should be set in a good vegetation. Weighing of colonies can be a help to know the seasons and different weather types in one to a few years. Honeybee husbandry is meant to have a higher production than from the wild. Understanding and reduction of absconding leads to increased production.

Swarming
When honey bees swarm they will settle on a tree limb, bush, or other convenient site. The cohesiveness of the swarm is due to their attraction to a pheromone produced by the queen. The swarm will send out scout bees to seek a cavity to nest in and will move on when a suitable nesting site is found. Rarely, swarms may initiate comb construction in the open if a suitable cavity cannot be found. You may want to call a local beekeeper to see if he would like to collect the swarm. Contact your county extension office for a list of beekeepers in your area. Late season swarms are of little value to beekeepers.

A traditional poem advises:
A swarm in May - is worth a load of hay.
A swarm in June - is worth a silver spoon.
A swarm in July - isn't worth a fly.

The bee swarm is looking for a new nesting site. A beekeeper can capture a swarm by placing a suitable container, such as an empty beehive, on the ground below the swarm and dislodging the bees at the entrance to the hive. The bees will begin to move into the hive which can be removed after dark to the beekeeper's apiary. You can observe the bees scent-fanning at the entrance to signal the entrance to the new nest as the bees march into their new home. If for some reason the queen does not go into the new hive, the bees will abandon it and form a cluster where she lands.

Honey bees are cavity nesters and will seek a cavity of at least 15 liters of storage space. Hollow trees are preferred nesting sites. Occasionally, bees will nest in the hollow walls of buildings, under porches, and in other "man-made" sites if they can find an entrance to a suitable cavity.

Honey Bee Swarm in an Undesirable Place
Honey bees are beneficial pollinators and should be left alone and appreciated unless their nest are in conflict with human activity. If honey bees nest in the walls of a home, they can be removed or killed if necessary; however, it is advisable to open the area and remove the honey and combs or rodents and insects will be attracted.

Also, without bees to control the temperature, the wax may melt and honey drip from the combs. After removal, the cavity should be filled with foam insulation as the nest odor will be attractive to future swarms. You may want to seek the assistance of a professional beekeeper or exterminator. Nests should be removed promptly from problem sites. After several months, they may have stored a considerable amount of honey. You can prevent swarms from nesting in walls by preventive maintenance. Honey bees will not make an entrance to a nest. They look for an existing entrance, so periodic inspection and caulking is all that is necessary to prevent them from occupying spaces in walls.

Why are we observing fewer swarms than in previous years?
In the 1980's, two mites that parasitize honey bees were introduced into the U.S. They have spread throughout the state and have eliminated many wild or feral colonies. In addition, the number of colonies managed by beekeepers has declined during the past decade.

Farmers and gardeners producing tree fruits, small fruits, forage legumes, oil seed crops, and vegetable crops requiring bee pollination need to consider pollination requirements as once abundant honey bee pollinators are no longer something they can take for granted. Managed honey bee colonies may be needed to assure adequate pollination of these crops.

Bee Facts

- ✓ Bees from the same hive visit about 225,000 flowers per day. One single bee usually visits between 50-1000 flowers a day, but can visit up to several thousand.
- ✓ Queens will lay almost 2000 eggs a day at a rate of 5 or 6 a minute. Between 175,000-200,000 eggs are laid per year.
- ✓ The average hive temperature is 93.5 degrees.
- ✓ Beeswax production in most hives is about 1 1/2% to 2% of the total honey yield.
- ✓ About 8 pounds of honey is eaten by bees to produce 1 pound of beeswax.
- ✓ Honeybees are the only insects that produce food for humans.
- ✓ Just a single hive contains approximately 40-45,000 bees!
- ✓ During honey production periods, a bee's life span is about 6 weeks.
- ✓ Honeybees visit about 2 million flowers to make one pound of honey.
- ✓ A bee travels an average of 1600 round trips in order to produce one ounce of honey; up to 6 miles per trip. To produce 2 pounds of honey, bees travel a distance equal to 4 times around the earth.
- ✓ Bees fly an average of 13-15 mph.

This course contains EPA's federal rule requirements. Please be aware that each state implements pesticide regulations that may be more stringent than EPA's regulations. Check with your state environmental/pesticide agency for more information.

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Bee Venom

The venoms of the AHB and the EHB are almost identical. Medical literature provides no evidence suggesting that AHB stings are more toxic than EHB stings. The amount of venom per sting does vary between the AHB and the EHB, with the AHB having approximately 27 percent less venom per sting. The smaller size of the AHB is the primary reason for the smaller amount of venom.

In the United States, deaths from all hymenopteran insects (bees, wasps, yellow jackets, fire ants) average between 40 and 50 per year. The arrival of the AHB in the United States has created a public awareness of the health risks associated with the bee. This awareness has provided an opportunity to educate the public on medical aspects of the AHB and the risks associated with all honey bees and other stinging hymenopterans.

The impact of the AHB on public health and on the health of domestic animals will depend on three factors:

First, and probably most important, is the amount of contact between the AHB and the public, or their domestic animals.

Second, the degree of knowledge the public has about encounters with the AHB, with stinging incidents, and how to deal with them.

Third, the availability and quality of medical assistance available. As the AHB progressed through South and Central America and into Mexico, adequate and timely medical assistance was often absent. In the United States, medical assistance from knowledgeable personnel is practically taken for granted. This factor alone will lessen the seriousness of multiple stinging incidents.

Feral Bee Colonies
Because of increases in numbers of feral bee colonies when the AHB becomes established in an area, and the possible increased interaction with people and animals, the number of stinging incidents should increase, as will the number of people requiring medical treatment. Some predictions estimate stinging incidents increasing to four or five times present levels.

The number of serious incidents can be reduced significantly through an intense educational program to inform the general public on how to deal with bees and potential bee problems.

Medical Aspect of Bees
Although serious reactions from bee venom occur in only a very small percentage of the population, all persons should be aware of the possibility that medical complications may result from stings to themselves, children, and others.

This section addresses the medical aspect of bee stings. It provides information on the venom itself and reactions to the venom. Also included is information on symptoms, first aid, and diagnosis of stings. Specific at-risk groups are discussed as well as what may be done to reduce the risk of interaction with bees.

A review of the problems associated with the AHB in Central America and Mexico shows that AHB should not become a significant public health threat anywhere in the United States. Bee venom is toxic; the lethal dose of bee venom for humans is about 10 stings per pound of body weight, assuming that all of the bee's venom is injected by the sting. Deaths due to the toxic effects of venom received in multiple stings are extremely rare. However, somewhere between 1 and 4 percent of the population is hypersensitive to honey bee venom. Some people are so hypersensitive that one sting can be fatal.

Reactions to Honey Bee Stings
Reactions to honey bee stings range from slight pain and swelling to much more serious symptoms, including anaphylaxis. Doctors, Emergency Medical Services, and other health care personnel are well educated in the diagnosis and treatment of bee stings and anaphylaxis.

- Anaphylactic reactions almost always involve the skin. More than 90% of patients have some combination of urticaria, erythema, and pruritus.

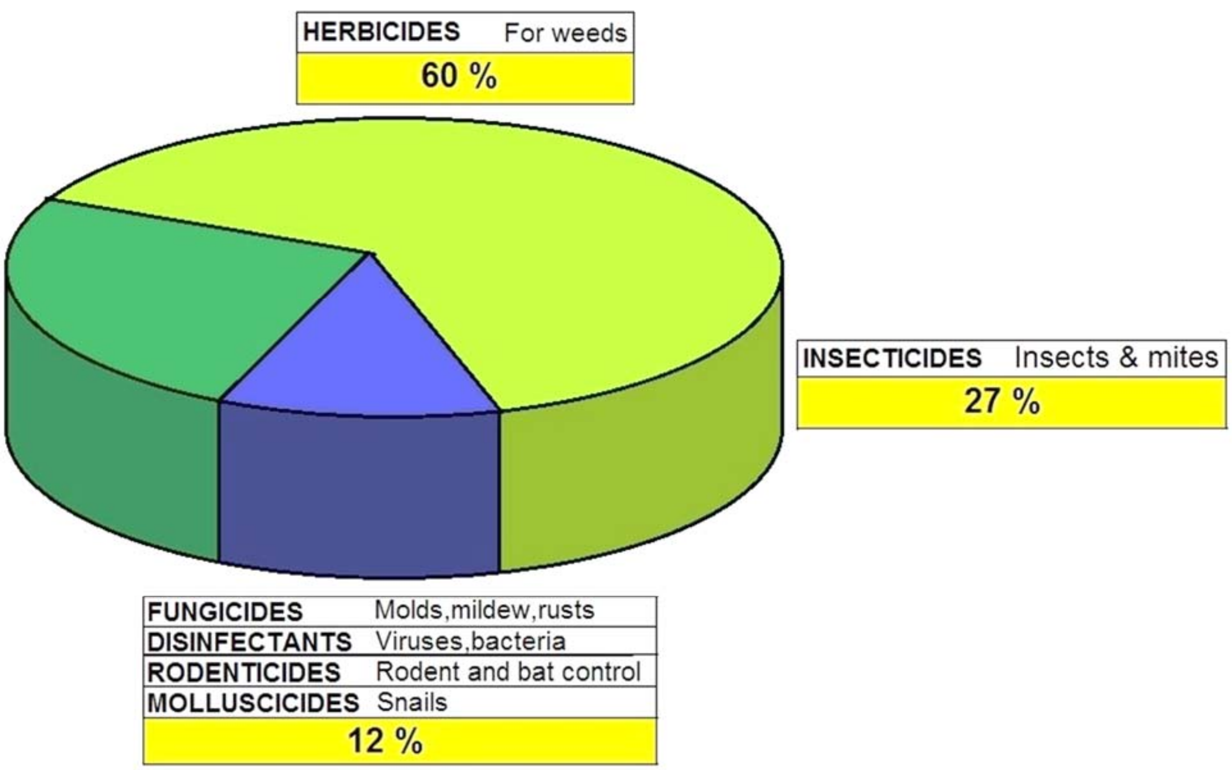
- The upper respiratory tract commonly is involved, with complaints of nasal congestion, sneezing, or coryza. Cough, hoarseness, or a sensation of tightness in the throat may present a significant airway obstruction.

- Eyes may itch and tearing may be noted. Conjunctival injection may occur.

- Dyspnea is present when patients have bronchospasm or upper airway edema. Hypoxia and hypotension may cause weakness, dizziness, or syncope. Chest pain may occur due to bronchospasm or myocardial ischemia (secondary to hypotension and hypoxia).

- GI symptoms of cramp-like abdominal pain with nausea, vomiting, or diarrhea also occur but are less common, except in the case of food allergy.

- In a classic case of anaphylaxis, the patient or a bystander provides a history of possible exposures that may have caused the rapid onset of skin and other manifestations. This history often is partial; exposure may not be recalled, or it may not be considered significant by the patient or physician. For example, when queried about medications, a patient may not mention over-the-counter (OTC) products. The clinician may not realize that, while reactions are usually rapid in onset, they also may be delayed.



PESTICIDE USE BY TYPE

Handling Medical Problems

All persons should know whether or not they are hypersensitive to bee and wasp stings.

Persons who do not know should see their doctor and be tested. Hypersensitive persons should carry medication when frequenting an area where interaction with bees and wasps may occur. Parents of hypersensitive children should alert school nurses, day care facilities, or babysitters concerning their children's condition, and provide medications where necessary. Hypersensitive persons should inform fellow students, business associates, coworkers, or fellow sports enthusiasts of their condition. All persons should be familiar with the symptoms of hypersensitivity and, if symptoms occur after being stung, should seek medical attention immediately.

Allergic Reactions
A single bee sting is seldom fatal unless one has a severe allergic reaction. Swelling of the affected area is a normal reaction to bee stings and does not indicate a systemic allergy. Early symptoms of an allergic reaction include a tingling sensation on the palms, bottoms of the feet, tongue and lips, tightening of the throat, dizziness, and nausea. Allergy tests are available but can be expensive. If their normal routine does not bring them in contact with insects, people should not have to take the test.

However, beekeepers or other persons who work where bees are present should take the test. As well, fire fighters or police officers who may be answering emergency calls for insect stings should be tested. Allergy testing will determine how sensitive a person is, and will build up the person's immunity with small, regularly scheduled injections of the bee venom. Kits are available as a prescription item for people who are allergic to bee stings. Such kits are equipped with syringes and epinephrine for emergency treatment.

First Aid for Stinging Victims
If the victim is showing no signs of dizziness or difficulty in breathing, or has been stung only once, practical first aid measures are:

A. Remove sting with a sideways scraping movement of a fingernail, credit card, or dull knife to prevent more venom from being pumped in by the venom sac. Do not use tweezers or squeeze the sting, as this will inject more venom into the victim. The venom from an AHB sting is no more toxic than that of other bees.

B. Apply a paste of baking soda and cold cream, or of wet salt. To be most effective, do this within five minutes after the sting.

C. Apply an ice pack to relieve pain and calamine lotion to relieve itching.

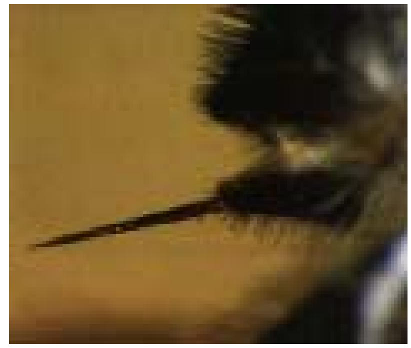
D. Watch for any unusual reaction, such as the appearance of red blotches anywhere on the body within 2 to 20 minutes, or breathing difficulties. People who experience difficulty in breathing after having been stung by any insect must seek medical attention within 15-20 minutes. Administer artificial respiration or CPR if the victim stops breathing.

- Keep the victim calm.
- Give the victim an antihistamine tablet, if available. First aid kits for treating localized bee stings are available at some sporting and camping stores.
- Take people who have been stung repeatedly to a medical facility for a complete examination. Remove stings as described earlier.
- Seek medical attention immediately if a person with health problems is stung by an insect.
- Stay with the victim until medical care is obtained.

Stinging Incidents

Accurate records of stinging incidents seldom exist. Even records of serious, multiple stinging incidents often are at best sketchy. If AHB has become established in your area, then appropriate reporting should be set up as well.

Close up view of Bee Stinger



At-Risk Groups

Certain groups in the population may be considered "*at-risk*" for incidents involving bees. These groups fall into two categories: those who are more likely to interact with bees, and those who are incapable of handling an interaction with bees.

Children

Children may fall into either of the above categories. Playing outdoors, children are exposed to habitats that increase the chances of interaction with bees.

Upon encountering bee swarms or colonies, children have a tendency to disturb them. This can bring about a defensive reaction from the insects, resulting in a serious incident.

Younger children encountering bees in a defensive behavior may not know what to do, or may not be able to seek cover.

Therefore, they can be extremely vulnerable. Children should be taught what bees look like. They should be instructed to avoid possible problems. The following instructions may be used even with very young children:

1. Keep your distance (Stay away).
2. Don't disturb (Bug a Killer Bee ***NOT***!).
3. Leave the area (Do not bug a bee).
4. Report the incident (Tell parents, teachers, or other adults about the bees).

Elderly

Elderly people who can't move out of an area rapidly can be vulnerable to multiple stings if bees are encountered. The physical condition and health of an elderly person may also place them in the at-risk group. The elderly need not give up picnics or outings, or such recreational pursuits as hiking, fishing, hunting, or other outdoor activities.

However, they should consider the possibility of encountering bees and prepare for such an encounter. Suggestions for those wishing to frequent habitats favorable to bees and wasps are listed below:

1. If possible, have the area "*checked out*" in advance.
2. If possible, always have "*cover*" nearby, such as a vehicle, house, or barn.
3. Always bring a companion along (two are even better).
4. If bees are encountered, do not disturb them.
5. Carry some type of protection, such as a blanket in a boat or tarp in a vehicle.

Handicapped

Handicapped persons placed in a situation where bees are in a defensive action may not be able to leave the area or seek cover fast enough to prevent multiple stings. Those requiring assistance walking could be especially vulnerable. Handicapped persons should avoid habitats that may contain bees.

If they wish to frequent such areas, the following suggestions may help prevent problems:

1. Have the area scouted for stinging insects prior to use.
2. Avoid use of perfumes, shaving lotions, hair sprays, and other sweet-smelling cosmetics.
3. If encountered, do not disturb bees.
4. Carry a blanket, jacket, or other protective covering to use if bees attack.
5. Arrange for emergency assistance beforehand.

Outdoor Workers

Persons working outdoors could be considered at risk if their work involves exposure to habitats likely to be occupied by bees. The risk is greater when operating mowers, weed eaters, heavy equipment, chainsaws, or other tools that may provoke defensive behavior from bees. Workers unable to flee, such as those on poles or scaffolding, are at higher risk.

Personnel should be instructed in the possibility of encountering bees and other venomous pests. If a few common sense steps are followed, work should not be hampered, even in areas that most likely contain bees:

1. Check out areas where workers' mobility may be restricted (poles, towers, manholes, scaffolding, under buildings).
2. If bees are encountered, do not disturb them.
3. Contact an authorized and experienced person to eliminate the bees before work continues.
4. If risks are great and encounters frequent, protective equipment, such as a veil and full bee suit or coveralls, should be available for use.

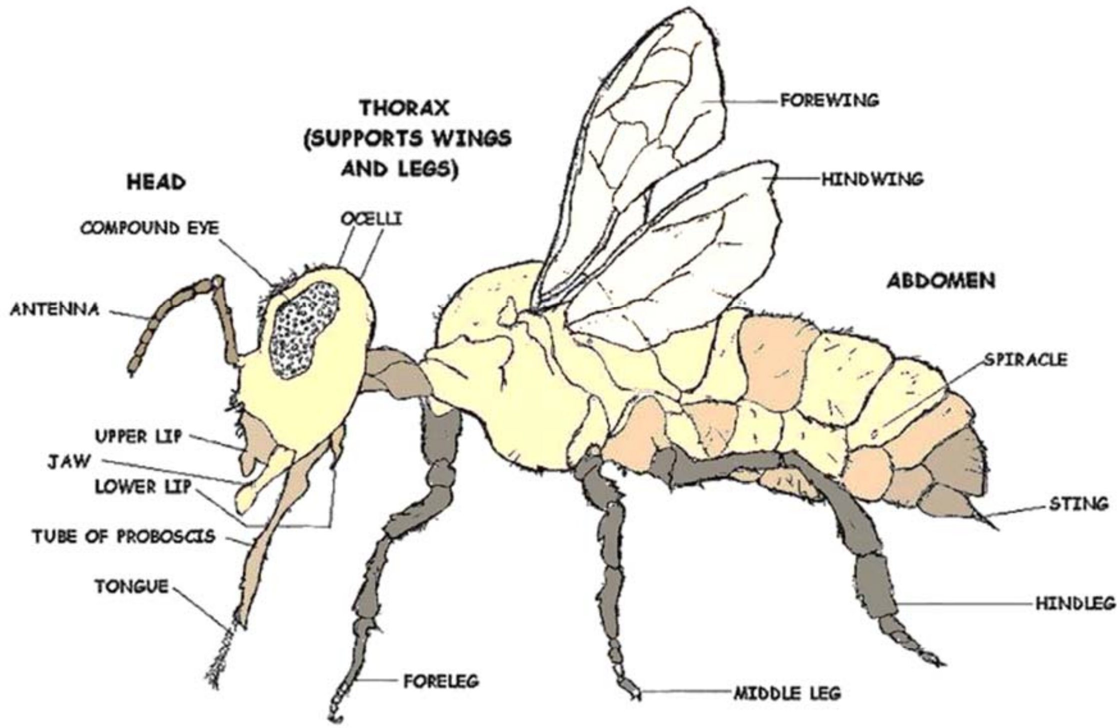
Sports Enthusiasts

Hunters, fishermen, hikers, and other sports enthusiasts can be at-risk due to their increased chances of entering bee habitats.

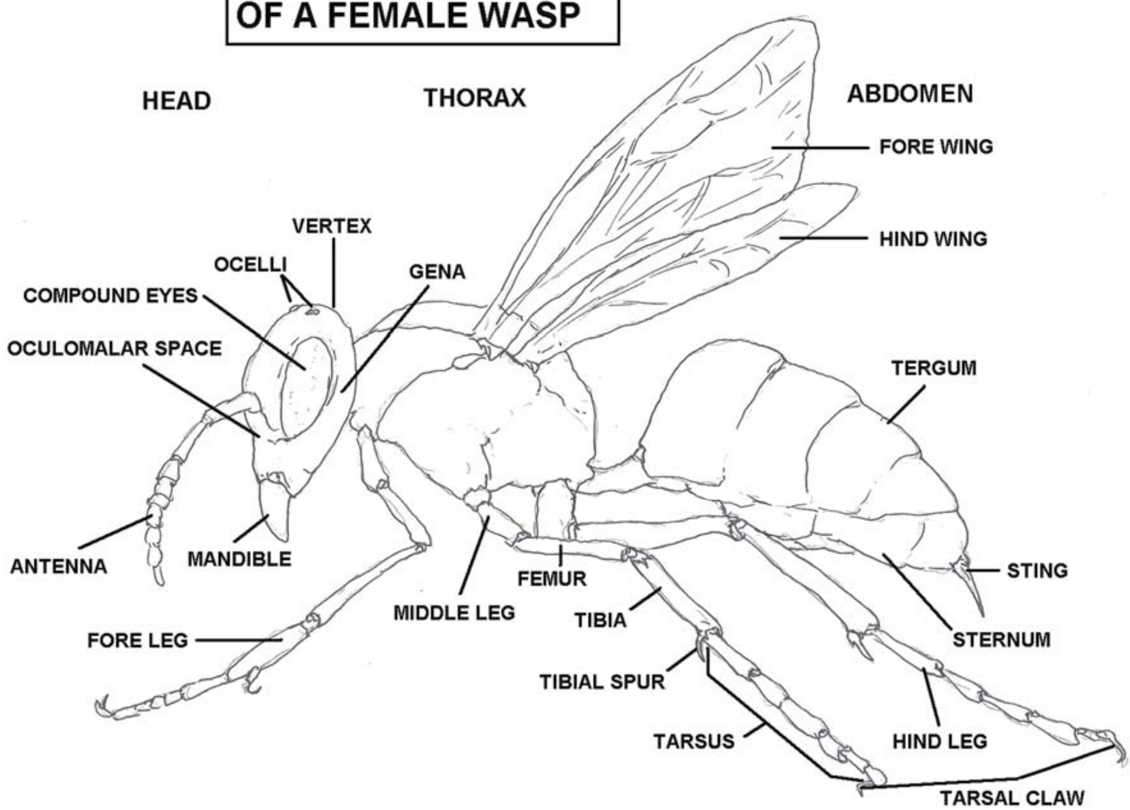
Sports enthusiasts may reduce the risk of bee stings by following a few common sense suggestions:

1. Always be on the alert for potential problems.
2. Check out cabins, deer stands, and boats before use.
3. Seek help or advice from an experienced person before attempting to eliminate bee colonies.
4. Do not attempt to "***burn-out***" bee colonies by pouring gasoline or other flammable liquids on them.
5. KNOW if you are hypersensitive to bee venom and carry necessary medication.
6. If you are hypersensitive, always participate with a companion.

Bee Hive



BASIC MORPHOLOGY OF A FEMALE WASP



What to do if Attacked by Africanized Honey Bees

Remember these important steps:
1. RUN away quickly. Do not stop to help others. However, small children and the disabled may need some assistance.
2. As you are running, pull your shirt up over your head to protect your face, but make sure it does not slow your progress. This will help keep the bees from targeting the sensitive areas around your head and eyes.
3. Continue to RUN. Do not stop running until you reach shelter, such as a vehicle or building. A few bees may follow you indoors. However, if you run to a well-lit area, the bees will tend to become confused and fly to windows. Do not jump into water! The bees will wait for you to come up for air. If you are trapped for some reason, cover up with blankets, sleeping bags, clothes, or whatever else is immediately available.
4. Do not swat at the bees or flail your arms. Bees are attracted to movement and crushed bees emit a smell that will attract more bees.
5. Once you have reached shelter or have outrun the bees, remove all stingers. When a honey bees stings, it leaves its stinger in the skin. This kills the honey bee so it can't sting again, but it also means that venom continues to enter into the wound for a short time.
6. Do not pull stingers out with tweezers or your fingers. This will only squeeze more venom into the wound. Instead, scrape the stinger out sideways using your fingernail, the edge of a credit card, a dull knife blade or other straight-edged object.
7. If you see someone being attacked by bees, encourage them to run away or seek shelter. Do not attempt to rescue them yourself. Call 911 to report a serious stinging attack. The emergency response personnel in your area have probably been trained to handle bee attacks.
8. If you have been stung more than 15 times, or are feeling ill, or if you have any reason to believe you may be allergic to bee stings, seek medical attention immediately. The average person can safely tolerate 10 stings per pound of body weight. This means that although 500 stings can kill a child, the average adult could withstand more than 1100 stings.

Wetting Agents
Bees are easily immobilized and killed by wetting agents (surfactants) - including commercial liquid dishwashing detergent. Non-foaming fire control chemicals and fire-fighting foams with surfactant characteristics such as the aqueous film-foams (AFFF) also work.

Not all commercially available products have been tested, but most such wetting agents should be equally effective. Chemicals tested so far include: original Palmolive dishwashing liquid, 9-55 R fire control chemical, Silvex R foam concentrate and FC-600 Light Water brand ATC/AFFF. All had a light but distinctive odor. A one percent solution was sufficient to immediately immobilize honey bees and apparently kill them within 60 seconds.

If there is doubt whether a particular chemical will work, rescue personnel should enlist the aid of a local beekeeper. Clearly, human and animal safety must be the most important consideration. The U.S. Environmental Protection Agency has conditionally approved detergents for use against AHB¹s.

Victim Rescue
After arriving at a site, rescue personnel first should assess the situation from within their vehicles. Then they should retreat several hundred yards, put on protective clothing and move any onlookers to a safe distance.

Each situation is unique, but to rescue a victim, two things must be done as quickly as possible: establish an adequate insect barrier, and neutralize the insects¹ alarm odor - which consists of chemical components of venom that enable more bees to find and attack the victim. Fire and rescue units responding with standard fire-fighting equipment can quickly accomplish both objectives by using water plus a non-toxic wetting agent.

Using standard fire-fighting procedures, set up a line with an educator capable of delivering a one to three percent spray of one of the foaming/wetting agents and a nozzle capable of delivering a wide fan patter. A light initial application to the victim will stop the attack by most of the insects on or near the victim within 60 seconds. These insects, unable to fly, will begin to suffocate and can be quickly brushed aside.

If an obvious line of insect flight can be determined, a vertical wall of spray 20 to 30 feet in the air should intercept further flight activity. Or, the nozzle can be inverted near the victim to provide a curtain of safety.

Rescuers wearing proper protective gear then can carry a victim into a house, van or ambulance for treatment and transport. Many bees, however, will follow to continue their attack. In a house, vacuum up bees attracted to windows by light. In a rescue vehicle, drive away and then roll down the windows and chase the insects out.

Sting Removal
Once the victim is protected, remove stings as quickly as possible. Otherwise, the white, translucent, venom sac - with its nerves and muscles attached - will continue to pump venom into the wound for a minute or more. Removing the victim¹s outer layer of garments may help because stings embedded through the fabric will be dislodged in the process.

The best way to remove stings is to simply scrape them away with a fingernail, credit card or similar instrument. Never pinch, tweeze or otherwise attempt to pull stings out, as this will simply inject the remaining contents of the venom sacs. After sting victims have been cared for, rescuers should launder the bees¹ alarm-odor chemical from suits, veils and equipment.

Training
Fire and rescue personnel should familiarize themselves with normal activities of stinging social insects in their area. Local bee experts or beekeepers can provide extremely valuable advice and assistance, particularly when unusual situations arise. All states have active beekeeper organizations, as do many local communities, and they usually welcome requests for assistance.

Most beekeeper groups would welcome an invitation to help develop training exercises, where bees would be used to simulate an actual attack and allow rescuers an opportunity to practice their skills.
Typically an EHB hive will swarm once every 12 months. However, the AHB may swarm as often as every six weeks and can produce a couple of separate swarms each time. This is important for you to know, because if the AHB swarms more often, the likelihood of your encountering an AHB swarm increases significantly.

Regardless of myths to the contrary, Africanized honey bees do not fly out in angry swarms to randomly attack unlucky victims. However, the AHB can become highly defensive in order to protect their hive, or home. Again, it is now better to consistently exercise caution with respect to all bee activity. So keep your distance from any swarm of bees.

The AHB is far less selective about what it calls home. The AHB will occupy a much smaller space than the EHB. Known AHB nesting locations include water meter boxes, metal utility poles, cement blocks, junk piles, and house eaves. Other potential nesting sites include overturned flower pots, old tires, mobile home skirts, and abandoned structures. Holes in the ground and tree limbs, mail boxes, even an empty soda pop, could be viewed as "home" to the AHB.

The Africanized honey bee is extremely protective of their hive and brood. The AHB's definition of their "home turf" is also much larger than the European honey bee. So, try to allow ample physical distance between the hive. At least 100 feet, or the width of a four-lane highway, is a good distance. The best advice is that if you see a bee hive, start moving away immediately.

Bee behavior refers to what bees do – as individuals and as a colony. By studying their behavior, we may learn how to change it to our benefit. Two practical discoveries of bee behavior made our beekeeping of today possible. One was the discovery by Langstroth of bee space. The other was the discovery by G. M. Doolittle that large numbers of queens could be reared by transferring larvae to artificial queen cups. The discovery of the “language” of bees and of their use of polarized light for navigation has attracted considerable interest all over the world.

Much has been learned about the behavior of insects, including bees, in recent years. As an example, the term “pheromone” had not been coined in 1953, when Ribbands summarized the subject of bee behavior in his book, The Behavior and Social Life of Honeybees. A pheromone is a substance secreted by an animal that causes a specific reaction by another individual of the same species. Now many bee behavior activities can be explained as the effect of various pheromones.

Recently, we have learned how certain bee behavior activities are inherited, and this information gives us a vast new tool to tailor-make the honey bee of our choice. Further studies should reveal other ways to change bees to produce specific strains for specific uses

The sophisticated social organization that enables the efficient collection and storage of both nectar and pollen in times of plenty which allows then to survive during times of dearth is a key feature of the honey bees' biology. Tropical bees have slightly more flexible patterns of survival during dearth periods. They will probably store an excess of honey and pollen. However, they also have the potential to migrate or abscond to a place where nectar and pollen may be more easily available. Beekeepers should be sure not to rob the bees of ALL their honey stores. The bees will need some of the honey they have stored to maintain their own life or they will either die or abscond.

Acute Bee Paralysis Virus Causes Paralysis in Bees (*Apis mellifera)*

Viral diseases of honeybees are a major concern in apiculture, causing serious colony losses worldwide.

Paralysis, a minor disease of adult honey bees, is usually associated with filterable viruses. Two different viruses, chronic bee paralysis virus (CBPV) and acute bee paralysis virus (ABPV), have been isolated from paralytic bees. Other suspected causes of paralysis include pollen and nectar from such plants as buttercup, rhododendron, laurel, and some species of basswood; deficient pollen during brood rearing in the early spring; and consumption of stored fermented pollen.

Bees affected by this disease tremble uncontrollably and are unable to fly. In addition, they lose the hair from their bodies and have a dark, shiny, or greasy appearance.

Paralytic bees are submissive to attack. When paralysis is serious, large numbers of afflicted bees can be found at the colony entrance, crawling up the sides of the hive and blades of grass, and tumbling to the ground. Healthy bees often tug at infected bees in an effort to drive them away from the hive. Affected bees also may be found on top bars or frames next to the hive cover, with wings extended.

ABPV is a virus that affects mainly the honeybee (*Apis mellifera*). ABPV has also been found in bumblebees and is the only bee virus known to have a natural alternate host.

This virus spreads by way of salivary gland secretions of adult bees and in food stores to which these secretions are added. In Europe and North America, ABPV has been shown to kill adult bees and bee larvae in colonies infested with the mite *Varroa jacobsoni*. The mite damages bee tissues and, in so doing, may act as a vector, releasing viral particles into the hemolymph.

The biology of bee viral diseases, their relationship with mites, and their effects on bees are poorly understood. Analysis of the complete genome sequence of *Acute Bee Paralysis Virus* will provide a better understanding of the relationship among viruses, mites and colony decline.

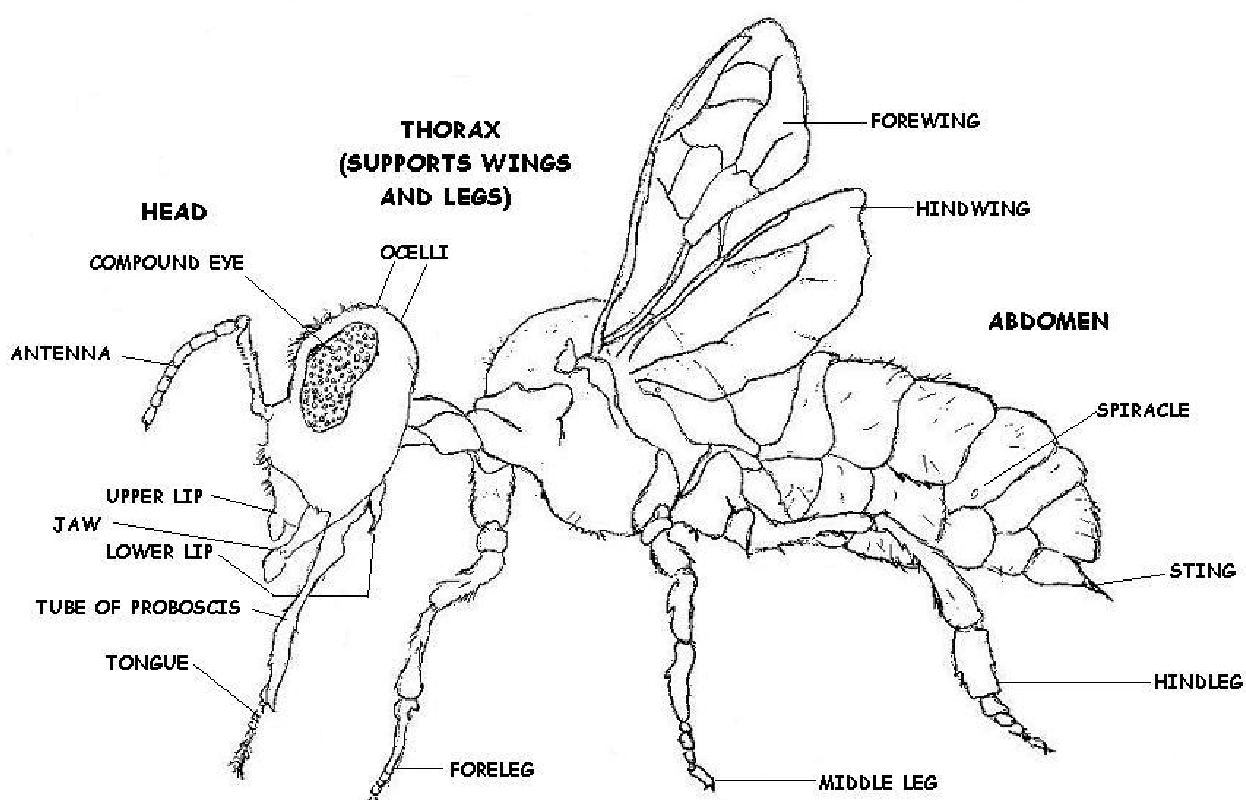
The genome sequencing project has stated that the overall genome structure of ABPV showed similarities to those of *Drosophila* C virus, *Plautia stali* intestine virus, *Rhopalosiphum padi* virus, and *Himetobi* P virus, which have been classified into a novel group of picorna-like insect-infecting RNA viruses called cricket paralysis-like viruses. It is suggested that ABPV belongs to the cricket paralysis-like viruses.

What is Killing Honeybees?

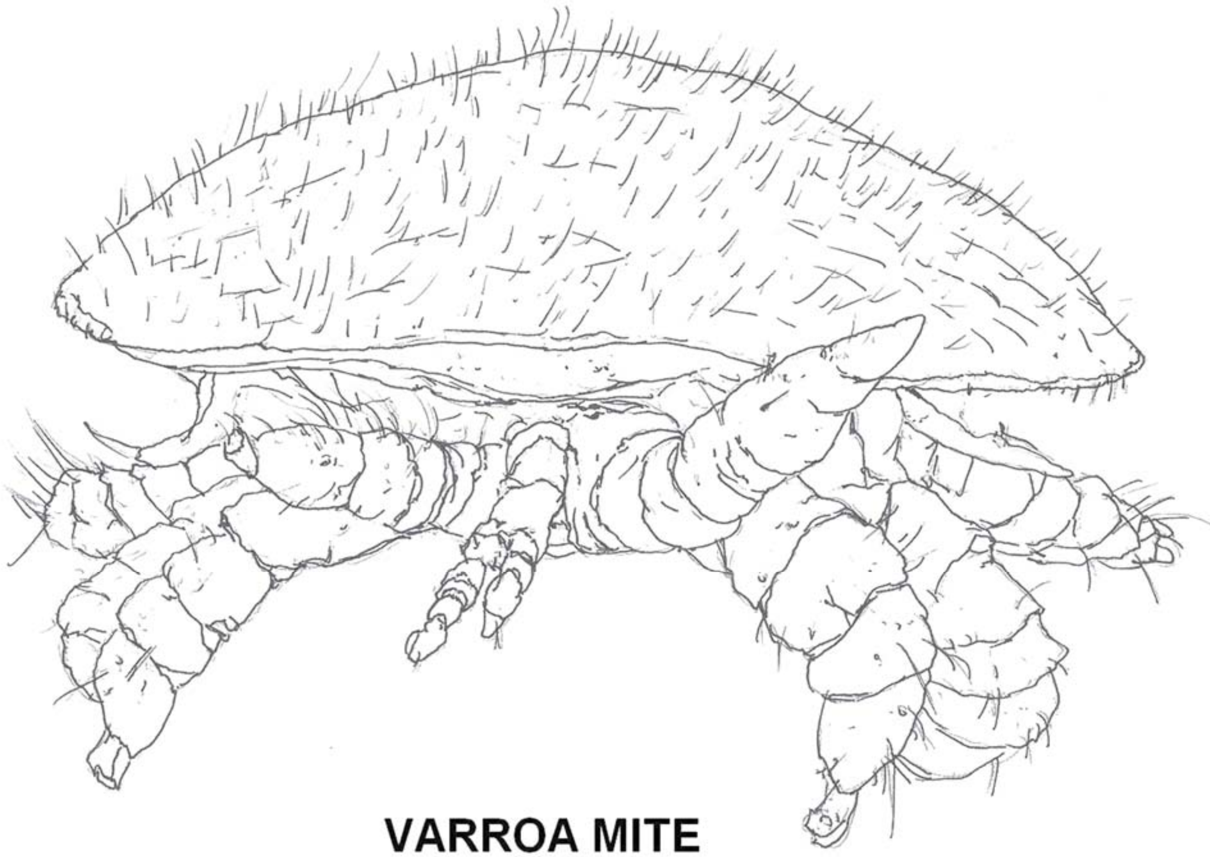
The honeybees may have been especially vulnerable to the varroa epidemic. When the honeybee genome was sequenced a few years ago, researchers discovered fewer immune-system genes than you'd find in other insects. This is despite the fact that the honeybee lives in tenement like conditions, anywhere between 15,000 and 30,000 of them crammed into a hive the size of a filing cabinet. To make matters worse, a weakened hive often becomes the target of honey-raiders from healthier colonies, which only helps the parasites to spread. It's possible that if the American honeybees had been left to their own devices, they would have died off in epic numbers and then evolved natural defenses against varroa (like more effective grooming), as they did in Asia. But crops had to be pollinated and no one had the time to sit around and wait.

Biology of Varroa Mites

The Varroa mite (*Varroa jacobsoni*) is an external parasite of honey bees. It was first discovered in the U.S. in 1987. Previous to this discovery, the mite had not been found in the U.S., although it had been a major problem in Europe, Asia and South America. The Varroa mite is a small, red brown mite measuring approximately 1 - 1.5 millimeters in length and width. The mites feed on the blood of adult bees, larvae and pupae. The feeding of Varroa mites has a number of effects on the bee, from damaging tissue to shortening the bee's lifespan as an adult. In addition, the mites vector disease viruses. Heavy levels of parasitism increase bee mortality and weaken colonies. Colony mortality varies from a few percent the first year to levels approaching 100% by the fourth or fifth year.



Varroa Mite



Deformed Wing Virus
Deformed wing virus (DWV) can cause wing deformity and premature death in adult honeybees, although, like many other bee viruses, DWV generally persists as a latent infection with no apparent symptoms. Using reverse transcription (RT)-PCR and Southern hybridization, scientists detected DWV in all life stages of honeybees, including adults with and without deformed wings. Scientists also found DWV in the parasitic mite *Varroa destructor*, suggesting that this mite may be involved in the transmission of DWV.

However, the detection of the virus in life stages not normally associated with mite parasitism (i.e., eggs and larvae) suggests that there are other modes of transmission. The levels of DWV in different life stages of bees were investigated by using TaqMan real-time quantitative RT-PCR. The amounts of virus varied significantly in these different stages, and the highest levels occurred in pupae and in adult worker bees with deformed wings.

The variability in virus titer may reflect the different abilities of bees to resist DWV infection and replication. The epidemiology of DWV and other factors such as mite infestation, malnutrition, and climate should also be considered.

Colony Collapse Disorder

Colony Collapse Disorder, also known as Fall-Dwindle Disease, is of great concern to beekeepers worldwide. Beekeepers are reporting the sudden loss of adult bees in their colonies – few, if any, adult bees are found in or near the dead colonies. Queen and baby (brood) bees remain in the colonies, but the adults are not returning to provide food, so the colonies collapse or die. Over 22 US states reported significant colony losses in the fall of 2006. Similar reports are coming from Europe as well. Researchers are considering viruses, bacteria, fungi, weather, food loss, and other stresses as possible causes.

General Description of Condition:
Beekeepers report the sudden loss of a colony's population of adult bees. In all cases few, if any, adult bees were found in or near the dead colonies. Capped brood was often found in these colonies. Dead out colonies often contained food reserves that had not been robbed out, despite the presence of living colonies in an area. Most dead out colonies showed no, or minimal, evidence of wax moth or small hive beetle damage. In colonies that still have bees, small clusters were reported with evidence of a laying queen. The surviving workers tended to look young in age.

From 1972 to 2006, there was a dramatic reduction in the number of feral honey bees in the U.S. (now almost absent) and a significant though somewhat gradual decline in the number of colonies maintained by beekeepers. This decline includes the cumulative losses from all factors, such as urbanization, pesticide use, tracheal and Varroa mites, and commercial beekeepers' retiring and going out of business. However, in late 2006 and early 2007 the rate of attrition was alleged to have reached new proportions, and the term "colony collapse disorder" began to be used to describe this sudden rash of disappearances, (sometimes referred to as Spontanious Hive Collapse or the Mary Celeste Syndrome in the United Kingdom).

Losses had remained stable since the 1990s at 17%-20% per year attributable to a variety of factors, such as mites, diseases, and management stress. The first report of CCD was in mid-November 2006 by a Pennsylvania beekeeper overwintering in Florida. By February 2007, large commercial migratory beekeepers in several states had reported heavy losses associated with CCD. Their reports of losses varied widely, ranging from 30% to 90% of their bee colonies; in some cases beekeepers reported loss of nearly all of their colonies with surviving colonies so weakened that they might no longer be viable to pollinate or produce honey.

Losses were reported in migratory operations wintering in California, Florida, Oklahoma and Texas. In late February, some larger non-migratory beekeepers in the mid- Atlantic and Pacific Northwest regions also reported significant losses of more than 50%. Colony losses also were reported in five Canadian provinces, several European countries, and countries in South and Central America and Asia. In 2010 the USDA reported that data on overall honey bee losses for 2010 indicated an estimated 34 percent loss, which is statistically similar to losses reported in 2007, 2008, and 2009.

Limited occurrences resembling CCD have been documented as early as 1869 and this set of symptoms has in the past several decades been given many different names (disappearing disease, spring dwindle, May disease, autumn collapse, and fall dwindle disease). Most recently, a similar phenomenon in the winter of 2004/2005 occurred, and was attributed to Varroa mites (the "Vampire Mite" scare), though this was never ultimately confirmed. Nobody has been able to determine the cause of any past appearances of this syndrome. Upon recognition that the syndrome does not seem to be seasonally restricted, and that it may not be a "disease" in the standard sense—that there may not be a specific causative agent—the syndrome was renamed.

Signs and Symptoms
A colony which has collapsed from CCD is generally characterized by all of these conditions occurring simultaneously:

- Presence of capped brood in abandoned colonies. Bees normally will not abandon a hive until the capped brood have all hatched.
- Presence of food stores, both honey and bee pollen: which are not immediately robbed by other bees and/or. which when attacked by hive pests such as wax moth and small hive beetle, the attack is noticeably delayed.

- Presence of the queen bee. If the queen is not present, the hive died because it was queen less, which is not considered CCD.

Precursor symptoms that may arise before the final colony collapse are:
- Insufficient workforce to maintain the brood that is present.
- Workforce seems to be made up of young adult bees.
- The colony members are reluctant to consume provided feed, such as sugar syrup and protein supplement.

The National Agriculture Statistics Service reported that there were 2.44 million honey-producing hives in the United States as of February 2008, down from 4.5 million in 1980, and 5.9 million in 1947, though these numbers underestimate the total number of managed hives as they exclude several thousand hives managed for pollination contracts only, and also do not include hives managed by beekeepers owning fewer than 5 hives. This under-representation may be offset by the practice of counting some hives more than once; hives that are moved to different states to produce honey are counted in each state's total and summed in total counts.

In the U.S., at least 24 different states as well as portions of Canada had reported at least one case of CCD in 2007. However, subsequent analysis revealed that in many cases beekeepers reporting significant losses of bees did not experience true CCD, but losses due to other causes. In a 2007 survey of 384 responding beekeepers from 13 states reporting the number of hives containing few or no bees in spring, 23.8% met the specified criterion for CCD (that 50% or more of their dead colonies were found without bees and/or with very few dead bees in the hive or apiary). In the U.S., CCD-suffering operations had a total loss of 45% compared to the total loss of 25% of all colonies experienced by non-CCD suffering beekeepers in 2006-2007; however, non-CCD winter losses as high as 50% have occurred in some years and regions (e.g., 2000-2001 in Pennsylvania), though normal winter losses are typically considered to be in the range of 15-25%.

Possible Causes
The exact mechanisms of CCD are still unknown, but many causes have been proposed as causative agents; malnutrition, pathogens, immunodeficiencies, mites, fungus, pesticides, beekeeping practices (such as the use of antibiotics, or long-distance transportation of beehives) and electromagnetic radiation. Whether any single factor or a combination of factors (acting independently in different areas affected by CCD, or acting in tandem) is responsible is still unknown for certain, however most recent information suggests a combination of factors is most likely. It is likewise still uncertain whether CCD is a genuinely new phenomenon as opposed to a known phenomenon that previously only had a minor impact.

At present, the primary source of information, and the presumed "lead" group investigating the phenomenon, is the Colony Collapse Disorder Working Group, based primarily at Pennsylvania State University. Their preliminary report pointed out some patterns but drew no strong conclusions.

A survey of beekeepers early in 2007 indicated that most hobbyist beekeepers believed that starvation was the leading cause of death in their colonies while commercial beekeepers overwhelmingly believed that invertebrate pests (Varroa mites, honey bee tracheal mites, and/or small hive beetles) were the leading cause of colony mortality. A scholarly review in June 2007 similarly addressed numerous theories and possible contributing factor, but left the issue unresolved.

In July 2007, the United States Department of Agriculture (USDA) released its "CCD Action Plan", which outlined a strategy for addressing CCD consisting of four main components:
1. Survey and data collection;
2. Analysis of samples;
3. Hypothesis-driven research; and
4. Mitigation and preventative action.

Natural Bee Pests and Destroyers

Brood Diseases
The most common brood diseases found in the United States are American and European foulbrood, sacbrood, and chalk brood.

American Foulbrood
American foulbrood disease occurs throughout the world where honey bees are kept. About 3 percent of all colonies inspected in the United States are found to be infected.

Bacillus larvae White, the causative organism of American foulbrood disease, is a spore-forming bacterium which produces over a billion spores in each infected larva. Only spores are capable of inciting the disease. The spores are extremely resistant to heat and chemical agents. Worker, drone, and queen larvae are susceptible to the disease. Under natural conditions, infected queen and drone larvae are rarely seen.

A severely infected American foulbrood comb has a mottled appearance due to a mixture of healthy capped brood, cells containing the remains of diseased larvae, and empty cells. The cappings of cells containing disease appear moist and darkened. The convex cappings found on cells of diseased larvae become concave as the disease progresses. Another symptom commonly associated with the disease is the punctured capping. Larvae are susceptible to American foulbrood only when they are less than 3 days old. A healthy larva has a glistening, pearly white appearance. Normally it begins development curled on the base of the cell. As it grows, it elongates to the full length of the cell. It is in the elongated position that the larva or pupa dies. As the infection progresses, the larva or pupa changes to creamy brown and eventually becomes dark brown. The remains become ropy and can be drawn out as threads of an inch or more. A very unpleasant, foul odor develops at this stage. The odor resembles that of animal glues that are rarely used.

The remains of diseased brood finally dry down to form scales that adhere strongly to the lower sides of the cells. If death occurs in the pupal stage, the mouth parts may adhere as a fine thread to the upper side of the cell. This is a positive symptom of American foulbrood disease. The infection can be transmitted to a larva from nurse bees or from spores remaining in the bottom of the brood cell. Exchanging combs containing remains of diseased larvae or honey, or both, laden with spores of B. larvae is the most effective way to spread the disease from colony to colony. Early detection of the disease is helpful in preventing further spread. A colony that is weakened by American foulbrood may be robbed, and the robber bees inadvertently carry honey containing spores of B. larvae to healthy colonies.

European Foulbrood
In some areas, European foulbrood is a more serious threat to beekeepers than American foulbrood. This disease is serious because it occurs most frequently at the time that colonies are building their peak populations. The cause of this disease is Streptococcus pluton White, a nonspore-forming bacterium. Other bacteria commonly associated with the disease are Bacillus alvei Chesire & Cheyne and Bacterium eurydice White.

Superficial examination of diseased combs shows the same mottled effect and puncturing as seen in American foulbrood. Death usually occurs in the larval stage. Worker, drone, and queen larvae are equally susceptible to European foulbrood.

Larvae that die from European foulbrood are found in various positions. Some are in a curled stage and others elongated. The normal pearly white appearance of a healthy larva changes to a dull white, then yellow and finally brown. Ropiness and sour odor are caused by the secondary organisms associated with the disease. The elasticity of the ropy material i-s less than that associated with American foulbrood. The tracheae appear as fine silvery tubes immediately below the skin, especially as the larvae turn brown. This symptom is highly characteristic of European foulbrood. Loosely adhering scales also differentiate this disease from American foulbrood.

European foulbrood can be transmitted by contaminated food stores, and equipment. The disease usually is most serious in the spring and clears up during the summer when nectar and pollen are abundant. However, outbreaks of European foulbrood in the late summer are not unusual.

Chalk Brood
Chalk brood disease was not found in this country until 1968. Since that time, the disease has spread throughout the United States and Canada. No accurate figures are available on losses attributed to this disease. Chalk brood appears primarily in the spring, although outbreaks in the summer and fall can occur.

Ascosphaera apis (Massen ex Claussen) Olive and Spiltoir, a fungus, is the cause of chalk brood disease. Larvae, 3 to 4 days old, are most susceptible to the fungus, especially if they are chilled after ingesting spores of A. apis. Worker, drone, and queen larvae all are susceptible to chalk brood disease.
Infected larvae become permeated with the mycelia of the fungus, leading to their death. Eventually, the mycelia-filled larvae dry up to form the typical hard white mummies characteristic of chalk brood disease. Diseased larvae are stretched out in their cells and also can be mottled or completely gray or black. This color variation is due to the presence or absence of the black fruiting bodies that are formed on the outside of the larvae.

The disease can be detected by examining the combs, the entrance, and bottom boards of the hives for the presence of the mummies. The mummies do not stick to the cells and are easily removed by nurse bees. If colonies have pollen traps, the mummies frequently are found in the traps and are a source of infection in trapped pollen. The mummies have a faint yeast-like odor.

Chalk brood disease can be transmitted by adult bees and equipment contaminated with spores of A. apis. The disease appears to clear up spontaneously and may reappear later in the season or the following year. The disease rarely destroys a colony but can reduce the population of bees and consequently affect the honey yield.

Sacbrood
Death of a colony by sacbrood is rare. Because of the similarity to other diseases, however, the beekeeper should learn to distinguish sacbrood from the more serious diseases. The etiologic agent in sacbrood is a virus. Larvae die of sacbrood in capped cells in the elongated position. As the disease progresses, the larval skin forms a sac, which separates from the pre-pupal skin. Between these two layers of skin is an accumulation of fluid. The outer skin toughens and, as a result, the larva can be picked up in its entirety without the release of the fluid.

The larva changes from pearly white to off-white, then brown, and finally almost black. The head of the larva usually curls up from the cell floor (fig. 4). A loosely adhering scale is formed from the larval remains. It has the appearance of a foulbrood scale but no odor, and is free of bacteria.

Like European foulbrood, sacbrood is most commonly found in the spring. No chemotherapeutic agent is effective against sacbrood. Re-queening may be helpful, but most colonies appear to recover spontaneously from the disease.

Other Blood Diseases
Aspergillus flavus Link, a fungus, usually is isolated from bees that have stonebrood. This disease is unusual in that it infects both brood and adults. Bees dying from this disease form mummies. The fruiting bodies of the fungus make the infected bee appear yellowish-green or brown.

Purple brood is a nutritional disease of larvae and pupae. It is believed to be caused by nectar or pollen from Cyrilla racemiflora L., also called southern leatherwood, black titi, red titi, summer titi, and he-huckleberry. This problem exists only in the Southern States, where southern leatherwood is found. Diseased larvae and pupae are purple.

Other conditions that mimic contagious diseases are chilled and starved brood. Chilled brood is caused by lack of sufficient bees to keep the brood area warm. Consequently, chilled brood usually is found at the outer edge of the brood nest. Brood may have the appearance of European foulbrood but is readily removed by nurses bees as the brood pattern expands. Starved brood generally is caused by insufficient nectar or honey. At times, wax moth damage to developing bees may cause them to appear diseased.

Adult Diseases
Nosema Disease
Nosema disease is the most widespread of all bee diseases. It was found in over 60 percent of the apiaries sampled in the United States. This disease is caused by the protozoan, Nosema apis Zander. Nosema disease reduces the life expectancy of adult bees. It can cause queen supersedure and reduce the honey production of infected colonies.

The disease cycle is initiated by adult bees that ingest spores of N. apis, which germinate and multiply in the epithelial cells of the ventriculus. In addition to affecting the digestive process, the hypopharyngeal glands of infected worker bees and the ovaries of infected queens become atrophied. The disease is found in workers, queens, and drones. No external symptoms may be visible in bees or in colonies infected with N. apis. Some of the infected ventriculi may become distended and white. Nosema disease is diagnosed by examining for the presence of N. apis spores. However, the absence of spores does not ensure freedom from nosema disease, since other life stages of the protozoan may be present. The disease has an annual cycle which results in maximum numbers of spores in the spring. Spore numbers decline in the summer, and in some cases, a small peak in the fall may be visible.

Virus Bee Paralysis
Bee paralysis is caused by several different viruses, but some nectars and pollens also may induce similar symptoms. Chronic bee paralysis and hairless black syndrome are caused by the same virus. Acute bee paralysis, caused by another virus, kills bees more quickly than the chronic virus.

Affected bees quiver and cannot fly. Frequently, they appear greasy and shiny with no hair on their thorax. The disease is transmitted to healthy bees when they attack diseased bees or when food is exchanged between healthy and diseased bees. Workers, drones, and queens are susceptible to chronic bee paralysis. It appears that susceptibility to the disease is inherited from the queen. Consequently, re-queening of colonies with the disease may rid the colony of all symptoms.

Septicemia
Septicemia is a bacterial disease of adult honey bees that is rarely encountered; it is caused by Pseudomonas apiseptica Burnside. The bacteria, by some unknown method, make their way to the hemolymph, multiply rapidly, and ultimately cause the death of the host. Bees that die from septicemia appear to have no connective tissues and dismember easily. The legs, wings, head, thorax, and abdomen separate-even by the slightest handling. Hemolymph of infected bees also may be milky white in color. The isolation and identification of Ps. apiseptica bacteria from the hemolymph may be necessary for verification.

Mite Diseases
The Asiasitic mites, Varroa jacobsoni Oudemans and Tropilaelaps clareae Baker and Delfinado, both affect larvae and pupae of the honey bees. Varroa jacobsoni has been found in South America but is not present in North America. However, T. clareae has not been found on bees outside Southeast Asia.

The mature female V. jacobsoni mite attaches itself to bees and can be transmitted from colony to colony by robbing and drifting bees. The female mite lays her eggs in cells containing larvae just before being sealed. After the eggs hatch, the nymphs feed on the developing larvae or pupae, causing malformation and sometimes death of the host.

Acarine Disease
Acarapis woodi Rennie, the causative agent of acarine disease, has not been found in North America. The Honeybee Act enacted in August 1922 and amended several times since prohibits the importation of all live stages of the honey bees and was written principally to prevent the entry of A. woodi into North America. The mite enters its host via the spiracles and spends most of its life in the thoracic tracheae. At maturity, the female mite emerges from the tracheae in search of a new host. Noone symptom characterizes this disease; an affected bee could have disjointed wings and be unable to fly or have a distended abdomen, or both. Positive diagnosis of this disease can be made by microscopic examination of the tracheae for discoloration (black spots) and the presence of eggs, nymphs, and adult stages of the mite.

External Mites
External mites frequently are present on bees in the United States. These mites closely resemble Acarapis woodi but cause no apparent harm to the bees. A microscope is necessary to differentiate external mites from A. woodi.

Other Adult Diseases
Amoeba disease and gregarines are protozoans sometimes found in honey bees in North America. Neither disease seems to be of economic importance. Amoeba disease is caused by Malpighamoeba (Vahlkampfia) mellificae Prell. This disease sometimes is found together with nosema disease, and the combination may be more serious than either disease alone. The cysts of the amoeba are transmitted by the excreta of bees, and the infection is localized in the Malpighian tubules. It is believed that the amoeba interferes with the function of the Malpighian tubules, which ultimately leads to the death of the bee. Diagnosis for this disease is made by microscopic examination of the Malpighian tubules for the presence of amoeba cysts. Gregarines are found in the digestive tract of adult bees. No pathological significance, however, has been attached to these protozoans. Several different genera of gregarines are found in the United States.

Wax Moths
The most serious pest to honey bee colonies is the greater wax moth, Galleria mellonella L. In addition to the greater wax moth, comb damage is caused by the lesser wax moth, Achroia grisella F. and the Mediterranean flour moth, Anagasta kuehniella Zeller.

Damage by the greater wax moth is severest in the Southern United States because of the long warm season and high temperatures. The wax moth distribution, however, includes all areas where honey bees are kept. It is not a threat to normal colonies and cannot kill a colony, but weakened colonies are invaded and unused combs destroyed.

Female wax moths lay their eggs on combs or in cracks between the wooden parts of the hives. After egg hatch, the larvae feed on the wax combs, obtaining nourishment from the cast-off honey bee pupal skins, pollen, and other impurities found in the combs. For this reason, darkened combs are more likely to be infested than light combs or foundation.

The fully grown larva spins its own cocoon, which usually is attached to wooden parts inside the hive-such as the inner cover, hive body, and frame. In colder climates, the greater wax moth overwinters as a pupa. In warmer areas, adults emerge all year. The adult female is about 3/4-inch long and 1 to 1-1/4 inches wide from wingtip to wingtip. Within 4 to 10 days after emergence, the female begins to lay eggs. She lays about 300 eggs in her lifetime, which usually is somewhat less than 3 weeks. Combs are most often destroyed by the wax moth when stored in dark, warm, and poorly ventilated rooms. However, there can be considerable damage to combs even while in use, especially in hives where the population of adult bees is too small to protect all the combs.

Paradichlorobenzene and ethylene dibromide have been used in the past for the control of wax moths. Other control measures include carbon dioxide, heat, or cold treatments. Larvae of the Mediterranean flour moth and the lesser wax moth also can cause damage to combs in storage and in the hives. The damage caused by these insects is quite similar, and it is necessary to identify the insects to be certain which is causing the problem. The same control methods work for all three insects.

Other Insect Pests
In some areas of the United States, termites may damage the wooden parts of the hive. The termites do not affect the bees directly. Although ants can be found in hives, they rarely cause any problem. Ants are more of a nuisance to the beekeepers than to the bees. Other insects such as certain wasps and robber flies also prey on honey bees but are considered of no economic importance in the United States.

Braula coeca Nitzsch, the “bee louse,” is found primarily in the Mid-Atlantic States. The bee louse actually is a wingless fly and not a louse. This insect can be found on drones, workers, and queens. The destructive stage of the insect is the larva, which burrows under the cappings of honeycombs and ruins what would be good comb honey. No apparent damage is attributed to the adult bee louse, which spends its life on the bodies of workers and queens.

Enemies of Bees
Bears cause severe damage to the hives as they feed on the honey, adult bees, and brood. Electric fences and bear platforms have been used successfully to prevent bear damage. Skunks, birds, toads, and frogs also feed on adult bees. Skunks can cause serious damage, as they consume large numbers of bees and thereby deplete populations to critical levels. In the winter, mice can enter hives without entrance reducers. Although mice do not feed on bees, they chew on the combs and frames to construct nests in a warm, secluded area of the hive where they are not disturbed by the clustered bees.

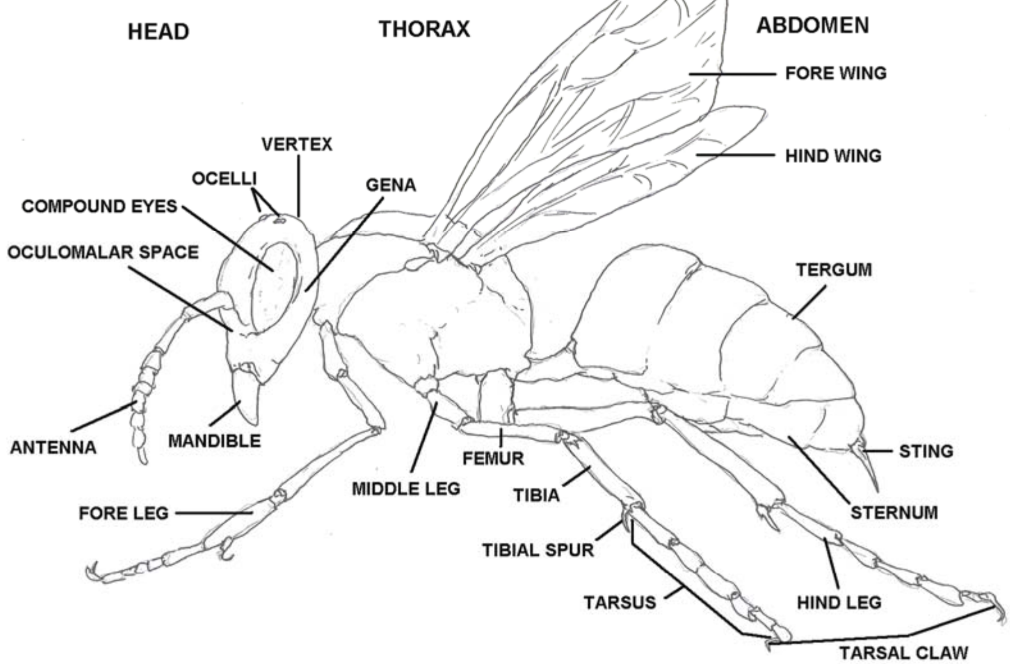
Control of Bee Diseases
The U.S. Food and Drug Administration approved labeling for oxytetracycline and fumagillin as aids in the control and prevention of bee diseases. Oxytetracycline is effective in the control of both American and European foul brood disease. Fumagillin is used to control nosema disease. Users should read the container label-it has specific instructions for the use of these materials. These drugs can be used subject to State laws and regulations in the manner specified but should never be used at a time or in such a way that would result in contamination of the marketable honey. Some States require that the bees, contaminated combs, and honey from infected colonies be destroyed by burning. Beekeepers should consult their local apiary inspector for instructions on the disposal of diseased hives and the use of drugs.

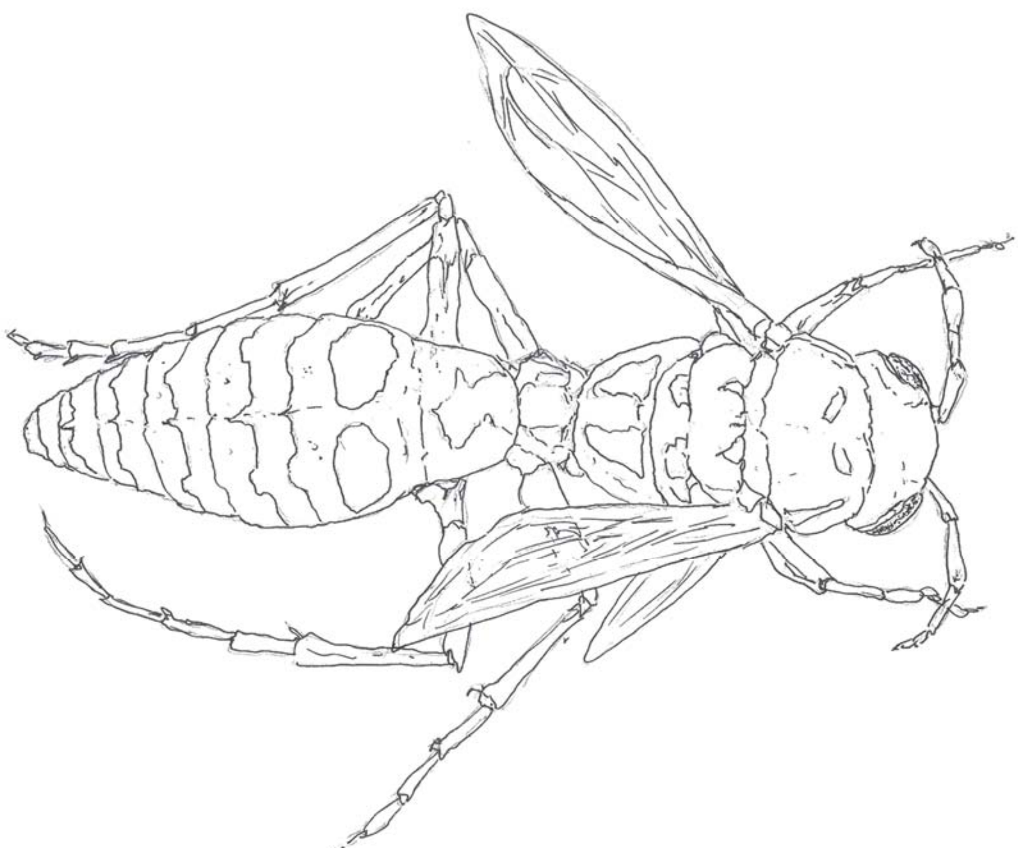
Sending Samples for Laboratory Examination
If only a small amount of the brood or a few bees are affected or if the symptoms are unusual, a definite diagnosis in the apiary is sometimes difficult. Examination by laboratory methods is then necessary. Sometimes laboratory verifications of diagnoses made in the apiary also are desirable. Diagnosis of disease in the laboratory is a service made available to beekeepers and State apiary inspectors by the U.S. Department of Agriculture.

A sample of brood comb for laboratory examination should be 4 or 5 inches square and contain as much of the dead brood as possible. No honey should be present, and the comb should not be crushed. A sample of adult bees should consist of at least 200 sick or recently dead bees.

Mail the samples in a wooden or strong cardboard box. Do not use a tin, glass, or plastic container, and do not wrap the comb or bees in waxed paper or aluminum foil. Send all samples to the U.S. Department of Agriculture, Science and Education Administration, Bioenvironmental Bee Laboratory, Building 476, BARC-E, Beltsville, Md. 20705. Your name and address should be plainly written on the box. If the sample is forwarded by an inspector, his or her name and address also should appear on the box.

BASIC MORPHOLOGY OF A FEMALE WASP





UMBRELLA WASP

Topic 2 Bees and Related Bee-Like Insects Post Quiz
Answers at rear of Glossary
Fill-In-the-blank

1. Mostly seen hovering bushes and flowers. In its strict application, the name refers to members of the______________, a large family of bees that are common in most of the world except Australia and Southeast Asia, where they are only a minor faunistic element. In the USA, the common species are black, brown, red, or metallic green, and sometimes with yellow markings, and usually 1/4 to 1/2 inch (4-10 mm) in size.

Identifying characteristics for the family Halictidae include:

2. In many species, the tongue is long and pointed, adapted for probing into flowers. All bees are covered with hair, to which pollen sticks when flowers are visited; most female bees have apparatus for gathering this pollen; it is combed into a special basket or brush located on the hind legs. Males do not collect pollen and lack these structures. There are a few species, especially the parasitic bees that have_______________.

Mason Bee

3. Smaller than a honeybee, mason bees resemble ____________more than honey bees. They are deep blue-black in color and have no stripes. Mason bees are native to North America. They are active pollinators between cherry blossom and apple blossom season, and then die out by summer. Attract mason bees by providing them a home. Drill holes exactly 5/16-inch in diameter into wooden blocks and mount the blocks by cherry blossom season facing morning sun.

Orchid Bee Not to be confused with Orchard Bee

4. Male orchid bees have uniquely modified legs which are used to collect and store different volatile compounds (often esters) throughout their lives, primarily from orchids in the sub-tribes Stanhopeinae and Catasetinae, where all species are exclusively pollinated by____________.

5. Different orchid bee males are attracted to different chemicals, so there is also some specificity regarding which orchid bees visit which types of orchid. Not all orchids utilize euglossines as pollen vectors, of course; among the other types of insects exploited are other types of bees, wasps, flies, ants, and moths. The male *Eufriesea purpurata* is highly unusual in actively collecting the _____________in huge amounts from houses in Brazil, without suffering any harm from it.

Cuckoo Bee

6. Cuckoo Bees are parasites, in that the female cuckoo bee lays her eggs in the nest of other bees, primarily digger bees and Andrenids. Cuckoos are also said to be kleptoparasites, stealing honey and pollen collected by others. Cuckoo bees lack any pollen-transporting apparatus (_______________). Look for cuckoo bees flying low over the ground and foliage, hunting for foraging and nesting potential victims.

7. Many cuckoo bees are closely related to their hosts, and may bear similarities in appearance reflecting this relationship. This common pattern gave rise to the ecological principle known as "____________". Others parasitize bees in different families, like *Townsendiella*, a nomadine apid, one species of which is a cleptoparasite of the melittid genus *Hesperapis*, while the other species in the same genus attack halictid bees.

Bumble Bee or Carpenter Bee?
8. When encountering black, almost round bees buzzing around their home most people do not know the difference between the bumble bee and__________________. There are two basic things to note that should quickly let you know which bee you are seeing: location and activity of the bee and certain physical characteristics of the bee.

Queen Bumble Bee
9. The queen bumble bee comes out of hibernation every ______________to find a new spot to build her nest and start a new colony. The queen bee is fertilized the previous season and has managed to live through the winter months. The same nesting spots (from previous seasons) are rarely used. A suitable place for nesting is usually on the ground, beneath a flat object. An old mouse hole or similar hole in the ground is preferred if it is underneath an old tarp, flat stone or man-made objects such as a deck. The hole chosen by the queen bee is first padded by pieces of vegetation such as dry grass or moss.

Bumble Bee Control
10. Bumble bees are ___________________that pollinate plants and flowers. Their activity in gardens is desirable, but allowing them to nest in areas where children and pets frequent or where you garden is not desirable.

Topic 3 Bee Control Section

Honey bees play an important role in agriculture. For decades, entomologists have included a strong statement about the protection of honey bees in their insect control guides and pest management programs. However, when honey bees become a threat to public health or the welfare of domestic animals, they must be dealt with differently. When bees colonize an area frequented by humans or domestic animals, they become a pest or health risk. At such times they must be removed or eliminated.

Bees that need to be removed fall into two categories: *swarms and established colonies*.

Bee Swarms
Capturing swarms is a common method of obtaining bees by hobbyists and commercial beekeepers. Swarms are captured and introduced into hives with removable frames, where they can be managed properly for honey production or pollination services.

Capturing a swarm is a relatively easy procedure because bees are not defensive when swarming. However, it is not recommended for those who aren't familiar with the habits of bees or who don't have the proper protective equipment.

Once the AHB is established in an area, it is more difficult to get beekeepers to capture swarms for their own use. They will not wish to risk capturing a swarm that may be Africanized.

Swarms seldom remain long before scout bees find a suitable site to colonize. However, it may be desirable, in an area where the AHB is established, to eliminate swarms in an effort to prevent colonization of certain sites, such as in or near dwellings.

Swarms may be eliminated with approved insecticides. They may also be eliminated by spraying with soapy water. Liquid dishwashing soap in a 5% solution is recommended (1 cup of soap/gal). A high volume spray achieves the best effect. Avoid fine mists.

A swarm of honey bees is a temporary inconvenience that may last a few hours or days. Honey bees in a swarm are usually gentle because they have stomachs full of honey. If left undisturbed, a swarm will locate new quarters and often disappear as quickly as it appeared. In the past, local beekeepers collected swarms to put into their unused hives. They would at times charge a nominal fee for their time and effort.

Remember: A swarm is only temporary and will move away as soon as the bees find a new home. Only in unusual situations will a swarm remain to build comb and not move from a cluster site.

Bee Colonies
Although feral colonies seldom cause problems unless provoked, if they are established in an area where interaction with man or domestic animals may occur, they should be eliminated. Once a colony is established it will defend its nest. Only experienced persons with protective equipment should attempt to remove or eliminate bee colonies.

Insecticides
Numerous insecticides are approved for use on bees. These chemicals are very effective when used properly. Soapy water doesn't work effectively on a colony because honeycomb prevents adequate coverage. Bee colonies may be removed physically by hand or by vacuuming with special types of vacuums. Once collected, the bees can be placed in a hive, released at a different location, or killed with insecticide.

Removing Bees
Occasionally, even honey bees are considered pests and must be dealt with like any other unwanted insect. Because of the attention recently focused on AHBs, it is important to provide homeowners, pest control operators, and others with sound information on how to deal with honey bees when they are pests. Bee colonies may nest in tree hollows or in structures, such as attics, between the wall studs of houses or garages, within porch roofs, or in similar areas.

Bees in Buildings
Bees nesting in buildings, unlike swarms, are a great problem. There is no easy, convenient method of removing the bees. However, every effort should be made to determine the extent of the nest and to give priority to removing and relocating the bees, brood, and honey stores.

Simply killing the bees will only make for more complex problems in the future. For instance, an unattended nest of beeswax, honey, brood, and pollen will attract other insects and animals. Wax moths will enter to consume the wax, cockroaches and ants will find the brood and honey.

Decaying brood and fermenting honey will cause undesirable odors. Melting wax and honey can soak into walls, making them impossible to paint or wallpaper. Walls will also remain moist to the touch for a considerable period of time. If removing the bees and their nest is not practical, then other methods of dealing with them can be considered. The following steps are appropriate guidelines.

Locating Bees
The first step in eliminating the pest problem is locating the nest and getting rid of the adult bees. It may be difficult to locate the comb, as it may be some distance from the entrance/exit used by the bees. Some of the most common methods of locating comb are:

1. If bees are inside a wall with sheetrock on one side, feel the sheetrock for warmth; tap the sheetrock and listen for a solid sound vs. a hollow sound. Listen also for buzzing when tapping.

2. If bees are in a wood, brick, or sheetrock wall, when you think you have located the nest, drill a hole (1/16") large enough for a coat hanger wire. Straighten out a coat hanger and stick it in the hole. You should have honey or wax on the hanger when you withdraw it. Work close to the top of the wall with holes and coat hanger because bees always hang the honeycomb down from an overhead support.

Drenching a bee hive is the last resort for problem bees.

Removal of the Comb

In some instances, it will be quite expensive to attempt removal of the nest. The homeowner may be willing to put up with the smell and take his/her chances with damage from honey-soaked walls. Several materials can then be used to poison honey bees:

1. Aerosol sprays. Aerosol sprays may be very effective if sprayed through the holes drilled for the coat hanger probe. It may be necessary to drill a number of holes to inject an aerosol spray.

2. Spray concentrates or dusts. Some insecticide liquids or dusts are also very effective for controlling bees and wasps. Equipment to mix and apply such formulations is necessary.

Insecticide

Insecticide should be applied at the entry/exit area of the nest and, if feasible, directly onto the nest (drilling small holes to the nest may be necessary). The nest itself may be some distance upwards, left or right from the entry/exit area and is almost always suspended from some overhead support. Several repeat applications are usually necessary to kill the bees. Whenever using an insecticide, **check the container label for proper concentration, safe use, and area requirements.** For nests in trees or garages, removal usually is not necessary.

Other Problems Associated With Bee Control

Only qualified, experienced personnel should be allowed to remove or destroy bee colonies. **The following must be considered:**

1. Effective, approved pesticides.
2. Safety of the applicator and onlookers.
3. Possible damage, such as staining of wallpaper or wood trim.
4. Pesticide residue that may be harmful to foraging domestic bees.
5. Problems associated with dead bees, honey, and comb after bees are killed.
6. Possibility of re-infestation if structure is not modified.

Publications that elaborate on bee removal and control are:

1. "*Disposing of Africanized Swarms or Feral Colonies*" by Dr. James E. Tew & A.M. Collins
2. "*How to Remove Bees from Buildings*" by Ward Stanger
3. "*Control of Honey Bees in and around Homes*" by Drs. Alton Sparks and Philip Hammon.

Handling Bee Problems

It is better to prevent bee stings than treat them. This section includes information that may be used to make an area safer by reducing interactions between people and bees. Tips are given that will help prevent interactions with bees.

Safening an Area

"***Safening***" is a term we can use for action taken to modify a habitat, structure, or other factor that will result in a safe environment for people or domestic animals. With respect to bees, this is usually action taken to reduce or eliminate a population. It could also be action taken to prevent or discourage bees from colonizing an area.

Safening the Home

Homes may be made safer by locating and removing bee colonies. Desirable nesting sites may be reduced by discarding barrels, old appliances, abandoned cars, piles of debris, and other materials. Hollow trees and logs should be removed. Cavities in landscape trees may be filled with foam insulation. Loose insulation beneath mobile homes, and open vents beneath homes or attics should be repaired. Vents should be screened with wire mesh small enough to prevent bee entry. Knot holes and cracks in houses, barns, and storage structures need to be repaired or filled. Holes made for utilities and plumbing should be inspected, and any openings should be closed or filled to prevent entry of bees.

Safening the School

Safening a school is much like safening a home. Inspections should be made periodically, such as just prior to the beginning of each school year. All colonies should be removed and modifications made to prevent re-colonization. Students should be informed about bees and instructed to report any swarm or colony immediately.

Safening Recreation Areas and Training Sites
All inside and outside facilities of parks and recreational areas should be thoroughly inspected. All bee colonies should be eliminated and modifications made to prevent future colonization. High-use areas, such as campsites, boat launches and picnic grounds, should be re-inspected periodically to remove any new colonies of bees.

In large wooded areas used for recreational purposes or training sites, signs can be posted informing people that bee swarms may be encountered, requesting that such swarms not be disturbed, and directing that swarms be reported to appropriate authorities.

Avoiding Bee Problems
Most serious incidents involving bees can be avoided with a little effort. In areas where the AHB has become established, people should learn the basics about bees and their habits. When activities increase the possibility of interaction with bees, care should be taken to reduce incidents.

Lawnmowers, Weed eaters, and Chain Saws
Bees dislike the noise, vibrations, and air movement created by lawnmowers. Quick inspection of an area to be mowed or shredded can often reveal bee or wasp colonies that would be disturbed by such actions. Removal of bee colonies prior to mowing dramatically reduces the likelihood of multiple stings.

Domestic Animals
Dogs and other domestic animals have been killed by bee stings. Wherever the AHB becomes established, the number of animal deaths due to bee stings is predicted to increase four to five times. Animals that are not confined, seldom receive many stings because they usually flee the area defended by the bees. Animals in pens or that are tied cannot run away and may receive a lethal dose of venom. Animals should not be confined or tied unless the area has first been checked to make sure that no bee colonies are established nearby.

Large Motorized Equipment
Large equipment can incite an AHB attack through disturbance by engine noise and exhaust, or simply by hitting the colony. Persons most susceptible to attack are those who operate vehicles with open cabs, such as jeeps, bulldozers, backhoes, and tractors. In the event of an AHB attack, exposure can be minimized if the cab can be quickly closed.

This course contains EPA's federal rule requirements. Please be aware that each state implements pesticide regulations that may be more stringent than EPA's regulations. Check with your state environmental/pesticide agency for more information.

General Bee Control and Treatments

The most important element of wasp and bee control is to *destroy the nest*. Aerosol “wasp and hornet” sprays can be used to knock down bees/wasps around the nest. Small amounts of pesticides (dust and wettable powder formulations work well) applied into the nests of carpenter bees and cicada killers provide good control. Nests of mud daubers also can be treated this way or by simply scraping them off structures. To prevent re-infestation, finishes (paint, etc.) can be applied to unfinished wood to discourage carpenter bees.

In some cases, attempting to destroy a nest becomes a greater health risk than simply tolerating and avoiding it. But nests, especially those of social species, should be destroyed if they are close enough to humans to pose a stinging threat. The nests of honey bees, bumble bees, yellowjackets and hornets should always be approached with caution, preferably at night when most of the workers are present but reluctant to fly.

Try not to *carry* a light, as wasps and bees may fly toward it. Instead, set the light aside or cover it with red cellophane (insects cannot see red light). If there is direct access to the nest, a fast-acting dust or wettable powder formulation can be applied. If possible, inject the material into the nest. If you must approach these nests during daytime, a quick knockdown aerosol can be used to keep the bees/wasps at bay, while you treat the nest as above. Heavy clothing or a “bee suit” can be worn for added protection.

Sometimes, yellowjacket and honey bee nests occur in voids such as vents, attics, crawlspaces or hollow walls. Destroying nests in these locations can be difficult, often requiring the services of pest management professionals. Honey bee nests contain honey that must be removed after the bees are eliminated because it will rot and attract secondary pests.

Also, be mindful that nests may be located several feet away from the point at which the bees/wasps are entering the structure. Simply applying pesticides into the entrance holes may not be sufficient. It may be necessary to drill into the structure to enable injection of pesticides directly into the nest. Entrance holes should never be plugged, even after treatment, because the bees/wasps will look for other ways to get out of the nest and have been known to chew their way into living quarters, endangering persons inside. Also, use extreme caution when performing bee/wasp control from a ladder.

Another special case occurs when large numbers of yellowjackets forage in public areas such as parks, schools and zoos. Attracted to human food, especially meats and sweet liquids, wherever it is being prepared, eaten or discarded, yellowjackets pose an increased threat to humans. Control is often difficult. When located in wooded areas, the nests can be difficult if not impossible to find and treat.

Yellowjacket baits and traps can kill large numbers, but there can be a lot more where they came from and the problem may continue. Other types of pesticide applications for control of yellowjackets in outdoor recreation areas are rarely effective. Consequently, management of yellowjackets should focus on prevention, such as keeping food enclosed.

Tight-fitting lids should be kept on outdoor trash containers and they should be moved away from people. In the end, not eating in infested outdoor areas may be the only sure way to avoid being stung.

NOTE: When pesticides are used, it is the applicator’s legal responsibility to read and follow directions on the product label. Not following label directions, even if they conflict with information provided herein, is a violation of federal law.

Mechanical Control: Removing bees without bee poison

Killing bees with bee traps.
One of the most common traps used to kill bees with is the bottle trap. To make one, get an empty two liter soda bottle, remove the lid, cut the top off the bottle at the point where the neck starts to slant inward, turn the top upside down and place it into the bottle so that the two cut surfaces are flush, and secure it there with staples, tape, or both. Once the bee trap is made, pour in a couple inches of something sweet like fruit juice or Mountain Dew, add a couple drops of liquid dish detergent, set your trap out, and watch as bees fly in and die because they're too stupid to get back out.

Remove bees from the house with a vacuum cleaner.
Unless you have a thousand bees swarming your face, the vacuum cleaner is a great way to get rid of bee pests that are in the house. Simply use the hose attachment and suck them into oblivion.

Use a cardboard box for bee swarm removal.
Bee swarms are often found at rest on the ends of tree branches. In order to take care of this problem, some people, who are far braver than I, will take a large cardboard box out to the swarm site in the early morning when the bees are sluggish, open the box and set it below the swarm, quickly jerk the bees' branch up and down a few times to shake them into the box, and quickly close the lid. After checking the branch over really well to make sure the queen is not still on it, the bees are then relocated.

Biological Control: Natural ways to relocate or exterminate bees
Contact a local beekeeper. If you have a colony of honeybees and you want it gone, put some effort into finding someone to come and take them off your hands before killing bees or calling the bee exterminators to do it for you. These days, considering the severity of Colony Collapse Disorder, there's a good chance that some local beekeeper will be more than happy to come and supply you with free bee removal services.

Get rid of ground bees with a sprinkler. Quite often ground bees can be gotten rid of simply by spraying them with water. Connect a sprinkler to your garden hose, set it up next to where the bees are living, and let the fun begin.

Repel carpenter bees with almond oil. During the day, when the bees are out and about, plug their holes and spray the structure they're drilling into with almond oil. Almond oil is a natural bee repellent.

Soap and water kills bees. To exterminate bees nesting in the ground, all you need is some buckets, some warm water, and some liquid dish detergent. Fill a few buckets with some nice, warm, soapy water (exact measurements aren't really needed; just be generous with the soap), and dump the soap water down their holes. If you want to dispatch a bee swarm, exact measurements are a little more important but only because you will be using a sprayer and wanting it to spray properly. Mix a 2% water to soap solution (about 1/3 cup soap to 1 gallon water), and spray away.

Boric acid is a natural bee insecticide. This effective bee killer is a dust that sticks to the legs and bodies of bees. Once on their legs and bodies, bees unwittingly carry it into their hives or nests and poison the rest of the colony. Sprinkle boric acid on the ground around ground nesting sites, at the entrances of hives and nests, or, when dealing with honeybees in the walls, directly into hives via holes drilled through the wall and into the side of the hive.

Pyrethrins are another natural bee pesticide. Pyrethrins, bee killers derived from the flowers of the chrysanthemum, work quite well as a spray for controlling bee populations. Pyrethrins are not generally used to destroy entire bee colonies. Instead, as they only kill the bees that get sprayed directly, pyrethrins are usually just used to keep populations from getting too out of hand. Microcare Aerosol is a good brand.

Specific Bee Treatments

Certain pesticides are harmful to bees. That's why we require instructions for protecting bees on the labels of pesticides that are known to be particularly harmful to bees. This is one of many reasons why everyone must read and follow pesticide label instructions. When most or all of the bees in a hive are killed by overexposure to a pesticide, we call that a bee kill incident resulting from acute pesticide poisoning. But acute pesticide poisoning of a hive is very different from Colony Collapse Disorder and is almost always avoidable.

There have been several incidents of acute poisoning of honeybees covered in the popular media in recent years, but sometimes these incidents are mistakenly associated with CCD. A common element of acute pesticide poisoning of bees is, literally, a pile of dead bees outside the hive entrance. With CCD, there are very few if any dead bees near the hive. Piles of dead bees are an indication that the incident is not colony collapse disorder. Indeed, heavily diseased colonies can also exhibit large numbers of dead bees near the hive.

Pesticides vary in their effects on bees. Worker bees are those primarily affected by pesticides. The symptoms of poisoning can vary depending on the developmental stage of the individual bee and kind of chemical employed . Contact pesticides are usually sprayed on plants and can kill bees when they crawl over sprayed surfaces of plants or other media. Systemic pesticides, on the other hand, are usually incorporated into the soil or onto seeds and move up into the stem, leaves, nectar, and pollen of plants.

Dust and wettable powder pesticides tend to be more hazardous to bees than solutions or emulsifiable concentrates for contact pesticides. Actual damage to bee populations is a function of toxicity and exposure of the compound, in combination with the mode of application. A systemic pesticide, which is incorporated into the soil or coated on seeds, may kill soil-dwelling insects, such as grubs or mole crickets as well as other insects, including bees that are exposed to the leaves, fruits, pollen, and nectar of the treated plants

Pesticides can affect honey bees in different ways. Some kill bees on contact in the field; others may cause brood damage or contaminate pollen, thus killing house bees. Before dying, poisoned bees can become irritable (likely to sting), paralyzed or stupefied, appear to be 'chilled' or exhibit other abnormal behavior. Queens are likely to be superseded when a colony is being poisoned. Sometimes solitary queens, banished as if they were somehow "blamed" for poisoning, may be found near a colony. These symptoms are not always distinct and they cannot be taken as definite signs of pesticide poisoning. Many chronic management problems such as starvation, winter kill, chilled brood or disease may result in the same symptoms. Often these problems may be caused by pesticides in an indirect manner. So it is difficult in many instances to categorically state that bees have been poisoned.

Only one readily recognized symptom is good evidence of pesticide damage; the presence of many dead or dying bees near a colony's entrance. In a short period of time, however, these dead bees may dry up and the remains be blown away and eaten by ants or other scavengers. A beekeeper, therefore, who visits his yards only occasionally may not see these dead bees and thus not be aware that his colonies have been poisoned.

Most major bee poisoning incidents occur when plants are in bloom. However, bees can be affected in other circumstances as well. Keep the following suggestions in mind when applying pesticides. Use pesticides only when needed: Foraging honey bees, other pollinators, and insect predators are a natural resource and their intrinsic value must be taken into consideration. Vegetable, fruit, and seed crop yields in nearby fields can be adversely affected by reducing the population of pollinating insects and beneficial insect predators. It is always a good idea to check the field to be treated for populations of both harmful and beneficial insects.

Do not apply pesticides while crops are in bloom: Insecticide should be applied only while target plants are in the bud stage or just after the petals have dropped.

Apply pesticide when bees are not flying: Bees fly when the air temperature is above 55-60°F and are most active from 8 a.m. to 5 p.m. Always check a field for bee activity immediately before application.

Pesticides hazardous to honey bees must be applied to blooming plants when bees are not working, preferably in the early evening. Evening application allows time for these chemicals to partially or totally decompose during the night.

Do not contaminate water: Bees require water to cool the hive and feed the brood. Never contaminate standing water with pesticides or drain spray tank contents onto the ground, creating puddles.

Use less toxic compounds: Some pest control situations allow the grower-applicator a choice of compounds to use. Those hazardous to honey bees must state so on the label. Select other materials or vary dosages, based on the honey bee mortality predictor model to be discussed in a later section of this publication. When in doubt, consult your County Agricultural Extension Agent for details, recommendations and further information about the toxicity of specific compounds to honey bees.
Use less toxic formulations:

Not all insecticides have the same effects when prepared in different formulations. Research and experience indicate:

- New microencapsulated insecticides are much more toxic to honey bees than any formulation so far developed. Because of their size, these capsules are carried back to the colony and there can remain poisonous for long periods. These insecticides should never be used if there is any chance bees might collect the microcapsules. Always consider using another formulation first.
- Dusts are more hazardous than liquid formulations.
- Emulsifiable concentrates are less hazardous than wettable powders.
- Ultra-low-volume (ULV) formulations are usually more hazardous than other liquid formulations.
- Identify attractive blooms: Before treating a field with pesticides, it is a good idea to check for the presence of other blooming plants and weeds which might attract bees. In many instances bees have been killed even though the crop being sprayed was not in bloom. Many times these attractive blooms can be mowed or otherwise removed, although mowing can result in destroying other beneficial insect habitat or force destructive insects into the crop being cultivated.

Notify beekeepers: If beekeepers are notified in advance of application, colonies can be moved or loosely covered with burlap or coarse cloth to confine the bees and yet allow them to cluster outside the hive under the cloth. Repeated sprinkling each hour with water prevents overheating. Never screen or seal up colonies and do not cover with plastic sheeting. This can result in overheating, leading to bee suffocation and death. Some states require every apiary or bee yard to be plainly marked with the owner's name, address and telephone number.

Application of Pest Products

When applying pesticide dusts into cracks, crevices or entry points, proper filling of the dusting device is of utmost importance. When a hand bellows duster is completely filled to its capacity, or when dust is packed down inside the duster, dust does not come out in proper form. Never overfill a hand-bellows type insecticide duster. Fill duster 1/2 to 2/3 from top. After replacing the fill plug, gently shake the duster just prior to application. The small area inside the duster (created by NOT over-filling the duster) creates a space that is sorely needed. When the duster is shaken, a small "cloud" of insecticide dust is formed in the empty space.

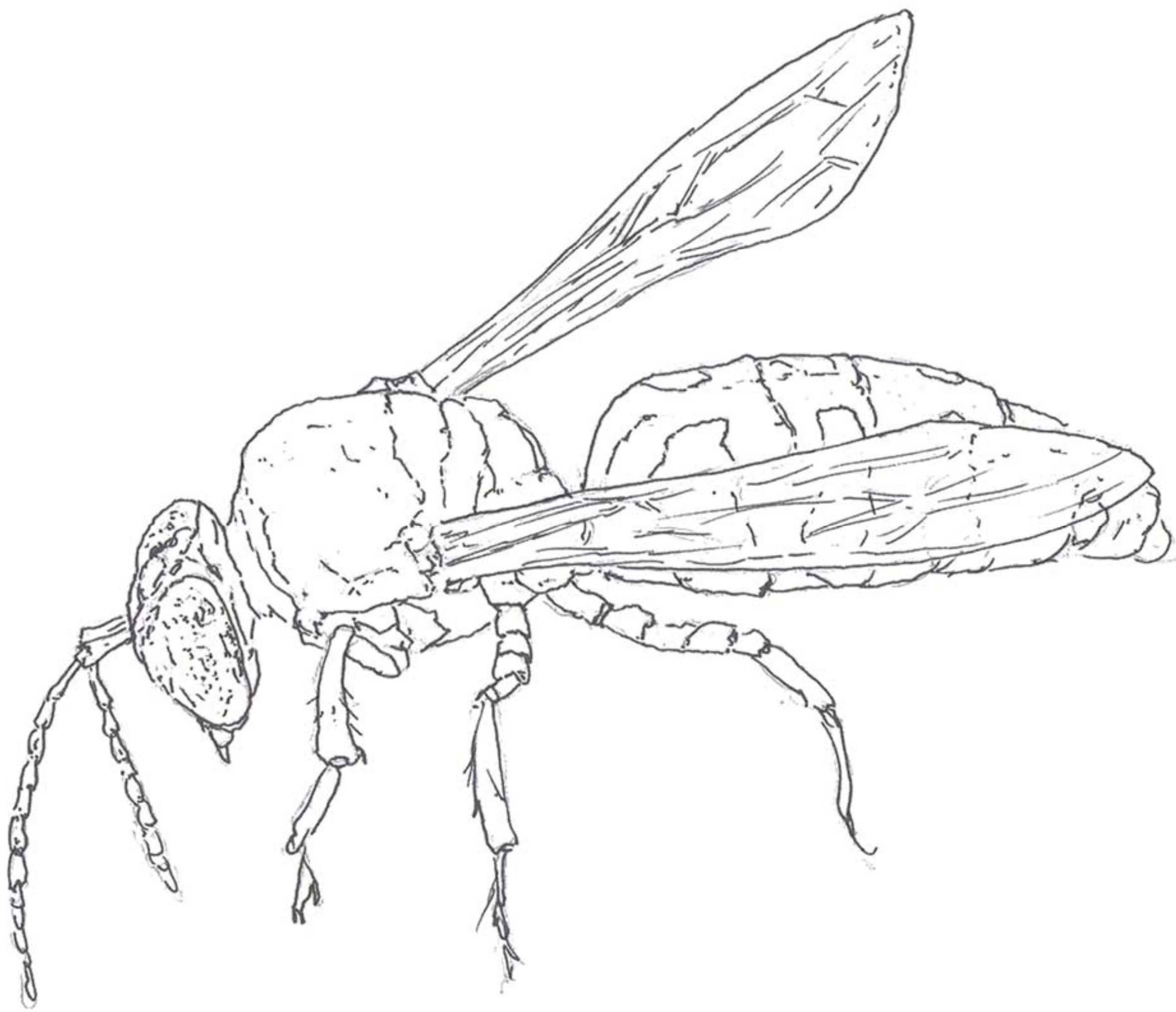
By gently shaking a properly filled duster, the dust particles will exit the duster nozzle in a thin, smoke-like cloud as the hand bellows duster is squeezed. This thin cloud of dust will travel further through the targeted area (in this case, an underground bumble bee nest), reaching far more adults, eggs and larvae. The next effect of proper application is overall coverage.

If large amounts of Deltamethrin(Delta Dust or Drione Dust) are merely "dumped" into the nest entrance, the majority of the dust will merely pile up in one place. Properly applied dust will "float" through the chambers and most of the particles will tend to stick to top, bottom and sides of the tunnel as well as the nest itself. Treatment of a bumble bee nest involves coating the nest entrance, nest, eggs, grubs and adults. For most nests, you will need to apply two applications: partially fill your duster, shake thoroughly, empty contents into nest; repeat.

This double application will assure better control over all stages of the bee and will contaminate the nest and void, which will kill bees returning to the nest area.

As mentioned previously, the best time to kill bumble bees is when they are at rest or as they sleep. Avoid treatment during daylight hours; treat the bumble bee nest at dusk or when it is dark enough for the bees to cease their activity but just light enough for you to see what you are doing. You can kill bees at night (using a flashlight) but there are a couple of possible hazards that you might run into: stumbling over unseen objects and actually attracting angry bees. The first possible hazard listed is mainly common sense. If you trip and fall over any unseen object in the area, you not only risk possible harm from the fall but also risk waking up the resting bees. Using a flashlight to navigate to the sight or while treating the nest can be a problem.

If the bees are disturbed and exit the nest, they could very well be attracted to light emitted from your flashlight. (If light is needed, try setting your flashlight in one area before you approach the nest from another area.)



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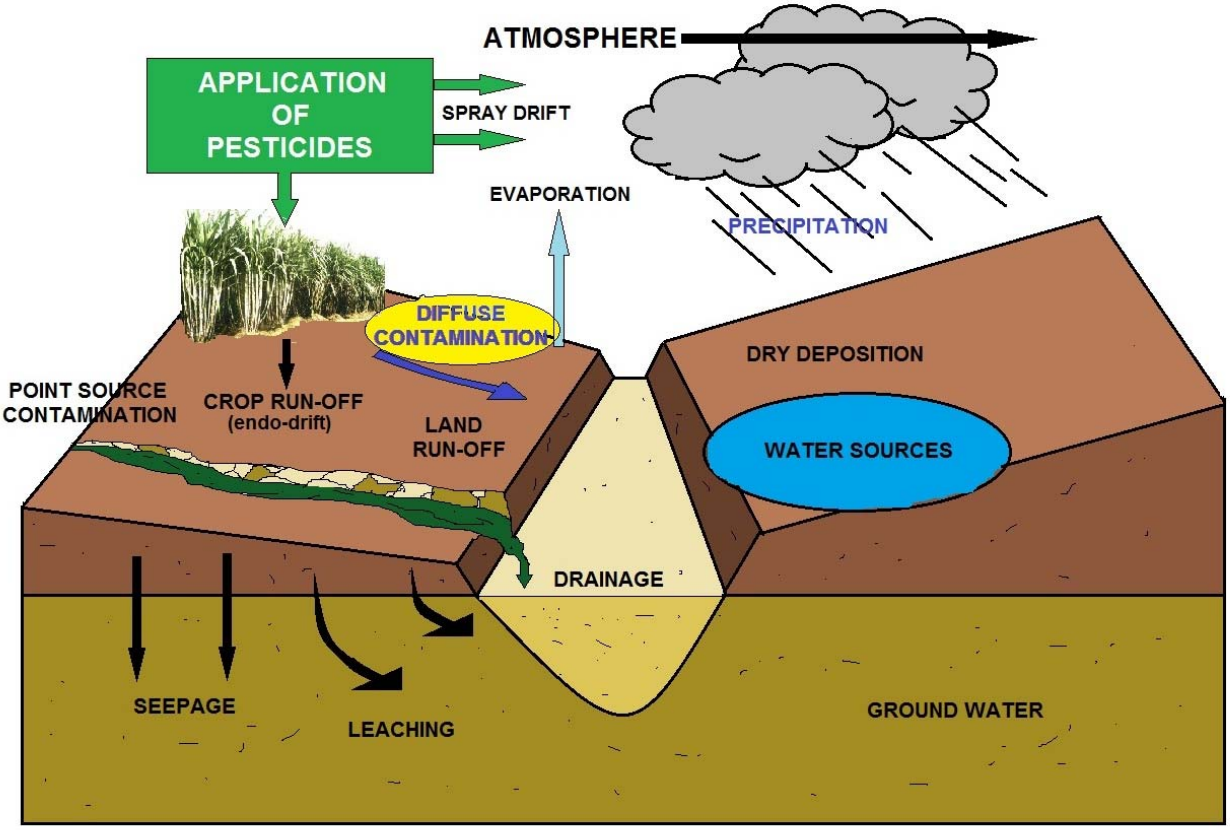
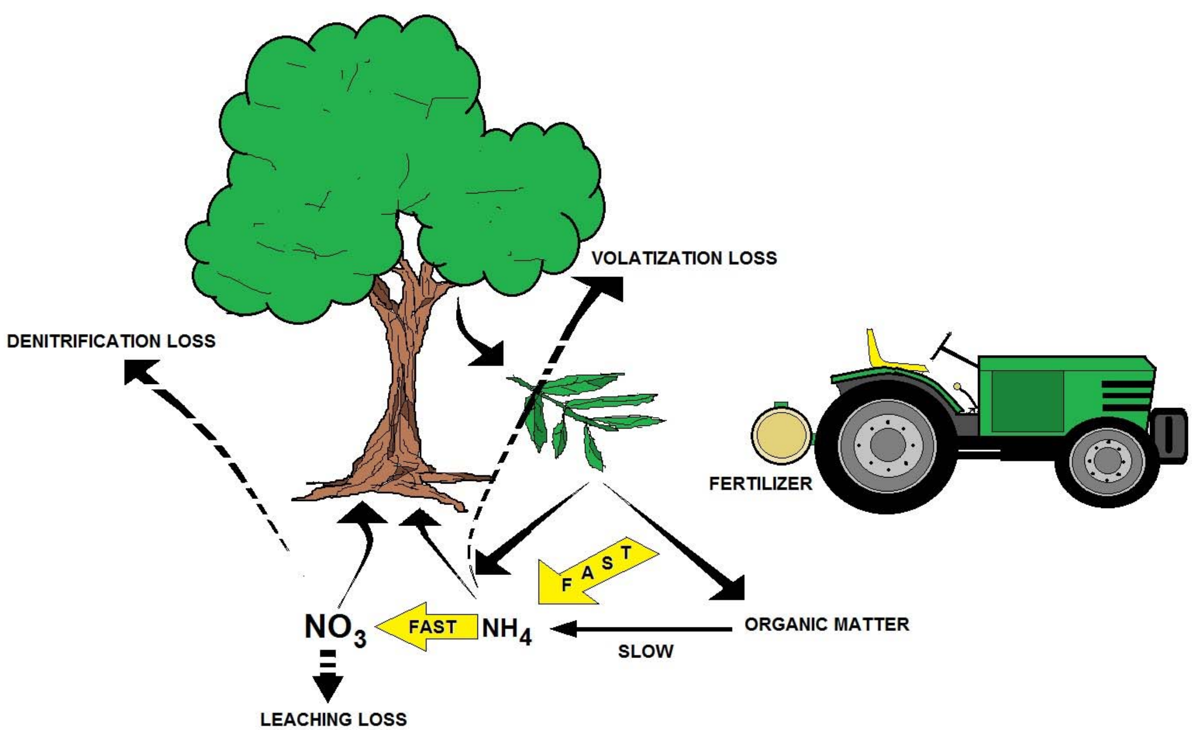


ENVIRONMENTAL CONTAMINATION FROM PESTICIDES



Insecticides that Kill Bees *Intentionally and otherwise*

Kill bees with insecticidal dusts. Dusts make great bee insecticides because they stick to the legs of bees and get dragged inside the bee hive where they can start affecting even more bees. Sprinkle dusts directly into the entrances of ground bee nests in the early morning and/or in the late evening when everyone is back home. If a bee hive is located in your walls, find its exact location. If it's a small hive, you might be able to get away with only dusting at the bees' entrances. If it's a larger hive, drill several holes through the wall and into the hive, and shoot dust in with a hand duster. Hand dusters are made and designed specifically for the administration of insecticidal dusts. In cases of bees in walls, it's important to know whether or not you're dealing with honey bees. If it is honey bees, not only will you need to drill a few extra holes into the hive for applying dust, you will also need to make damn sure to remove the bee hive once bee extermination is complete. If you don't, honey can seep into walls, sheet rock, wood, insulation, etc., and cause serious damage to your home. Use dust brands like Sevin, Apicide, Drione, Dursban, and Delta Dust.

Use sprays for bee killing. Anyone who decides to be their own bee exterminator should know that dusts aren't the only option. While they do work great, there are a number of sprays available that do a pretty bang up job as well. Many of them (Cyper WP, Sevin, Cynoff WP, Cyonara, Demon WP, and Demon WP, just to name a few) are available as concentrates that you mix in a hand sprayer with water. Once they're mixed, wait until evening and spray the piss out of nests, hives, and their entrances. If you don't feel like mixing your own, there are a number of aerosols available as well. Look for brands like Baygon, Propoxur Aerosol, and Tri-Die.

Chemical Control Trade Names

2,4-Dichlorophenoxyacetic acid

2,4-Dichlorophenoxyacetic acid (2,4-D) is a common systemic pesticide / herbicide used in the control of broadleaf weeds. It is the most widely used herbicide in the world, and the third most commonly used in North America. 2,4-D is a synthetic auxin (plant hormone), and as such it is often used in laboratories for plant research and as a supplement in plant cell culture media such as MS medium.

2,4-D is a synthetic auxin, which is a class of plant hormones. It is absorbed through the leaves and is translocated to the meristems of the plant. Uncontrolled, unsustainable growth ensues, causing stem curl-over, leaf withering, and eventual plant death. 2,4-D is typically applied as an amine salt, but more potent ester versions exist as well.

Acephate

Acephate is an organophosphate foliar insecticide of moderate persistence with residual systemic activity of about 10-15 days at the recommended use rate. It is used primarily for control of aphids, including resistant species, in vegetables (e.g. potatoes, carrots, greenhouse tomatoes, and lettuce) and in horticulture (e.g. on roses and greenhouse ornamentals). It also controls leaf miners, caterpillars, sawflies and thrips in the previously stated crops as well as turf, and forestry. By direct application to mounds, it is effective in destroying imported fire ants.

Acephate is sold as a soluble powder, as emulsifiable concentrates, as pressurized aerosol, and in tree injection systems and granular formulations.

NOTE: When pesticides are used, it is the applicator’s legal responsibility to read and follow directions on the product label. Not following label directions, even if they conflict with information provided herein, is a violation of federal law.

Aldicarb

Aldicarb is a carbamate insecticide which is the active substance in the pesticide Temik. It is effective against thrips, aphids, spider mites, lygus, fleahoppers, and leafminers, but is primarily used as a nematicide. Aldicarb is a cholinesterase inhibitor which prevents the breakdown of acetylcholine in the synapse. In case of severe poisoning, the victim dies of respiratory failure. Aldicarb is effective where resistance to organophosphate insecticides has developed, and is extremely important in potato production, where it is used for the control of soil-borne nematodes and some foliar pests.

Its weakness is its high level of solubility, which restricts its use in certain areas where the water table is close to the surface. Aldicarb is a fast-acting cholinesterase inhibitor, causing rapid accumulation of acetylcholine at the synaptic cleft. It is widely used to study cholinergic neurotransmission in simple systems such as the nematode C. elegans.

Exposure to high amounts of aldicarb can cause weakness, blurred vision, headache, nausea, tearing, sweating, and tremors in humans. Very high doses can be fatal to humans because it can paralyze the respiratory system.

Always follow label instructions and take steps to avoid exposure. If any exposures occur, be sure to follow the First Aid instructions on the product label carefully. For additional treatment advice, contact the Poison Control Center at 1-800-222-1222. If you wish to report a pesticide problem, please call 1-800-858-7378.

NOTE: When pesticides are used, it is the applicator's legal responsibility to read and follow directions on the product label. Not following label directions, even if they conflict with information provided herein, is a violation of federal law.

Borates

"Borate" is a generic term for compounds containing the elements boron and oxygen. Boron never occurs alone naturally but as calcium and sodium borate ores in several places in the world. Borax and other sodium borates are used in numerous products such as laundry additives, eye drops, fertilizers, and insecticides. Though the mechanisms of toxicity are not fully understood, boron is very toxic to insects and decay fungi that commonly damage wood in structures. At low levels, however, boron is only minimally toxic, and perhaps beneficial, to humans, other mammals, and growing plants. Use of borate-treated wood for construction of homes and their wood-based contents appears to offer many advantages to today's environmentally sensitive world.

Unlike most other wood preservatives and organic insecticides that penetrate best in dry wood, borates are diffusible chemicals—they penetrate unseasoned wood by diffusion, a natural process. Wood moisture content and method and length of storage are the primary factors affecting penetration by diffusion. Properly done, diffusion treatments permit deep penetration of large timbers and refractory (difficult-to-treat) wood species that cannot be treated well by pressure. The diffusible property of borates can be manipulated in many ways; suitable application methods range from complex automated industrial processes to simple brush or injection treatments.

Application methods include momentary immersion by bulk dipping; pressure or combination pressure/diffusion treatment; treatment of composite boards and laminated products by treatment of the wood finish; hot and cold dip treatments and long soaking periods; spray or brush-on treatments with borate slurries or pastes; and placement of fused borate rods in holes drilled in wood already in use. This publication contains pesticide recommendations that are subject to change at any time.

These recommendations are provided only as a guide. It is always the pesticide applicator's responsibility, by law, to read and follow all current label directions for the specific pesticide being used. Due to constantly changing labels and product registration, some of the recommendations given in this writing may no longer be legal by the time you read them. If any information in these recommendations disagrees with the label, the recommendation must be disregarded.

No endorsement is intended for products mentioned, nor is criticism meant for products not mentioned. The author and Technical Learning College (TLC) assume no liability resulting from the use of these recommendations.

Always follow label instructions and take steps to avoid exposure. If any exposures occur, be sure to follow the First Aid instructions on the product label carefully. For additional treatment advice, contact the Poison Control Center at 1-800-222-1222. If you wish to report a pesticide problem, please call 1-800-858-7378.

Carbaryl
Carbaryl (1-naphthyl methylcarbamate) is a chemical in the carbamate family used chiefly as an insecticide. It is a white crystalline solid commonly sold under the brand name Sevin, a trademark of the Bayer Company. Union Carbide discovered carbaryl and introduced it commercially in 1958. Bayer purchased Aventis CropScience in 2002, a company that included Union Carbide pesticide operations. It remains the third most-used insecticide in the United States for home gardens, commercial agriculture, and forestry and rangeland protection. Approximately 11 million kilograms were applied to U.S. farm crops in 1976

Carbofuran
Carbofuran is one of the most toxic carbamate pesticides. It is marketed under the trade names Furadan, by FMC Corporation and Curater, among several others. It is used to control insects in a wide variety of field crops, including potatoes, corn and soybeans. It is a systemic insecticide, which means that the plant absorbs it through the roots, and from here the plant distributes it throughout its organs where insecticidal concentrations are attained. Carbofuran also has contact activity against pests.

Carbofuran usage has increased in recent years because it is one of the few insecticides effective on soybean aphids, which have expanded their range since 2002 to include most soybean-growing regions of the U.S. The main global producer is the FMC Corporation. Carbofuran is banned in Canada and the European Union. In 2008, the United States Environmental Protection Agency (EPA) announced that it intends to ban carbofuran. In December of that year, FMC Corp., the sole US manufacturer of carbofuran, announced that it had voluntarily requested that the United States Environmental Protection Agency cancel all but 6 of the previously allowed uses of that chemical as a pesticide. With this change, carbofuran usage in the US would be allowed only on maize, potatoes, pumpkins, sunflowers, pine seedlings and spinach grown for seed. However, in May 2009 EPA cancelled all food tolerances, an action which amounts to a de facto ban on its use on all crops grown for human consumption.

Coumaphos
Coumaphos is a non-volatile, fat-soluble phosphorothioate with ectoparasiticide properties: it kills insects and mites. It is well known under manufacturer brand-names as a dip or wash, used on farm and domestic animals to control ticks, mites, flies and fleas. It is also used to control varroa mites in honey bee colonies, though in many areas it is falling out of favor as the varroa develop resistance and as the residual toxicity effects are becoming better understood.

This publication contains pesticide recommendations that are subject to change at any time. These recommendations are provided only as a guide. It is always the pesticide applicator's responsibility, by law, to read and follow all current label directions for the specific pesticide being used. Due to constantly changing labels and product registration, some of the recommendations given in this writing may no longer be legal by the time you read them.

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Cypermethrin (Common Bee Control Treatment Chemical)
Cypermethrin is a synthetic pyrethroid used as an insecticide in large-scale commercial agricultural applications as well as in consumer products for domestic purposes. It behaves as a fast-acting neurotoxin in insects. It is easily degraded on soil and plants but can be effective for weeks when applied to indoor inert surfaces. Exposure to sunlight, water and oxygen will accelerate its decomposition.

Cypermethrin is highly toxic to fish, bees and aquatic insects, according to the National Pesticides Telecommunications Network (NPTN). It is found in many household ant and cockroach killers, including Raid and ant chalk.

How does Cypermethrin Work?
Cypermethrin kills insects that eat or come into contact with it. Cypermethrin works by quickly affecting the insect's central nervous system.

What are some products that contain cypermethrin?
- ✓ Termiticides
- ✓ household insecticides
- ✓ outdoor insecticides
- ✓ AmmoTM
- ✓ CybushR
- ✓ Cynoff TM
- ✓ Cyperkill
- ✓ DemonR

How Toxic is Cypermethrin?
Animals
- Cockroach brain cells exposed to very small doses (up to 0.02 micrograms per gram of brain weight or cg/g) of cypermethrin exhibited a nervous system response, which in cockroaches, would result in restlessness, incoordination, prostration, and paralysis.
- Mice exposed to small doses (0.3 to 4.3 cg/g) of cypermethrin displayed symptoms including writhing, convulsions, and salivation.
- Rats exposed to cypermethrin exhibited similar symptoms including tremors, seizures, writhing, and salivation as well as burrowing behavior.
- Cypermethrin may be a weak skin sensitizer in guinea pigs.
- Newborn rats were more sensitive to cypermethrin than adult rats. The liver enzymes that break down cypermethrin in the body are not completely developed in the newborn rats.

Humans
People handling or working with pyrethrins and pyrethroids (including cypermethrin) sometimes developed tingling, burning, dizziness, and itching.

NOTE: When pesticides are used, it is the applicator's legal responsibility to read and follow directions on the product label. Not following label directions, even if they conflict with information provided herein, is a violation of federal law.

Deltamethrin(Delta Dust or Drione Dust)
Deltamethrin is an insecticide belonging to the pyrethroid family. Pyrethroids are the man-made versions of pyrethrins, natural insecticides from chrysanthemum flowers. Deltamethrin is used outdoors on lawns, ornamental gardens, golf courses, and indoors as a spot or crack and crevice treatment. In its purest form, deltamethrin is colorless or white to light beige crystals that have no odor.

Deltamethrin is in a variety of products used to kill a wide range of insects. Deltamethrin can be formulated in insecticide products as aerosols, sprays, dusts, granules and wettable powders. The illegal, unregistered product known as "Chinese Chalk" or "Miraculous Chalk" often contains deltamethrin as the active ingredient. "Chinese Chalk", "Miraculous Chalk", and products like them are not registered for use in the United States and illegal products such as these should be avoided at all times.

Always follow label instructions and take steps to avoid exposure. If any exposures occur, be sure to follow the First Aid instructions on the product label carefully. For additional treatment advice, contact the Poison Control Center at 1-800-222-1222. If you wish to report a pesticide problem, please call 1-800-858-7378.

How does Deltamethrin work?
Deltamethrin can kill insects by direct contact or if they eat it. It disrupts their normal nervous system function. It is less toxic to mammals due to their higher body temperature, larger body size, and decreased sensitivity to the chemical.

How might I be exposed to Deltamethrin?
You can be exposed to deltamethrin if you touch, eat, or breathe it in. As an example, it could be breathed in if a fine mist or dust containing deltamethrin gets in the air you breathe. Exposure to deltamethrin can be limited by reading and following label directions.

Demeton
Demeton is a phosphorothioate insecticide with the chemical formula $C_8H_{19}O_3PS_2$.

Demeton-S-methyl
Demeton-S-methyl is an organic compound with the molecular formula $C_6H_{15}O_3PS_2$. It is used as an acaricide and insecticide; more specifically it is an organothiophosphate acaricide and an aliphatic organothiophosphate insecticide, respectively. It is flammable.

Diazinon
Diazinon (IUPAC name: O,O-Diethyl O-[4-methyl-6-(propan-2-yl)pyrimidin-2-yl] phosphorothioate), a colorless to dark brown liquid, is a thiophosphoric acid ester developed in 1952 by Ciba-Geigy, a Swiss chemical company (later Novartis and then Syngenta). It is a non-systemic organophosphate insecticide formerly used to control cockroaches, silverfish, ants, and fleas in residential, non-food buildings. Diazinon was heavily used during the 1970s and early 1980s for general-purpose gardening use and indoor pest control. A bait form was used to control scavenger wasps in the western U.S. Residential uses of diazinon were outlawed in the U.S. in 2004 but it is still approved for agricultural uses.

Diazinon kills insects by inhibiting acetylcholinesterase, an enzyme necessary for proper nervous system function. Diazinon has a low persistence in soil. The half-life is 2 to 6 weeks. The symptoms associated with diazinon poisoning in humans include weakness, headaches, tightness in the chest, blurred vision, nonreactive pinpoint pupils, excessive salivation, sweating, nausea, vomiting, diarrhea, abdominal cramps, and slurred speech.

In 1988, the Environmental Protection Agency prohibited the use of Diazinon on golf courses and sod farms because of decimation of bird flocks that congregated in these areas. In the United States as of December 31, 2004, it became unlawful to sell outdoor, non-agricultural products containing diazinon. It is still legal for consumers to use diazinon products purchased before this date, provided that they follow all label directions and precautions

Dicrotophos
Dicrotophos is an organophosphate acetylcholinesterase inhibitor used as an insecticide. Some common brand names for dicrotophos include Bidrin, Carbicron, Diapadrin, Dicron and Ektafos.

Dimethoate
Dimethoate is a widely used organophosphate insecticide used to kill insects on contact. It was patented and introduced in the 1950s by American Cyanamid. Like other organophosphates, dimethoate is an anticholinesterase which disables cholinesterase, an enzyme essential for central nervous system function.

Endosulfan
Endosulfan is an off-patent organochlorine insecticide and acaricide that is being phased out globally. Endosulfan became a highly controversial agrichemical[1] due to its acute toxicity, potential for bioaccumulation, and role as an endocrine disruptor. Because of its threats to human health and the environment, a global ban on the manufacture and use of endosulfan was negotiated under the Stockholm Convention in April 2011. The ban will take effect in mid-2012, with certain uses exempted for 5 additional years. More than 80 countries, including the European Union, Australia and New Zealand, several West African nations, the United States, Brazil and Canada had already banned it or announced phase outs by the time the Stockholm Convention ban was agreed upon. It is still used extensively in India, China, and few other countries. It is produced by Makhteshim Agan and several manufacturers in India and China.

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Fenthion
Fenthion is an organothiophosphate insecticide, avicide, and acaricide. Like most other organophosphates, its mode of action is via cholinesterase inhibition. Due to its relatively low toxicity towards humans and mammals, fenthion is listed as moderately toxic compound in U.S. Environmental Protection Agency and World Health Organization toxicity class

Fenthion is a contact and stomach insecticide used against many sucking, biting pests. It is particularly effective against fruit flies, leaf hoppers, cereal bugs, stem borers, mosquitoes, animal parasites, mites, aphids, codling moths, and weaver birds. It has been widely used in sugar cane, rice, field corn, beets, pome and stone fruit, citrus fruits, pistachio, cotton, olives, coffee, cocoa, vegetables, and vines. Based on its high toxicity on birds, fenthion has been used to control weaver birds and other pest-birds in many parts of the world. Fenthion is also used in cattle, swine, and dogs to control lice, fleas, ticks, flies, and other external parasites.

Amid concerns of harmful effects on environment, especially birds, Food and Drug Administration no longer approves uses of fenthion. However, fenthion has been extensively used to control adult mosquitoes. After preliminary risk assessments on human health and environment in 1998 and its revision in 1999, USEPA issued an Interim Reregistration Eligibility Decision (IRED) for fenthion in January 2001. The EPA has classified fenthion as Restricted Use Pesticide (RUP), and warrants special handling because of its toxicity.

Some common trade names for fenthion are Avigel, Avigrease, Entex, Baytex, Baycid, Dalf, DMPT, Mercaptophos, Prentox, Fenthion 4E, Queletox, and Lebaycid. Fenthion is available in dust, emulsifiable concentrate, granular, liquid concentrate, spray concentrate, ULV, and wettable powder formulations.

Fenitrothion
Fenitrothion (IUPAC name: O,O-Dimethyl O-(3-methyl-4-nitrophenyl) phosphorothioate) is a phosphorothioate (organophosphate) insecticide. In experiments fenitrothion at sublethal doses affected the motor movement of marsupials, and at acute dose levels it reduced the energy of birds.

In chronic (low) dose tests, unexpectedly only the lowest concentration (0.011 microgram/liter) of fenitrothion depressed the growth of an algae, though all of the chronic dose levels used were toxic in other ways to the algae. Just half of fenitrothion's minimally effective dose altered the thyroid structure of a freshwater murrel (the snakehead fish).

Fenvalerate
Fenvalerate is an insecticide. It is a mixture of four optical isomers which have different insecticidal activities. The 2-S alpha (or SS) configuration is the most insecticidally active isomer. Fenvalerate consists of about 23% of this isomer.

Fenvalerate is an insecticide of moderate mammalian toxicity. In laboratory animals, central nervous system toxicity is observed following acute or long-term exposure. Fenvalerate has applications against a wide range of pests. Residue levels are minimized by low application rates.

Fenvalerate is most toxic to bees and fish. It is found in some emulsifiable concentrates, ULV, wettable powders, slow release formulations, insecticidal fogs, and granules. It is most commonly used to control insects in food, feed, and cotton products, and for the control of flies and ticks in barns and stables. Fenvalerate does not affect plants, but is active for an extended period of time. Fenvalerate may irritate the skin and eyes on contact, and is also harmful if swallowed

NOTE: When pesticides are used, it is the applicator's legal responsibility to read and follow directions on the product label. Not following label directions, even if they conflict with information provided herein, is a violation of federal law.

Imidacloprid
Imidacloprid is a nicotine-based, systemic insecticide, which acts as a neurotoxin and belongs to a class of chemicals called the neonicotinoids. Although it is now off patent, the primary manufacturer of this chemical is Bayer CropScience, (part of Bayer AG). It is sold under the trade names Kohinor, Admire, Advantage (Advocate) (flea killer for pets), Gaucho, Mallet, Merit, Nuprid, Prothor, Turfthor, Confidor, Conguard, Hachikusan, Premise, Prothor, Provado, and Winner. Imidacloprid is one of the most widely used insecticides and can be applied by soil injection, tree injection, application to the skin, or broadcast foliar or ground application as a granular or liquid formulation or as a pesticide-coated seed treatment.

In France, beekeepers reported a significant loss of honeybees in the 1990s, which they attributed to the use of imidacloprid (Gaucho). See Imidacloprid effects on bee population. In response to this loss of bees called "mad bee disease," the French Minister of Agriculture convened a panel of expert scientists (Comite Scientifique et Technique) to examine the impact of imidacloprid on bees. After reviewing dozens of laboratory and field studies conducted by Bayer CropScience and by independent scientists, the panel concluded that there was a significant risk to bees from exposure to imidacloprid on sunflowers and maize (corn), the only crops for which they had exposure data. Following the release of this report, the French Agricultural Ministry suspended the use of imidacloprid on maize and sunflowers. Italy, Germany, and Slovenia have also suspended certain uses of the neonicotinoids based on concerns for bees

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Malathion
Malathion is an organophosphate parasympathomimetic which binds irreversibly to cholinesterase. Malathion is an insecticide of relatively low human toxicity, however recent studies have shown that children with higher levels of malathion in their urine seem to be at an increased risk of attention deficit hyperactivity disorder.

Malathion is a pesticide that is widely used in agriculture, residential landscaping, public recreation areas, and in public health pest control programs such as mosquito eradication. In the US, it is the most commonly used organophosphate insecticide.

Malathion was used in the 1980s in California to combat the Mediterranean Fruit Fly. This was accomplished on a wide scale by the near weekly aerial spraying of suburban communities for a period of several months. Formations of three or four agricultural helicopters would overfly suburban portions of Alameda County, San Bernardino County, San Mateo County, Santa Clara County, San Joaquin County, Stanislaus County, and Merced County releasing a mixture of malathion and corn syrup, the corn syrup being a bait for the fruit flies. Malathion has also been used to combat the Mediterranean fruit fly in Australia.

Malathion was sprayed in many cities to combat West Nile virus. In the Fall of 1999 and the Spring of 2000, Long Island and the five boroughs of New York City were sprayed with several pesticides, one of which was malathion. While it was claimed by some anti-pesticide groups that use of these pesticides caused a lobster die-off in Long Island Sound, there is as of yet no conclusive evidence to support this.

Malathion is also used in conjunction with diesel fuel to fog an area where there is an infestation of mosquitoes. By diluting the mixture, it becomes much weaker. It is possible to dilute the mixture to the point where mosquitoes are not killed, but become more resistant to the mixture, making it less effective in subsequent foggings.

Malathion itself is of low toxicity; however, absorption or ingestion into the human body readily results in its metabolism to malaoxon, which is substantially more toxic. Chronic exposure to low levels of malathion have been hypothesized to impair memory, but this is disputed. According to the United States Environmental Protection Agency there is currently no reliable information on adverse health effects of chronic exposure to malathion. Acute exposure to extremely high levels of malathion will cause body-wide symptoms whose intensity will be dependent on the severity of exposure. Possible symptoms include skin and eye irritation, cramps, nausea, diarrhea, excessive sweating, seizures and even death.

Most symptoms tend to resolve within several weeks. Malathion present in untreated water is converted to malaoxon during the chlorination phase of water treatment, so malathion should not be used in waters that may be used as a source for drinking water, or any upstream waters.

In 1981, B. T. Collins, Director of the California Conservation Corps, publicly swallowed and survived a mouthful of dilute Malathion solution. This was an attempt to demonstrate Malathion's safety following an outbreak of Mediterranean fruit flies in California. Malathion was sprayed over a 1,400 sq. miles area to control the flies.

In 1976, numerous malaria workers in Pakistan were poisoned by isomalathion, a contaminant that may be present in some preparations of malathion. It is capable of inhibiting carboxyesterase enzymes in those exposed to it. It was discovered that poor work practices had resulted in excessive direct skin contact with isomalathion contained in the malathion solutions. Implementation of good work practices, and the cessation of use of malathion contaminated with isomalathion led to the cessation of poisoning cases.

Malathion breaks down into Malaoxon. In studies of the effects of long-term exposure to oral ingestion of malaoxon in rats, malaoxon has been shown to be 61 times more toxic than malathion. If malathion is used in an indoor, or other poorly ventilated environment, it can seriously poison the occupants living or working in this environment. A possible concern is that malathion being used in an outdoor environment, could enter a house or other building; however, studies by the EPA have conservatively estimated that possible exposure by this route is well below the toxic dose of malathion. Regardless of this fact, in jurisdictions which spray malathion for pest control, it is often recommended to keep windows closed and air conditioners turned off while spraying is taking place, in an attempt to minimize entry of malathion into the closed environment of residential homes.

Although current EPA regulations do not require amphibian testing, a 2008 study done by the University of Pittsburgh found that "cocktails of contaminants", which are frequently found in nature, were lethal to leopard frog tadpoles. They found that a combination of five widely used insecticides (carbaryl, chlorpyrifos, diazinon, endosulfan, and malathion) in concentrations far below the limits set by the EPA killed 99% of leopard frog tadpoles. A May 2010 study found that in a representative sample of US children, those with higher levels of organophosphate pesticide metabolites in their urine were more likely to have attention-deficit/hyperactivity disorder. Each 10-fold increase in urinary concentration of organophosphate metabolites was associated with a 55% to 72% increase in the odds of ADHD. The study was the first investigation on children's neurodevelopment to be conducted in a group with no particular pesticide exposure

Methiocarb
Methiocarb is a chemical mainly used as a bird repellent, as an insecticide and as molluscicide. It is toxic to humans, not listed as a carcinogen, is toxic to reproductive organs, and a potent neurotoxin. Methiocarb can also cause acute toxicity in humans if anyone is exposed to it for long periods of time. Methiocarb is also a known poison to water organisms.

Methidathion
Methidathion is an organophosphate insecticide.

Methoxychlor
Methoxychlor is used to protect crops, ornamentals, livestock, and pets against fleas, mosquitoes, cockroaches, and other insects. It was intended to be a replacement for DDT, but has since been banned based on its acute toxicity, bioaccumulation, and endocrine disruption activity. The amount of methoxychlor in the environment changes seasonally due to its use in farming and foresting. It does not dissolve readily in water, so it is mixed with a petroleum-based fluid and sprayed, or used as a dust.

Sprayed methoxychlor settles on the ground or in aquatic ecosystems, where it can be found in sediments. Its degradation may take many months. Methoxychlor is ingested and absorbed by living organisms, and it accumulates in the food chain. Some metabolites may have unwanted side effects. The use of methoxychlor as a pesticide was banned in the United States in 2003[2] and in the European Union in 2002.

Methomyl
Methomyl is a carbamate insecticide. It was introduced in 1966, but its use is restricted because of its high toxicity to humans. Its current primary use is on alfalfa for forage.

Parathion
Parathion, also called parathion-ethyl or diethyl parathion, is an organophosphate compound. It is a potent insecticide and acaricide. It was originally developed by IG Farben in the 1940s. It is highly toxic to non-target organisms, including humans. Its use is banned or restricted in many countries, and there are proposals to ban it from all use. Closely related is "methyl parathion".

Pirimicarb
Pirimicarb is a carbamate insecticide used to control aphids on vegetable, cereal and orchard crops by inhibiting acetylcholinesterase activity. It was originally developed by Imperial Chemical Industries Ltd., now Syngenta, in 1970.

Permethrin
General Information
Permethrin is a broad-spectrum pyrethroid insecticide. It is available in dusts, emulsifiable concentrates, smokes, ULV concentrates, and wettable-powder formulations. The historical development of the synthetic pesticides called pyrethroids is based on the pyrethrins, which are derived from chrysanthemums. Pyrethrins are a "natural" environmental product that is of low toxicity to mammals. They are highly photolabile and degrade quickly in sunlight, and the cost of reapplying them has limited their widespread agricultural use. Pyrethroids have been synthesized to be similar to pyrethrins yet more stable in the environment. Evidence suggests that they have a very large margin of safety when used as directed by the label (Aldridge, 1990; Chen et al., 1991; Snodgrass, 1992).

Commercial pyrethroid products commonly use petroleum distillates as carriers. Some commercial products also contain OP or carbamate insecticides because the rapid paralytic effect of pyrethrins on insects ("quick knockdown") is not always lethal (Cheremisinoff and King, 1994). Pyrethroids are formulated as emulsifiable concentrates, wettable powders, granules, and concentrates for ULV application.

Always follow label instructions and take steps to avoid exposure. If any exposures occur, be sure to follow the First Aid instructions on the product label carefully. For additional treatment advice, contact the Poison Control Center at 1-800-222-1222. If you wish to report a pesticide problem, please call 1-800-858-7378.

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Phosmet
Phosmet is a phthalimide-derived, non-systemic, organophosphate insecticide used on plants and animals. It is mainly used on apple trees for control of coddling moth, though it is also used on a wide range of fruit crops, ornamentals, and vines for the control of aphids, suckers, mites, and fruit flies.
Not to be confused with phosphoramidon.

Phosphamidon
Phosphamidon is an organophosphate insecticide first reported in 1960. It acts as a cholinesterase inhibitor.

Propoxur
Propoxur (Baygon®) is a carbamate insecticide and was introduced in 1959. Propoxur is a non-systemic insecticide with a fast knockdown and long residual effect used against turf, forestry, and household pests and fleas. It is also used in pest control for other domestic animals, Anopheles mosquitoes, ants, gypsy moths, and other agricultural pests. It can also be used as a molluscicide.

Several US states have petitioned the Environmental Protection Agency (EPA) to use propoxur against bedbug infestations, but EPA been reluctant to approve indoor use because of its potential toxicity to children after chronic exposure.

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Pyrethroids
To mimic the insecticidal activity of the natural compound pyrethrum another class of pesticides, pyrethroid pesticides, has been developed. These are non-persistent, which is a sodium channel modulators, and are much less acutely toxic than organophosphates and carbamates. Compounds in this group are often applied against household pests.

The pyrethroids are a large family of modern synthetic insecticides similar to the naturally derived botanical pyrethrins. They are highly repellent to MOST INSECTS AND ESPECIALLY termites, which may contribute to the effectiveness of the termiticide barrier. They have been modified to increase their stability in the natural environment. They are widely used in agriculture, homes, and gardens. Some examples are bifenthrin, cyfluthrin, cypermethrin, deltamethrin, and permethrin. They may be applied alone or in combination with other insecticides. Pyrethroids are formulated as emusifiable concentrates (EC), wettable powders (WP), granulars (G), and aerosols.

Certain pyrethroids exhibit striking neurotoxicity in laboratory animals when administered by intravenous injection, and some are toxic by the oral route. Systemic toxicity by inhalation and dermal absorption are low, however—there have been very few systemic poisonings of humans by pyrethroids. Though limited absorption may account for the low toxicity of some pyrethroids, rapid biodegradation by mammalian liver enzymes (ester hydrolysis and oxidation) is probably the major factor responsible.

This course contains pesticide recommendations that are subject to change at any time. These recommendations are provided only as a guide. It is always the pesticide applicator's responsibility, by law, to read and follow all current label directions for the specific pesticide being used. Due to constantly changing labels and product registration, some of the recommendations given in this writing may no longer be legal by the time you read them. If any information in these recommendations disagrees with the label, the recommendation must be disregarded.

No endorsement is intended for products mentioned, nor is criticism meant for products not mentioned. The author and Technical Learning College (TLC) assume no liability resulting from the use of these recommendations.

Most pyrethroid metabolites are promptly excreted, at least in part, by the kidney. In response to dermal exposure, some persons may experience a skin sensitivity called paresthesia. The symptoms are similar to sunburn sensation of the face and especially the eyelids. Sweating, exposure to sun or heat, and application of water aggravate the disagreeable sensations. This is a temporary effect that dissipates within 24 hours. For first aid, wash with soap and water to remove as much residue as possible, and then apply a vitamin E oil preparation or cream to the affected area. Paresthesia is caused more by pyrethroids whose chemical makeup includes cyano- groups: fenvalerate, cypermethrin, and fluvalinate. In addition to protecting themselves from future exposure, persons who have experienced paresthesia should choose a pyrethroid with a different active ingredient, as well as a wettable powder or microencapsulated formulation.

About These Pesticides
Pyrethrins and pyrethroids are insecticides included in over 3,500 registered products, many of which are used widely in and around households, including on pets, in mosquito control, and in agriculture. The use of pyrethrins and pyrethroids has increased during the past decade with the declining use of organophosphate pesticides, which are more acutely toxic to birds and mammals than the pyrethroids. This change to less acutely toxic pesticides, while generally beneficial, has introduced certain new issues. For example, residential uses of pyrethrins and pyrethroids may result in urban runoff, potentially exposing aquatic life to harmful levels in water and sediment.

Pyrethrins are botanical insecticides derived from chrysanthemum flowers most commonly found in Australia and Africa. They work by altering nerve function, which causes paralysis in target insect pests, eventually resulting in death. Pyrethroids are synthetic chemical insecticides whose chemical structures are adapted from the chemical structures of the pyrethrins and act in a similar manner to pyrethrins. Pyrethroids are modified to increase their stability in sunlight. Most pyrethrins and some pyrethroid products are formulated with synergists, such as piperonyl butoxide and MGK-264, to enhance the pesticidal properties of the product. These synergists have no pesticidal effects of their own but enhance the effectiveness of other chemicals.

Pyrethrins, a single pesticide active ingredient, contain six components that have insecticidal activity:

pyrethrin 1, pyrethrin 2, cinerin 1, cinerin 2, jasmolin 1, and jasmolin 2

Pyrethroids include:
Allethrin stereoisomers, Bifenthrin, Beta-Cyfluthrin, Cyfluthrin, Cypermethrin, Cyphenothrin, Deltamethrin, Esfenvalerate, Fenpropathrin, Tau-Fluvalinate, Lambda-Cyhalothrin, Gamma Cyhalothrin, Imiprothrin, 1RS cis-Permethrin, Permethrin, Prallethrin, Resmethrin, Sumithrin (d-phenothrin), Tefluthrin, Tetramethrin, Tralomethrin, and Zeta-Cypermethrin

Synergists include:
MGK-264 and Piperonyl butoxide

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Resmethrin
Resmethrin is a pyrethroid insecticide with many uses, including control of the adult mosquito population. The resmethrin molecule has four stereoisomers determined by cis-trans orientation around a carbon triangle and chirality. Technical resmethrin is a mixture of (1R,trans)-, (1R,cis)-, (1S,trans)-, (1S,cis)-isomers, typically in a ratio of 4:1:4:1. The 1R isomers (both trans and cis) show strong insecticidal activity, while the 1S isomers do not. The (1R,trans)- isomer is also known as Bioresmethrin,(+)-trans-Resmethrin, or d-trans-Resmethrin; although bioresmethrin has been used alone as a pesticide active ingredient, it is not now registered as a separate Active Ingredient (AI) by the U.S. EPA. The (1R,cis)- isomer is known as Cismethrin, but this is also not registered in the U.S. for use alone as a pesticide AI. Commercial trade names for products that contain resmethrin are Chrysron, Crossfire, Pynosect, Raid Flying Insect Killer, Scourge, Sun-Bugger #4, SPB-1382, Synthrin, Syntox, Vectrin and Whitmire PT-110

Always follow label instructions and take steps to avoid exposure. If any exposures occur, be sure to follow the First Aid instructions on the product label carefully. For additional treatment advice, contact the Poison Control Center at 1-800-222-1222. If you wish to report a pesticide problem, please call 1-800-858-7378.

Bumble Bee in above photograph.

Horny Bees

Honeybee queens have sex with harems of males apparently to give birth to much better dancers, research reveals.

Taking lots of male consorts is a dicey proposition for bee queens. For one thing, it increases their risk of catching sexually transmitted diseases. Also, if a queen's children have several fathers, they don't have as much in common with each other genetically speaking, which in theory could threaten how well they all get along.

Still, polyandry — where females each mate with several males — does happen among honeybees. Indeed, North American honeybee queens each have sex with an average of seven to 20 males; with the giant honeybee in Asia know to demand up to 104 mates.

To see why honeybee queens might prefer a life of promiscuity, researchers compared a trio of queens each inseminated by just one male drone with a trio of queens inseminated by 15 drones.

The genetically diverse colonies of queens inseminated by 15 males turned out better dancers — they performed more waggle dances and longer dances. Worker bees use waggle dances to reveal where food is to nest mates, and genetically diverse colonies dispatched more foragers to look for food.

BUMBLE BEE

Dealing With Bumble Bees

Large and lumbering, black and yellow bumble bee adults are important pollinators of a variety of plants. Measuring up to one inch in length, these fuzzy insects make a loud droning buzz as they fly somewhat awkwardly from flower to flower. Bumble bees nest in soil or leaf litter where a single queen lays 8 to 12 eggs in spring. Emerging workers are able to fly in very cool weather, making them a very valuable pollinator. A bumble bee (also spelled as bumblebee) is any member of the bee genus *Bombus*, in the family Apidae. There are over 250 known species, existing primarily in the Northern Hemisphere

Habitat

Bumble bees are typically found in higher latitudes and/or high altitudes; though exceptions exist (there are a few lowland tropical species). A few species (*Bombus polaris* and *B. alpinus*) range into very cold climates where other bees might not be found; *B. polaris* can be found in northern Ellesmere Island—the northernmost occurrence of any eusocial insect—along with its parasite, *B. hyperboreus*. One reason for this is that bumble bees can regulate their body temperature, via solar radiation, internal mechanisms of "shivering" and radiative cooling from the abdomen (called heterothermy). Other bees have similar physiology, but the mechanisms have been best studied in bumble bees.

Nests

Bumble bees form colonies. These colonies are usually much less extensive than those of honey bees. This is due to a number of factors including the small physical size of the nest cavity, the responsibility of a single female for the initial construction and reproduction that happens within the nest, and the restriction of the colony to a single season (in most species). Often, mature bumble bee nests will hold fewer than 50 individuals. Bumble bee nests may be found within tunnels in the ground made by other animals, or in tussock grass.

Bumble bees sometimes construct a wax canopy ("involucrum") over the top of their nest for protection and insulation. Bumble bees do not often preserve their nests through the winter, though some tropical species live in their nests for several years (and their colonies can grow quite large, depending on the size of the nest cavity). In temperate species, the last generation of summer includes a number of queens who overwinter separately in protected spots. The queens can live up to one year, possibly longer in tropical species.

Colony cycle

Bumble bee nests are first constructed by over-wintered queens in the spring (in temperate areas). Upon emerging from hibernation, the queen collects pollen and nectar from flowers and searches for a suitable nest site. The characteristics of the nest site vary among bumble bee species, with some species preferring to nest in underground holes and others in tussock grass or directly on the ground. Once the queen has found a site, she prepares wax pots to store food, and wax cells into which eggs are laid. These eggs then hatch into larvae, which cause the wax cells to expand isometrically into a clump of brood cells.

These larvae need to be fed both nectar for carbohydrates and pollen for protein in order to develop. Bumble bees feed nectar to the larvae by chewing a small hole in the brood cell into which nectar is regurgitated. Larvae are fed pollen in one of two ways, depending on the bumble bee species. So called "pocket-maker" bumble bees create pockets of pollen at the base of the brood cell clump from which the larvae can feed themselves. Conversely, "pollen-storers" store pollen in separate wax pots and feed it to the larvae in the same fashion as nectar. Bumble bees are incapable of trophallaxis (direct transfer of food from one bee to another).

With proper care, the larvae progress through four instars, becoming successively larger with each molt. At the end of the fourth instar, the larvae spin silk cocoons under the wax covering the brood cells, changing them into pupal cells.

The larvae then undergo an intense period of cellular growth and differentiation and become pupae. These pupae then develop into adult bees, and chew their way out of the silk cocoon. When adult bumble bees first emerge from their cocoons, the hairs on their body are not yet fully pigmented and are a greyish-white color. The bees are referred to as "callow" during this time, and they will not leave the colony for at least 24 hours. The entire process from egg to adult bee can take as long as five weeks, depending on the species and the environmental conditions.

After the emergence of the first or second group of workers, workers take over the task of foraging and the queen spends most of her time laying eggs and caring for larvae. The colony grows progressively larger and at some point will begin to produce males and new queens. The point at which this occurs varies among species and is heavily dependent on resource availability and environmental factors. Unlike the workers of more advanced social insects, bumble bee workers are not physically reproductively sterile and are able to lay haploid eggs that develop into viable male bumble bees. Only fertilized queens can lay diploid eggs that mature into workers and new queens.

Early in the colony cycle, the queen bumble bee compensates for potential reproductive competition from workers by suppressing their egg-laying by way of physical aggression and pheromonal signals. Thus, the queen will usually be the mother of all of the first males laid. Workers eventually begin to lay males later in the season when the queen's ability to suppress their reproduction diminishes. The reproductive competition between workers and the queen is one reason that bumble bees are considered "primitively eusocial".

New queens and males leave the colony after maturation. Males in particular are forcibly driven out by the workers. Away from the colony, the new queens and males live off nectar and pollen and spend the night on flowers or in holes. The queens are eventually mated (often more than once) and search for a suitable location for diapause (dormancy).

Mechanical Control: Removing bees without bee poison

Killing bees with bee traps.
One of the most common traps used to kill bees with is the bottle trap. To make one, get an empty two liter soda bottle, remove the lid, cut the top off the bottle at the point where the neck starts to slant inward, turn the top upside down and place it into the bottle so that the two cut surfaces are flush, and secure it there with staples, tape, or both. Once the bee trap is made, pour in a couple inches of something sweet like fruit juice or Mountain Dew, add a couple drops of liquid dish detergent, set your trap out, and watch as bees fly in and die because they're too stupid to get back out.

Remove bees from the house with a vacuum cleaner.
Unless you have a thousand bees swarming your face, the vacuum cleaner is a great way to get rid of bee pests that are in the house. Simply use the hose attachment and suck them into oblivion.

Use a cardboard box for bee swarm removal.
Bee swarms are often found at rest on the ends of tree branches. In order to take care of this problem, some people, who are far braver than I, will take a large cardboard box out to the swarm site in the early morning when the bees are sluggish, open the box and set it below the swarm, quickly jerk the bees' branch up and down a few times to shake them into the box, and quickly close the lid. After checking the branch over really well to make sure the queen is not still on it, the bees are then relocated.

Biological Control: Natural ways to relocate or exterminate bees
Contact a local beekeeper. If you have a colony of honeybees and you want it gone, put some effort into finding someone to come and take them off your hands before killing bees or calling the bee exterminators to do it for you. These days, considering the severity of Colony Collapse Disorder, there's a good chance that some local beekeeper will be more than happy to come and supply you with free bee removal services.

Get rid of ground bees with a sprinkler. Quite often ground bees can be gotten rid of simply by spraying them with water. Connect a sprinkler to your garden hose, set it up next to where the bees are living, and let the fun begin.

Repel carpenter bees with almond oil. During the day, when the bees are out and about, plug their holes and spray the structure they're drilling into with almond oil. Almond oil is a natural bee repellent.

Soap and water kills bees. To exterminate bees nesting in the ground, all you need is some buckets, some warm water, and some liquid dish detergent. Fill a few buckets with some nice, warm, soapy water (exact measurements aren't really needed; just be generous with the soap), and dump the soap water down their holes. If you want to dispatch a bee swarm, exact measurements are a little more important but only because you will be using a sprayer and wanting it to spray properly. Mix a 2% water to soap solution (about 1/3 cup soap to 1 gallon water), and spray away.

Boric acid is a natural bee insecticide. This effective bee killer is a dust that sticks to the legs and bodies of bees. Once on their legs and bodies, bees unwittingly carry it into their hives or nests and poison the rest of the colony. Sprinkle boric acid on the ground around ground nesting sites, at the entrances of hives and nests, or, when dealing with honeybees in the walls, directly into hives via holes drilled through the wall and into the side of the hive.

Pyrethrins are another natural bee pesticide. Pyrethrins, bee killers derived from the flowers of the chrysanthemum, work quite well as a spray for controlling bee populations. Pyrethrins are not generally used to destroy entire bee colonies. Instead, as they only kill the bees that get sprayed directly, pyrethrins are usually just used to keep populations from getting too out of hand. Microcare Aerosol is a good brand.

There are ways to avoid a bumble bee problem:

- Clean up yard of unwanted mulch or other such organic debris.
- When working in flower beds, gardens, etc. or when cleaning up other such areas around the home, be cautious when dealing with any flat board, stone, bricks, etc. as these are the most likely sites for a nest.
- Remove flat items that could provide a nesting site for bees: boards, plywood, other loose building materials, tarps or other junk. (This will not only reduce the chances of bumble bees nesting too close to house, children or pets but will also make your garden look nicer.)
- Flat rocks, stones or bricks should be removed unless they are part of a pathway or other decoration. Examine the ground beneath stones or brick for possible mouse holes which need to be filled in. Check these items to make sure that they are packed down to make good contact with the ground.
- If you find a nest, it is best to leave it alone and let the drones and workers die off during the winter. Use this option only when you are positive that children, pets or workers in the area are not at risk of being stung by the bees.
  Foraging bees are extremely beneficial and want nothing to do with people or pets; encounters with bees in and around their nest can be harmful to people and pets.

When people come into contact with an active nest there are only two alternatives:

1. Leave the nest alone and let nature run its course.
2. Eliminate the bumble bee nest when its location is potentially harmful to people or pets.

As beneficial as bumble bees are, they are indeed a pest when the location of their nest causes stings to people.

Eliminate Bumble Bee Nests
When the location of a bumble bee nest dictates elimination for safety's sake, certain products, techniques and timing are essential. Using the wrong pest control products or using any control products during the peak of bee activity are major mistakes you want to avoid. For instructions on how to get rid of bumble bees that have become a hazard, see Bumble Bee Control; How to Kill Bumble Bees If They Become a Pest. The control article will give you choices of products for different locations of bumble bee nests.

Bumble Bee Control

How to Kill Bumble Bees If They Become a Pest
These flying, stinging insects are usually considered beneficial and should be left alone. In most cases, their benefits far outweigh the dangers they may present. This article addresses problems where the bees have become pests, usually due to the location of their nests.

Chemical and non-chemical controls should both be considered. Non-chemical control mainly consists of prevention methods. Pesticide-free control of bumble bees is discussed on the bumble bee information page.

When the location of a bumble bee nest dictates elimination for safety's sake, certain products, techniques and timing are essential. Using the wrong pest control products or using any control products during the peak of bee activity usually results in failure to control the pests and (very often) being stung by angry bees.

First, there is timing to consider. Stinging insects such as bees, wasps, hornets or yellow jackets tend to be very active in daylight hours and rest (in their nests) after sundown. If you treat an active nest in daylight hours there are two possible bad results: you are at much greater risk of being stung and will not kill as many bees with initial application. Once you have located the nest, make note or mark the area so that you can find the nesting area at dusk or in the darker hours.

During daylight hours, bees are busy foraging for all of the colony's needs. Treating the nest during these hours will kill a few bees. Workers returning to the nest are exposed to the treatment but the treatment will not be as fast or as effective. Early evening treatment will catch the majority of the workers in the nest, trapped and unable to escape safely.

Nests located beneath loose objects (mulch, grass clippings) or covered by over-grown grass and weeds are treated differently than those that simply lie beneath a brick, stone or other similar object.

If a bumble bee nest is located in an over-grown area, do not use lawn mowers or other motorized grass and weed trimmers before the bumble bee nest has been neutralized!

The sound of such machinery will stir up and agitate the colony into attack mode. First eliminate the nest, and then finish your landscaping chores. There are two basic methods for treating bumble bee nests. Read this entire section before deciding on methods and products needed. Most people will need only one type of bee control; others may have such a severe problem that a combination of these two methods might be needed.

Treating Nests beneath Grass, Mulch
Treating nests in covered or over-grown areas is best done by first broadcasting an insecticide over the area. This is especially important when the entrance hole is not visible due to loose materials. The area should be fairly well drenched both on and around the suspected entrance to the nest. Products containing Cypermethrin work well for this job. Cypermethrin is available in both liquid and wettable powder concentrates.

Either formulation can be used; Demon EC, Cynoff EC are professional liquid concentrates and Demon WP, Cynoff WP are professional wettable powder concentrates.

Once you have sprayed the area (or areas), make note of the bumble bee population over the next 10 to 14 days. A repeat application might be necessary. If you think that you are dealing with multiple nests, pushing an insecticide dust into the entrance holes might also be necessary. This is especially important during the time of year when there could be many bee grubs or larvae that will soon be hatching out, producing even more worker bees. Dusting bee colonies is discussed in the section where elimination of underground bee nests is explained.

Dust and wettable powder pesticides tend to be more hazardous to bees than solutions or emulsifiable concentrates for contact pesticides. Actual damage to bee populations is a function of toxicity and exposure of the compound, in combination with the mode of application.

A systemic pesticide, which is incorporated into the soil or coated on seeds, may kill soil-dwelling insects, such as grubs or mole crickets as well as other insects, including bees that are exposed to the leaves, fruits, pollen, and nectar of the treated plants

Pesticides

Pesticides can affect honey bees in different ways. Some kill bees on contact in the field; others may cause brood damage or contaminate pollen, thus killing house bees. Before dying, poisoned bees can become irritable (likely to sting), paralyzed or stupefied, appear to be 'chilled' or exhibit other abnormal behavior. Queens are likely to be superseded when a colony is being poisoned. Sometimes solitary queens, banished as if they were somehow "blamed" for poisoning, may be found near a colony. These symptoms are not always distinct and they cannot be taken as definite signs of pesticide poisoning. Many chronic management problems such as starvation, winter kill, chilled brood or disease may result in the same symptoms. Often these problems may be caused by pesticides in an indirect manner. So it is difficult in many instances to categorically state that bees have been poisoned.

Only one readily recognized symptom is good evidence of pesticide damage; the presence of many dead or dying bees near a colony's entrance. In a short period of time, however, these dead bees may dry up and the remains be blown away and eaten by ants or other scavengers. A beekeeper, therefore, who visits his yards only occasionally may not see these dead bees and thus not be aware that his colonies have been poisoned.

Most major bee poisoning incidents occur when plants are in bloom. However, bees can be affected in other circumstances as well. Keep the following suggestions in mind when applying pesticides. Use pesticides only when needed: Foraging honey bees, other pollinators, and insect predators are a natural resource and their intrinsic value must be taken into consideration. Vegetable, fruit, and seed crop yields in nearby fields can be adversely affected by reducing the population of pollinating insects and beneficial insect predators. It is always a good idea to check the field to be treated for populations of both harmful and beneficial insects.

Do not apply pesticides while crops are in bloom: Insecticide should be applied only while target plants are in the bud stage or just after the petals have dropped.

Apply pesticide when bees are not flying: Bees fly when the air temperature is above 55-60°F and are most active from 8 a.m. to 5 p.m. Always check a field for bee activity immediately before application. Pesticides hazardous to honey bees must be applied to blooming plants when bees are not working, preferably in the early evening. Evening application allows time for these chemicals to partially or totally decompose during the night.

Do not contaminate water: Bees require water to cool the hive and feed the brood. Never contaminate standing water with pesticides or drain spray tank contents onto the ground, creating puddles.

Use less toxic compounds: Some pest control situations allow the grower-applicator a choice of compounds to use. Those hazardous to honey bees must state so on the label. Select other materials or vary dosages, based on the honey bee mortality predictor model to be discussed in a later section of this publication. When in doubt, consult your County Agricultural Extension Agent for details, recommendations and further information about the toxicity of specific compounds to honey bees.
Use less toxic formulations:

Notify beekeepers: If beekeepers are notified in advance of application, colonies can be moved or loosely covered with burlap or coarse cloth to confine the bees and yet allow them to cluster outside the hive under the cloth. Repeated sprinkling each hour with water prevents overheating. Never screen or seal up colonies and do not cover with plastic sheeting. This can result in overheating, leading to bee suffocation and death. Law requires every apiary or bee yard to be plainly marked with the owner's name, address and telephone number.

Besides bumble bees, any of these products can be used for general purpose pest control in and around the home. Liquid concentrates are more cost effective for this particular job. If you are positive that you are dealing with only one nest, a 4 ounce bottle of Cypermethrin concentrate may be all that you will need, especially if you have no other pest control needs. Pump type sprayers can be used for this type of pest control job but most people feel safer using a hose end sprayer. A hose end sprayer will give you the ability to treat the targeted area from a better distance and will also provide a more thorough soaking of the nest area. When using a hose end sprayer, liquid concentrate insecticides work better than wettable powder concentrates. The type and amount of loose materials covering the entrance to the nest will dictate the amount of spray needed. If cover is heavy, more than one application is often called for. Always follow the label instructions.

There are three different sizes of liquid concentrate Cypermethrin: 4 ounce, 16 ounce, and 32 ounce. If you do not intend on doing your own general household pest control, you will usually not need the larger containers. Only when there is a great deal of landscape area to deal with will you need larger volumes of liquid insecticides. In this case, Demon Max (Demon EC) is your best bet. For smaller jobs, buy one or two 4 ounce bottles of Cypermethrin. Always follow the label instructions.

Keep pets and children off of any treated area until the area has been allowed to dry thoroughly. Once dry, the area will be safe for re-entry - unless bumble bees are still noted flying in the area. Bumble bees do not always die as quickly as we would like; they are tough and stubborn. Always follow the label instructions.

Treating Nests beneath Rocks, Tarps, Decks
When the entrance to a bumble bee nest is easy to locate and is not covered with tall grass or mulch, the best control method is dusting. A professional grade insecticide dust is formulated with tiny particles that will float through the targeted area, almost like smoke. When properly applied into the nest entrance hole with a good hand bellows duster, the dust will travel deep into the nest.

Choosing Pest Products
There are two different dusts that will work: Drione Dust and Delta Dust. The advantage of Drione Dust is that it has a very fast knock-down or kill of targeted pests. Delta Dust has the advantage of being water-proof, an asset that is very attractive when treating soil that might contain any type of moisture. Delta Dust is the more popular of the two insecticides. Pest control technicians who have more products at their disposal have reported great results when combining the two dusts for a single application. This combination gives them a quick knock-down of existing bees and fewer call-backs when young bees can emerge. Always follow the label instructions. Apply insecticide dust with a hand bellows duster. There are two good hand bellows dusters to choose from: 360 DustWand and Crusader Duster. Either of these dusters will do a good job. The advantage of the Dust Wand is that the extensions provide a longer reach. Always follow the label instructions.

Application of Pest Products
When applying pesticide dusts into cracks, crevices or entry points, proper filling of the dusting device is of utmost importance. When a hand bellows duster is completely filled to its capacity, or when dust is packed down inside the duster, dust does not come out in proper form. Never overfill a hand-bellows type insecticide duster. Fill duster 1/2 to 2/3 from top. After replacing the fill plug, gently shake the duster just prior to application. The small area inside the duster (created by NOT over-filling the duster) creates a space that is sorely needed. When the duster is shaken, a small "cloud" of insecticide dust is formed in the empty space.

By gently shaking a properly filled duster, the dust particles will exit the duster nozzle in a thin, smoke-like cloud as the hand bellows duster is squeezed. This thin cloud of dust will travel further through the targeted area (in this case, an underground bumble bee nest), reaching far more adults, eggs and larvae. The next effect of proper application is overall coverage. If large amounts of Deltamethrin(Delta Dust or Drione Dust) are merely "dumped" into the nest entrance, the majority of the dust will merely pile up in one place. Properly applied dust will "float" through the chambers and most of the particles will tend to stick to top, bottom and sides of the tunnel as well as the nest itself.

Treatment of a bumble bee nest involves coating the nest entrance, nest, eggs, grubs and adults. For most nests, you will need to apply two applications: partially fill your duster, shake thoroughly, empty contents into nest; repeat. This double application will assure better control over all stages of the bee and will contaminate the nest and void, which will kill bees returning to the nest area. As mentioned previously, the best time to kill bumble bees is when they are at rest or as they sleep. Avoid treatment during daylight hours; treat the bumble bee nest at dusk or when it is dark enough for the bees to cease their activity but just light enough for you to see what you are doing. You can kill bees at night (using a flashlight) but there are a couple of possible hazards that you might run into: stumbling over unseen objects and actually attracting angry bees.

The first possible hazard listed is mainly common sense. If you trip and fall over any unseen object in the area, you not only risk possible harm from the fall but also risk waking up the resting bees.

Using a flashlight to navigate to the sight or while treating the nest can be a problem.

If the bees are disturbed and exit the nest, they could very well be attracted to light emitted from your flashlight. (If light is needed, try setting your flashlight in one area before you approach the nest from another area.)

Not all insecticides have the same effects when prepared in different formulations. Research and experience indicate:

- New microencapsulated insecticides are much more toxic to honey bees than any formulation so far developed. Because of their size, these capsules are carried back to the colony and there can remain poisonous for long periods. These insecticides should never be used if there is any chance bees might collect the microcapsules. Always consider using another formulation first.
- Dusts are more hazardous than liquid formulations.
- Emulsifiable concentrates are less hazardous than wettable powders.
- Ultra-low-volume (ULV) formulations are usually more hazardous than other liquid formulations.
- Identify attractive blooms: Before treating a field with pesticides, it is a good idea to check for the presence of other blooming plants and weeds which might attract bees. In many instances bees have been killed even though the crop being sprayed was not in bloom. Many times these attractive blooms can be mowed or otherwise removed, although mowing can result in destroying other beneficial insect habitat or force destructive insects into the crop being cultivated.

Always follow label instructions and take steps to avoid exposure. If any exposures occur, be sure to follow the First Aid instructions on the product label carefully. For additional treatment advice, contact the Poison Control Center at 1-800-222-1222. If you wish to report a pesticide problem, please call 1-800-858-7378.

NOTE: When pesticides are used, it is the applicator’s legal responsibility to read and follow directions on the product label. Not following label directions, even if they conflict with information provided herein, is a violation of federal law.

This course contains EPA’s federal rule requirements. Please be aware that each state implements pesticide regulations that may be more stringent than EPA’s regulations. Check with your state environmental/pesticide agency for more information.

Topic 3 Bee Control Section Post Quiz
Answers at rear of Glossary
Fill-In-the-blank

Bee Swarms

1. _____________is a common method of obtaining bees by hobbyists and commercial beekeepers. Swarms are captured and introduced into hives with removable frames, where they can be managed properly for honey production or pollination services.

2. Once the ____________is established in an area, it is more difficult to get beekeepers to capture swarms for their own use. They will not wish to risk capturing a swarm that may be Africanized.

Removing Bees

3. Occasionally, even honey bees are considered pests and must be dealt with like any other unwanted insect. Because of the attention recently focused on AHBs, it is important to provide homeowners, pest control operators, and others with sound information on how to deal with honey bees when they are pests. ______________may nest in tree hollows or in structures, such as attics, between the wall studs of houses or garages, within porch roofs, or in similar areas.

Bees in Buildings

4. Bees nesting in buildings, unlike swarms, are a great problem. There is _______________of removing the bees. However, every effort should be made to determine the extent of the nest and to give priority to removing and relocating the bees, brood, and honey stores.

Insecticide

5. Insecticide should be applied at the entry/exit area of the nest and, if feasible, directly onto the nest (drilling small holes to the nest may be necessary). The nest itself may be some distance upwards, left or right from the entry/exit area and is almost always suspended from some overhead support. Several repeat applications are usually necessary to kill the bees. Whenever using an insecticide, _________________For nests in trees or garages, removal usually is not necessary.

Safening the Home

6. Homes may be made safer by ___________bee colonies. Desirable nesting sites may be reduced by discarding barrels, old appliances, abandoned cars, piles of debris, and other materials. Hollow trees and logs should be removed.

7. Cavities in landscape trees may be filled with___________________. Loose insulation beneath mobile homes, and open vents beneath homes or attics should be repaired. Vents should be screened with wire mesh small enough to prevent bee entry. Knot holes and cracks in houses, barns, and storage structures need to be repaired or filled. Holes made for utilities and plumbing should be inspected, and any openings should be closed or filled to prevent entry of bees.

Avoiding Bee Problems

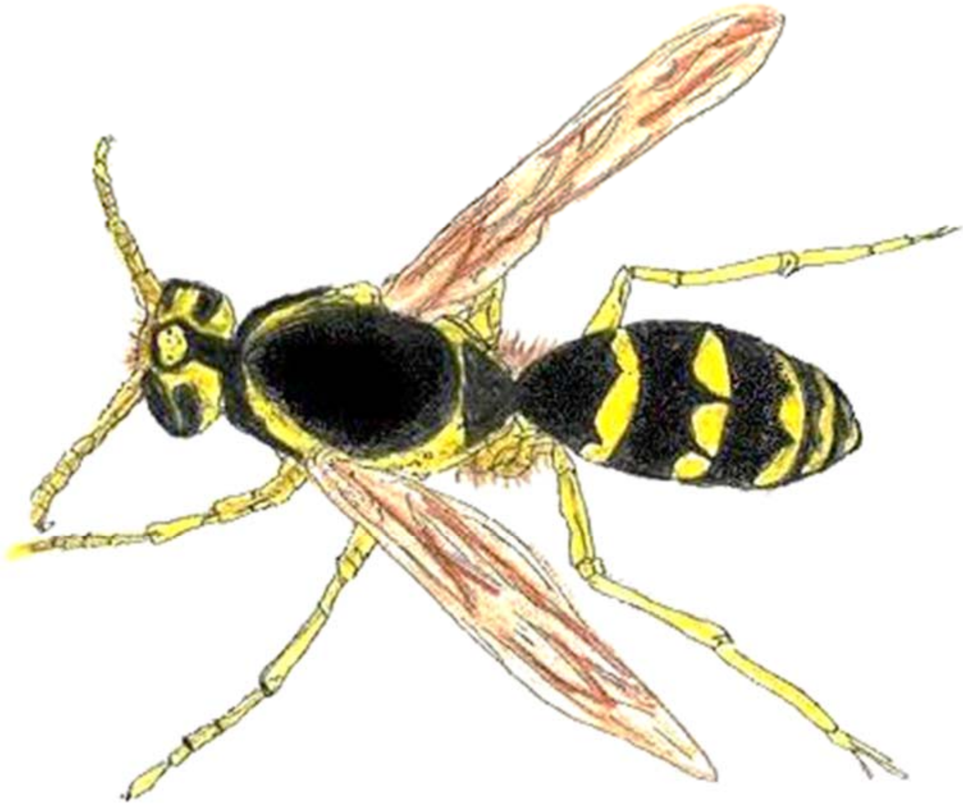
8. Most serious incidents involving bees can be avoided with a little effort. In areas where the _____________has become established, people should learn the basics about bees and their habits. When activities increase the possibility of interaction with bees, care should be taken to reduce incidents.

General Bee Control and Treatments

9. The most important element of wasp and bee control is to *destroy the nest*. Aerosol “wasp and hornet” sprays can be used to knock down bees/wasps around the nest. Small amounts of pesticides (__________________work well) applied into the nests of carpenter bees and cicada killers provide good control. Nests of mud daubers also can be treated this way or by simply scraping them off structures. To prevent re-infestation, finishes (paint, etc.) can be applied to unfinished wood to discourage carpenter bees.

10. Another special case occurs when large numbers of yellowjackets forage in public areas such as parks, schools and zoos. Attracted to human food, especially________________, wherever it is being prepared, eaten or discarded, yellowjackets pose an increased threat to humans. Control is often difficult.

Topic 4 Wasp Section



Yellowjackets
The solitary wasps rarely become a problem. Solitary means they do not colonize or form nests where many wasps live together. Although they may look threatening, most of them do not defend their nests and rarely sting people. Mud Daubers build a hard nest out of mud, usually on ceilings, walls or eaves of buildings. The nests are attended by a single female wasp. The mud dauber's favorite food is a spider meal. The Blue Mud Wasp is another solitary wasp less common but present in our area. This wasp seems incapable of building her own mud nest, but is able to repair and use abandoned nests. The Black Widow spider is at the top of her menu.

The social wasps can be fractured into 2 groups, the Yellowjackets / Hornets and Paper wasps. Most of these wasps feed on insect pests eliminating large numbers of them. Paper wasps feed abundantly on armyworms, corn earworms and other ag pests. Hornets will take house flies, blow flies and caterpillars. Other Yellowjacket species are exclusively scavengers. Unless they nest or are active near human activities, it's best to leave them alone. But unlike the solitary wasps, these wasps can become very defensive when their nests are disturbed. Loud noises such as a lawnmower, vibration from even footsteps or just coming too close to a nest can elicit a defensive response.

Yellowjackets, hornets and paper wasps are attracted to some types of odors and sources of water. Swimming pools, ornamental ponds and other sources of standing water will be attractive to nest building workers. Foraging and scavenging workers may be attracted in differing degrees to clover, ripe or rotting fruit, pet food, garbage, soft drinks and a variety of cooked meats. Also perfumes, hair sprays, suntan lotion and other cosmetics may less frequently attract wasps, bees and yellowjackets.

Adult wasps are ½ to 3/4 inch long, with characteristic yellow and black stripes and transparent wings. Yellow jackets are often feared for their sting, which is a hazard to people who are allergic. However, they are beneficial as predators of caterpillars, flies and beetle grubs. Nests need not be removed if they are not interfering with the lives of people in the area.

There are two distinct types of social wasps—yellowjackets and paper wasps. Yellowjackets are by far the most troublesome group, especially ground- and cavity-nesting ones such as the western yellowjacket, which tend to defend their nests vigorously when disturbed. Defensive behavior increases as the season progresses and colony populations become larger while food becomes scarcer. In fall, foraging yellowjackets are primarily scavengers, and they start to show up at picnics and barbecues, around garbage cans, at dishes of dog or cat food placed outside, and where ripe or overripe fruit are accessible. At certain times and places; the number of scavenger wasps can be quite large.

Paper wasps are much less defensive and rarely sting humans. They tend to shy away from human activity except when their nests are located near doors, windows, or other high-traffic areas.

Nests of both yellowjacket and paper wasps typically are begun in spring by a single queen, who overwinters and becomes active when the weather warms. She emerges in late winter to early spring to feed and start a new nest. From spring to midsummer nests are in the growth phase, and the larvae require large amounts of protein.

Workers forage mainly for protein at this time—usually in the form of other insects—and for some sugars. By late summer, however, the colonies grow more slowly or cease growth and require large amounts of sugar to maintain the queen and workers, so foraging wasps are particularly interested in sweet things at this time.

Yellowjackets
The term yellowjacket refers to a number of different species of wasps in the genera Vespula and Dolichovespula (family Vespidae). Included in this group of ground-nesting species are the western yellowjacket, V. pensylvanica, which is the most commonly encountered species and issometimes called the “meat bee,” and seven other species of Vespula. V. vulgaris is common in rotted tree stumps at higher elevations, and V. germanica, the German yellowjacket, is becoming more common in many urban areas of California, where it frequently nests in houses.

These wasps tend to be medium sized and black with jagged bands of bright yellow—or white in the case of the aerial-nesting D. (formerly known as V.) maculata—on the abdomen and have a very short, narrow “waist,” the area where the thorax attaches to the abdomen. V. vulgaris ranges across Canada and the northeastern United States. Common in higher elevations, it nests in shady evergreen forests around parks and camps in the western mountains and the eastern Appalachians. This species also is one of the most important stinging insects in Europe.

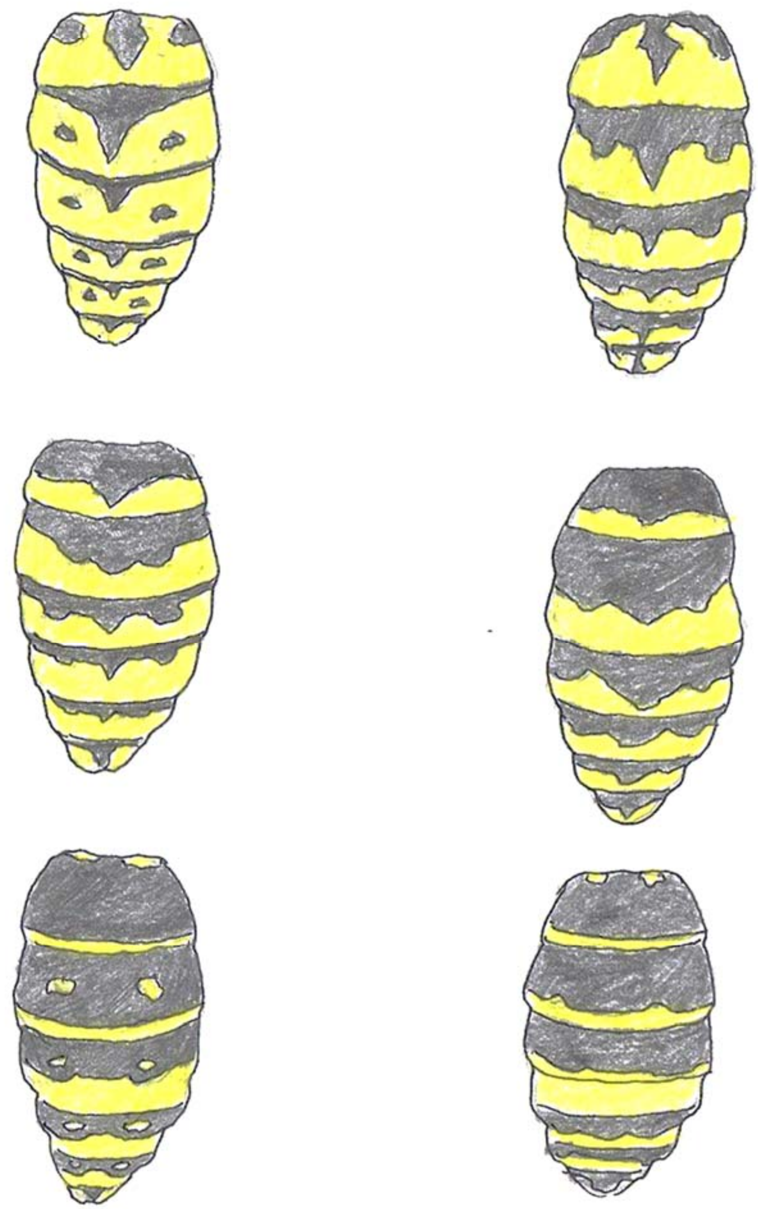
Eastern Yellowjacket (Vespula maculifrons)
This common ground nesting yellowjacket is distributed over the eastern half of the United States. Its western border is from eastern Texas north to eastern North Dakota. Workers are slightly smaller than most yellowjackets, but colony size can number around 5,000 or more individuals. The nest of V. aculifrons is dark tan, made of partially decomposed wood and is quite brittle.

The Eastern yellowjacket sometimes nests in building wall voids. Most yellowjackets have very slightly barbed stingers but the sting will not set in the victim's tissue like the barbed stinger of the honey bee. The stinger of V. maculifrons, however, often sticks and when the insect is slapped off, the stinger may remain.

Wasp Pesticides
Wasps and bees are beneficial insects, although they are generally considered to be pests because of their ability to sting. Wasps, in particular, can become a problem in autumn when they may disrupt many outdoor activities. People often mistakenly call all stinging insects "bees". While both social wasps and bees live in colonies ruled by queens and maintained by workers, they look and behave differently. It is important to distinguish between these insects because different methods may be necessary to control them if they become a nuisance.

COMMON WESTERN YELLOWJACKETS

QUEEN | **WORKER** | **SPECIES**



WESTERN YELLOWJACKET

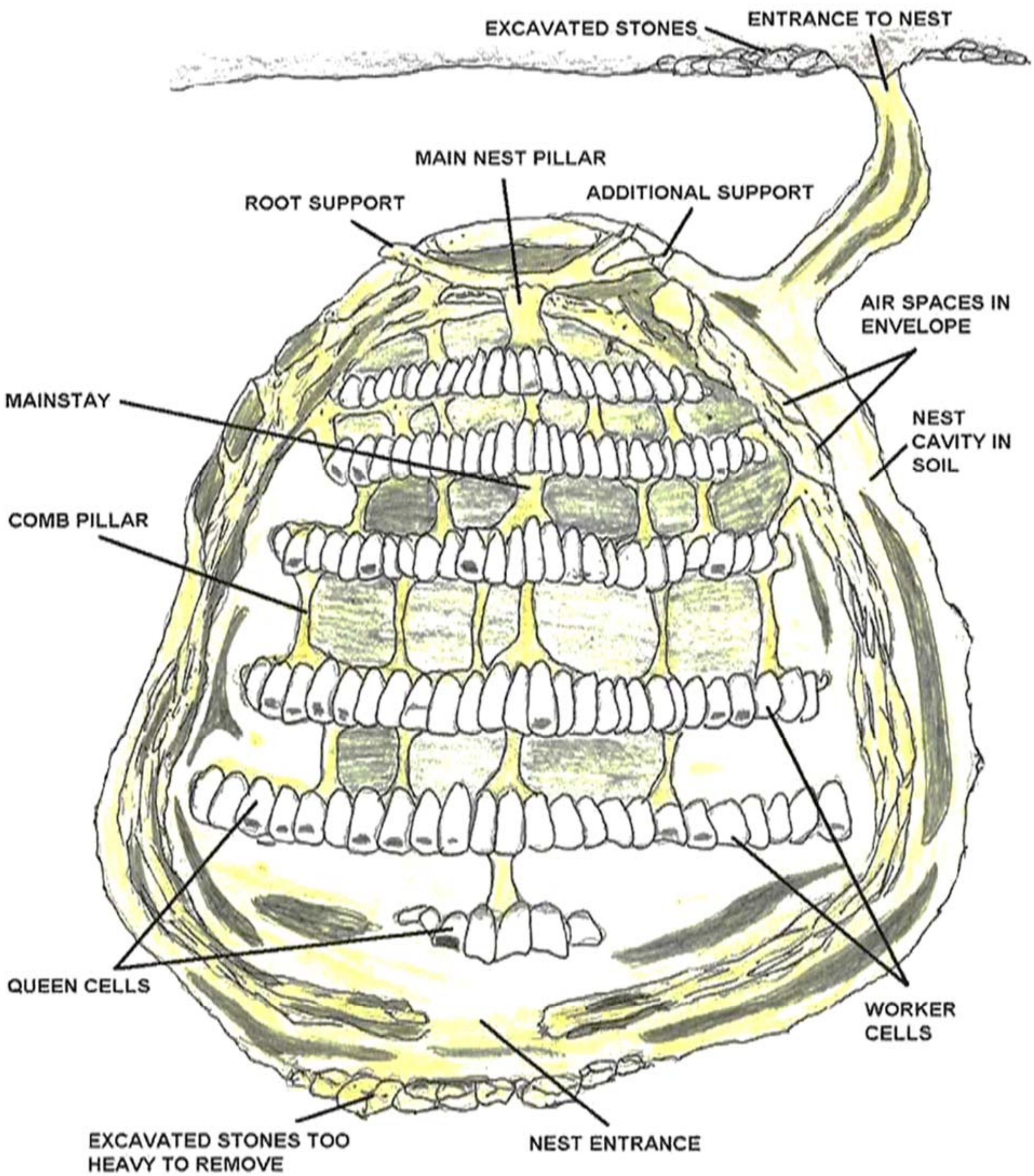
V. pensylvanica

COMMON YELLOWJACKET

V. vulgaris

FOREST YELLOWJACKET

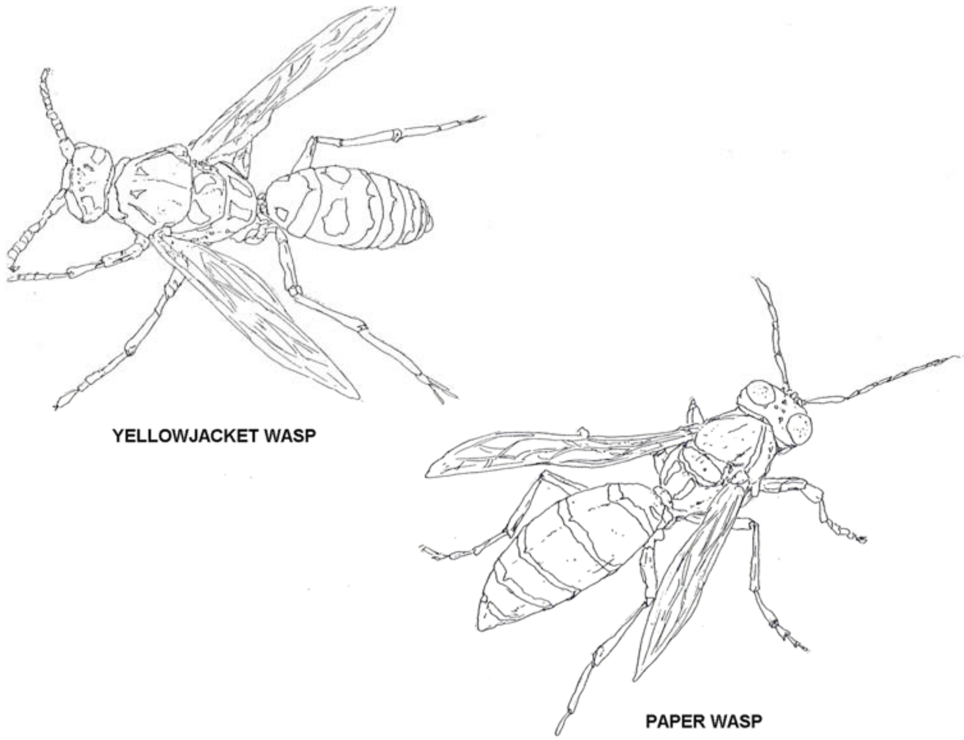
V. acadica



PARTS OF A WASP NEST

German yellowjacket (Vespula germanica)

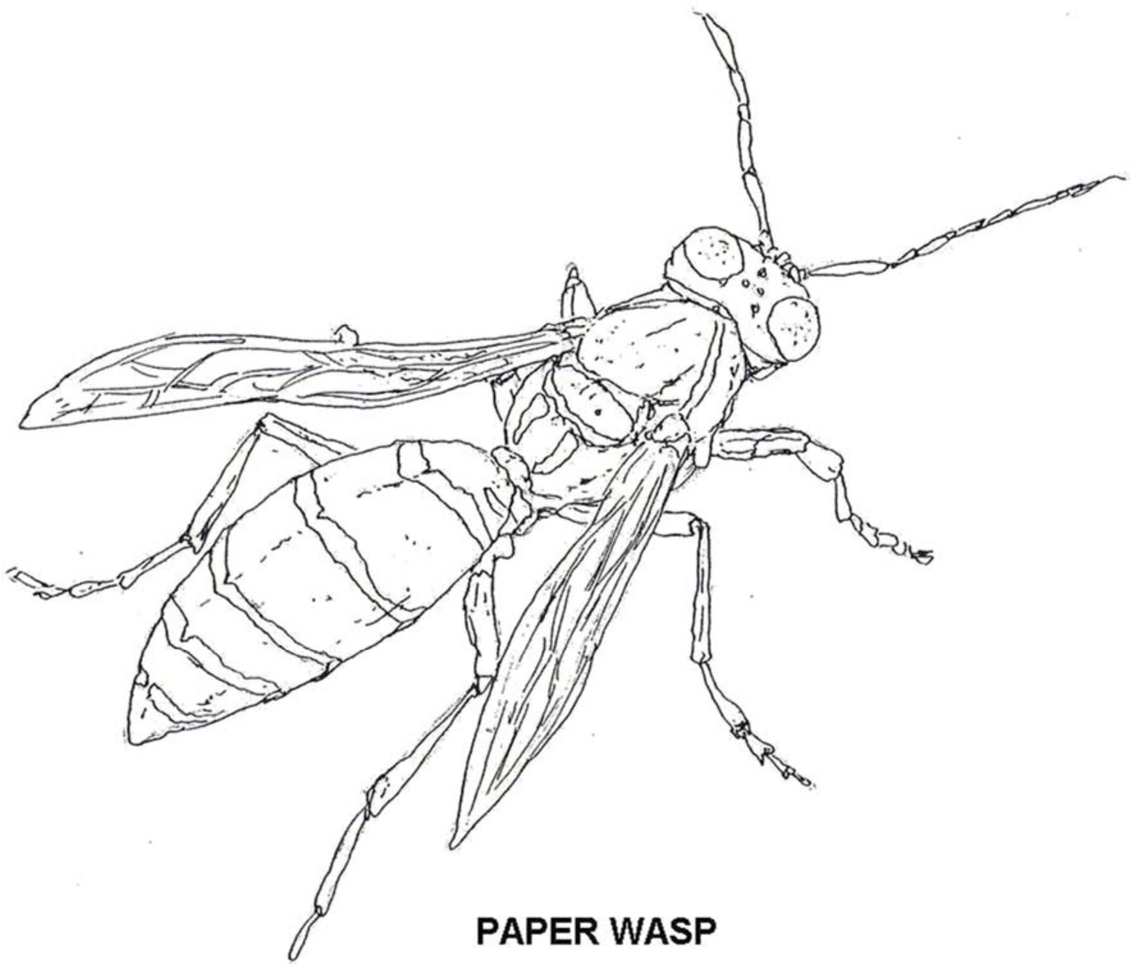
In Europe, German yellowjacket nests are subterranean, but in North America the vast majority of reported nests are in structures. This yellowjacket is distributed throughout the northeastern quarter of the United States. Nests in attics and wall voids are large, and workers can chew through ceilings and walls into adjacent rooms. The nest and nest envelope of this yellowjacket is made of strong light gray paper. Colonies of this yellowjacket may be active in protected voids into November and December when outside temperatures are not severe.



Nests
Yellowjackets commonly build nests in rodent burrows, but they sometimes select other protected cavities, such as voids in walls and ceilings of houses, as nesting sites. Colonies, which are begun each spring by a single reproductive female, can reach populations of between 1,500 and 15,000 individuals, depending on the species. The wasps build a nest of paper made from fibers scraped from wood mixed with saliva. It is built as multiple tiers of vertical cells, similar to nests of paper wasps, but enclosed by a paper envelope around the outside that usually contains a single entrance hole. If the rodent hole isn't spacious enough, yellowjackets will increase the size by moistening the soil and digging. Similar behavior inside a house sometimes leads to a wet patch that develops into a hole in a wall or ceiling.

Immature Yellowjackets
Immature yellowjackets are white, grub-like larvae that become white pupae. The pupae develop adult coloring just before they emerge as adult wasps. Immatures normally aren't seen unless the nest is torn open or a sudden loss of adult caretakers leads to an exodus of starving larvae.

Aerial-nesting yellowjackets, D. arenaria and D. maculata, build paper nests that they attach to the eaves of a building or that hang from the limb of a tree. The entrance normally is a hole at the bottom of the nest. These aerial nesters don't become scavengers at the end of the season, but they are extremely defensive when their nests are disturbed. Defending D. arenaria sometimes bite and/or sting, simultaneously. Wasp stingers have no barbs and can be used repeatedly, especially when the wasp gets inside clothing. As with any stinging incident, it is best to leave the area of the nest site as quickly as possible if wasps start stinging.

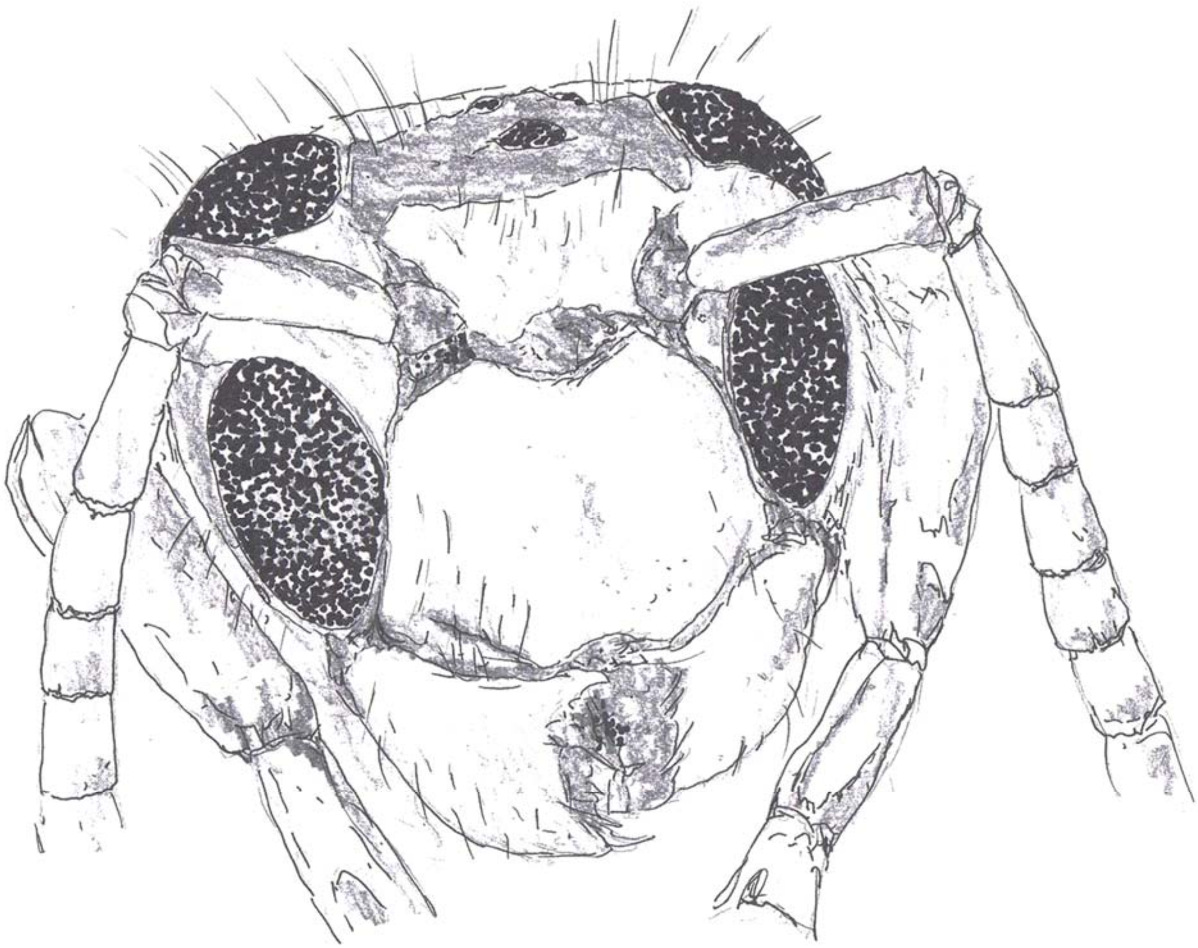


PAPER WASP

Paper Wasp
The paper wasp is made up of mostly the Polistes genus. They are easy to distinguish from other bees, hornets and yellowjackets as they are less aggressive and they build a hexagonal, open paper nest. Markings and colors vary but include yellows, browns and blacks. The nest is constructed in protected areas above the ground. Common areas their nests can be found include on walls or under eaves of homes and other buildings. Nest construction begins in the Spring and construction and maintenance continues as long as the colony continues to grow. Wasps gather fibers form old decaying wood or dead, dry plants, chew them up and mix the debris with water to make their grey paper nest. Populations in these nests rarely ever exceed 200.

Aerial Nesters
Several yellowjackets make the aerial football- shaped paper nests, commonly called hornets' nests. Two of these yellowjackets are common: the Aerial yellowjacket, Dolichovespula arenaria, and the Bald Faced hornet, Dolichovespula maculata. The Aerial yellowjacket is found in the west, Canada, and east (but not in the central and southern states). This species begins its nest in March or April and is finished and no longer active by the end of July. Their nests, usually attached to building overhangs are smaller and more round than those of other species. The Bald Faced hornet is larger than the other yellowjackets and is black and white -- not black and yellow. It lives along the west coast, across Canada, and in all of the states in the eastern half of the country.

On warm spring days, the large Aerial nesting queen develops a small comb, like the Paper wasp with a dozen or so cells, but she encloses it in a round gray paper envelope. The daughter workers later take over the nest duties, and by mid-summer, when the worker population is growing and food is plentiful, the nest is expanded to full size.



FACE OF YELLOWJACKET WASP

A full-sized Bald Faced hornet nest consists not of a single umbrella comb like the Paper wasp, but four to six wide circular combs -- one hanging below the other and all enclosed with an oval paper envelope consisting of several insulating layers. Bald faced hornets not only gather flies, but are large enough to kill and use other species of yellowjackets for larval food. They attach their nests to low shrubs or high in trees or on buildings. Although Aerial colonies can have four to seven hundred workers at one time, their food gathering habits do not routinely bring them in contact with humans. Large nests are often discovered only after leaves have fallen and the nests are exposed -- both to view and to nature's elements that finally bring about their disintegration.

Underground Nesters

The stinging wasp, often identified as a yellowjacket, is black and yellow. Primarily yellow bands cover a dark abdomen. These species are in the genus Vespula. They begin their nests like the aerial nesters -- with an enveloped small comb made of wood fiber paper. Only these nests are started in soil depressions, rodent burrows, or in any small hole in the ground that will give protection until workers can develop. Once workers begin nest care, they enlarge the entrance hole and expand the nest. Combs are placed in tiers, one below the other. They can be very large; they have firm support from the soil surrounding the external envelope. Several species of Vespula make their nests in building wall voids, attics; hollow trees and other enclosed spaces as well as the ground.

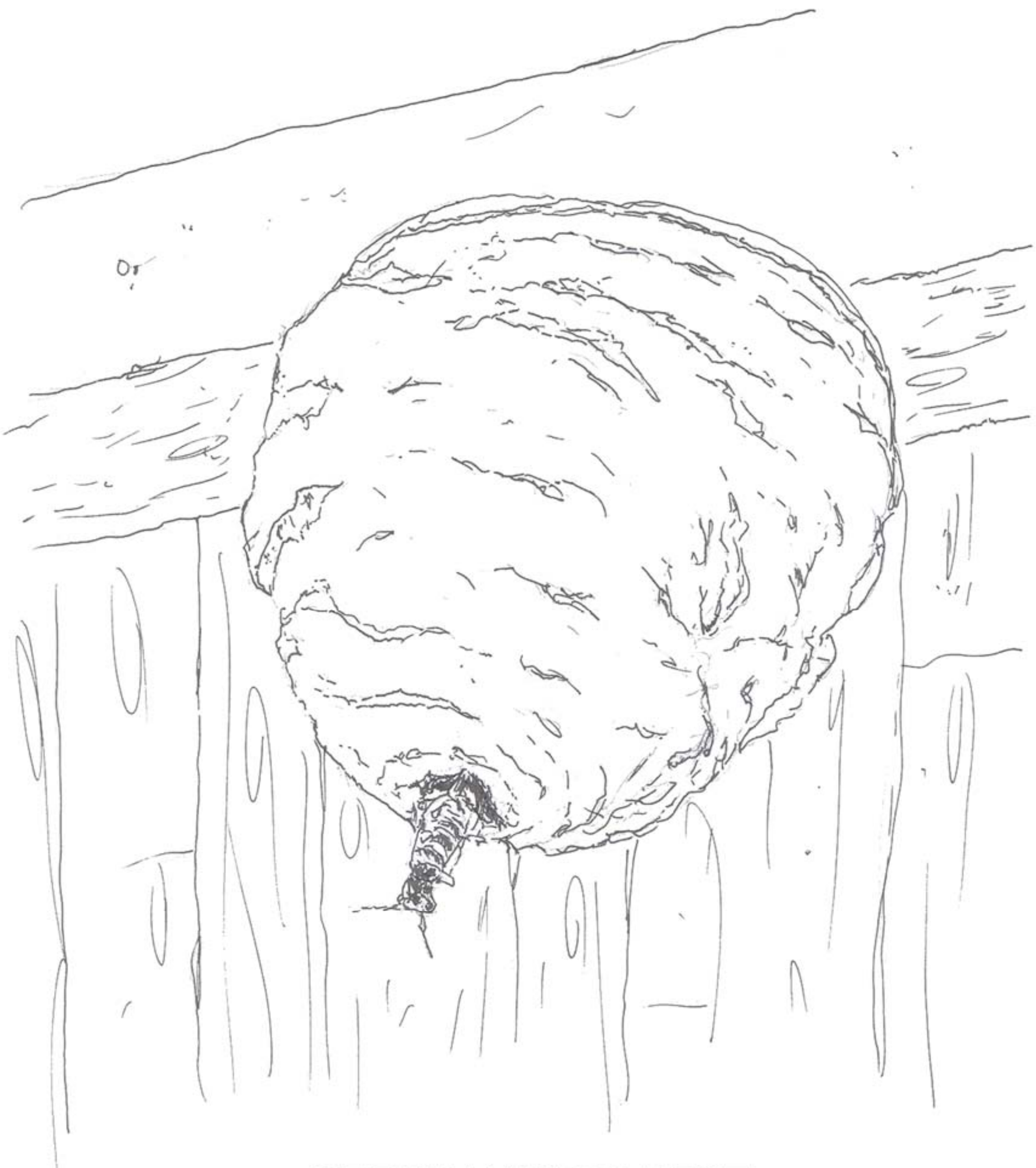
Both Aerial and Ground Nesters

Of the thirteen species in North America, only a few require pest management. These few species have certain characteristics and habits that put them on a collision course with people:

•They can live in what might be called disturbed environments (areas that have been changed to suit human activities in urban settings) such as yards, golf courses, parks, and other recreation areas.
•They have large colonies -- some will develop thousands of workers.
•Their habits do not restrict them to a specific kind of prey. Foraging workers capture insects for their larvae and nectar and other sweet carbohydrates for themselves where they can find it. Essentially, they are scavengers and work over garbage cans and dumpsters. They especially enjoy picnics and football games.

One can easily see that these habits put a large number of foraging stinging insects into close association with large populations of humans.

GERMAN YELLOWJACKET



GERMAN WASP NEST

Treating nests in covered or over-grown areas is best done by first broadcasting an insecticide over the area. This is especially important when the entrance hole is not visible due to loose materials. The area should be fairly well drenched both on and around the suspected entrance to the nest. Products containing Cypermethrin work well for this job. Cypermethrin is available in both liquid and wettable powder concentrates.

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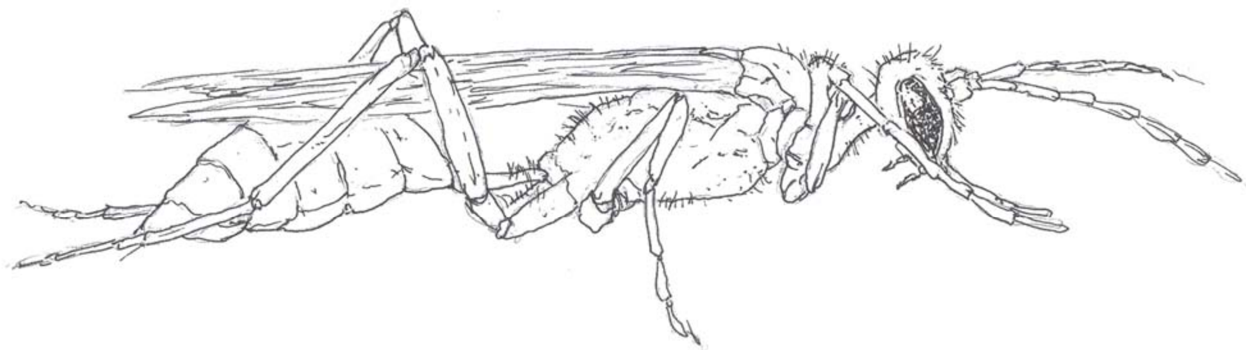
Dust and wettable powder pesticides tend to be more hazardous to bees than solutions or emulsifiable concentrates for contact pesticides. Actual damage to wasp populations is a function of toxicity and exposure of the compound, in combination with the mode of application.

A systemic pesticide, which is incorporated into the soil or coated on seeds, may kill soil-dwelling insects, such as grubs or mole crickets as well as other insects, including wasps that are exposed to the leaves, fruits, pollen, and nectar of the treated plants

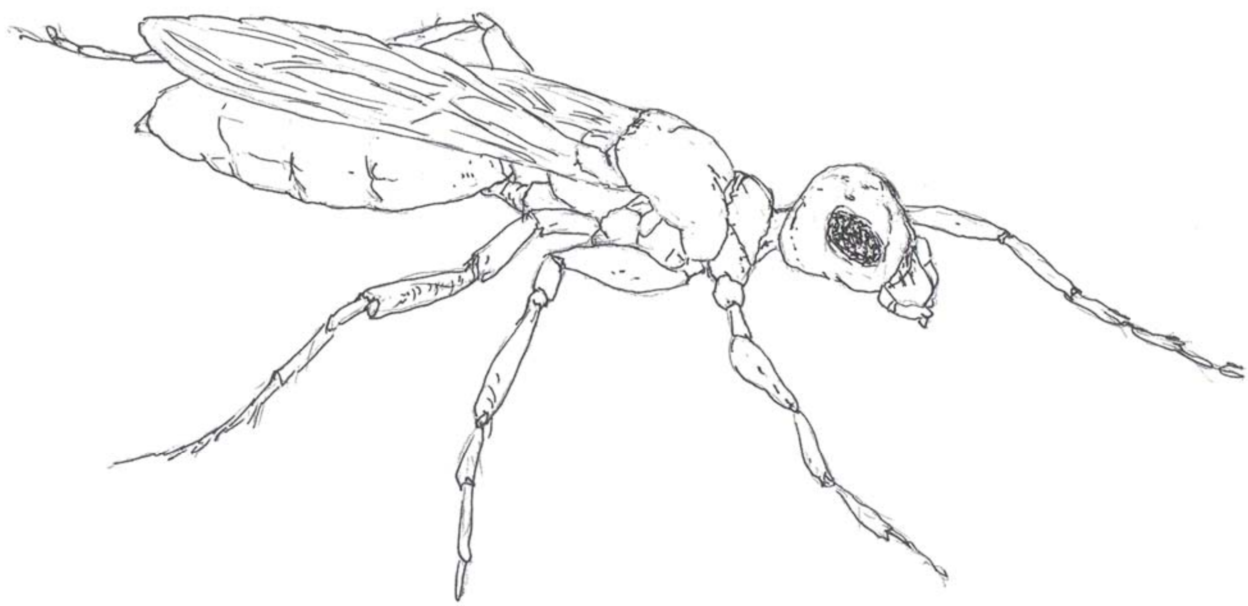
REMOVING A WASP NEST

Other Wasps



BLUE MUD WASP

Blue Mud Wasp *(Chalybion californicum)*
This wasp is a "poor relative" of the Mud Dauber. The females use vacant mud wasp nests. They hunt on the ground, preying mainly on Black Widow spiders. Adults are metallic blue, blue green or bluish black.



CRICKET WASP

Cricket Wasps *(Chlorion sp.)*
This species harvests crickets from their hiding places and buries them in a simple nest in the ground. These adults are usually slender, metallic bright blue-green or blue with dark violet-tinged wings.

DIGGER WASP

Digger Wasps *(Ammophila sp.)*
These wasps have a wide range of prey. They build simple, one cell vertical burrows and will use a rock to cover the entrance. The adults are very slender, have a long thread-waist, a black thorax marked with silver, and a gray or silvery abdomen with an orange or reddish tip.

MUD DAUBER

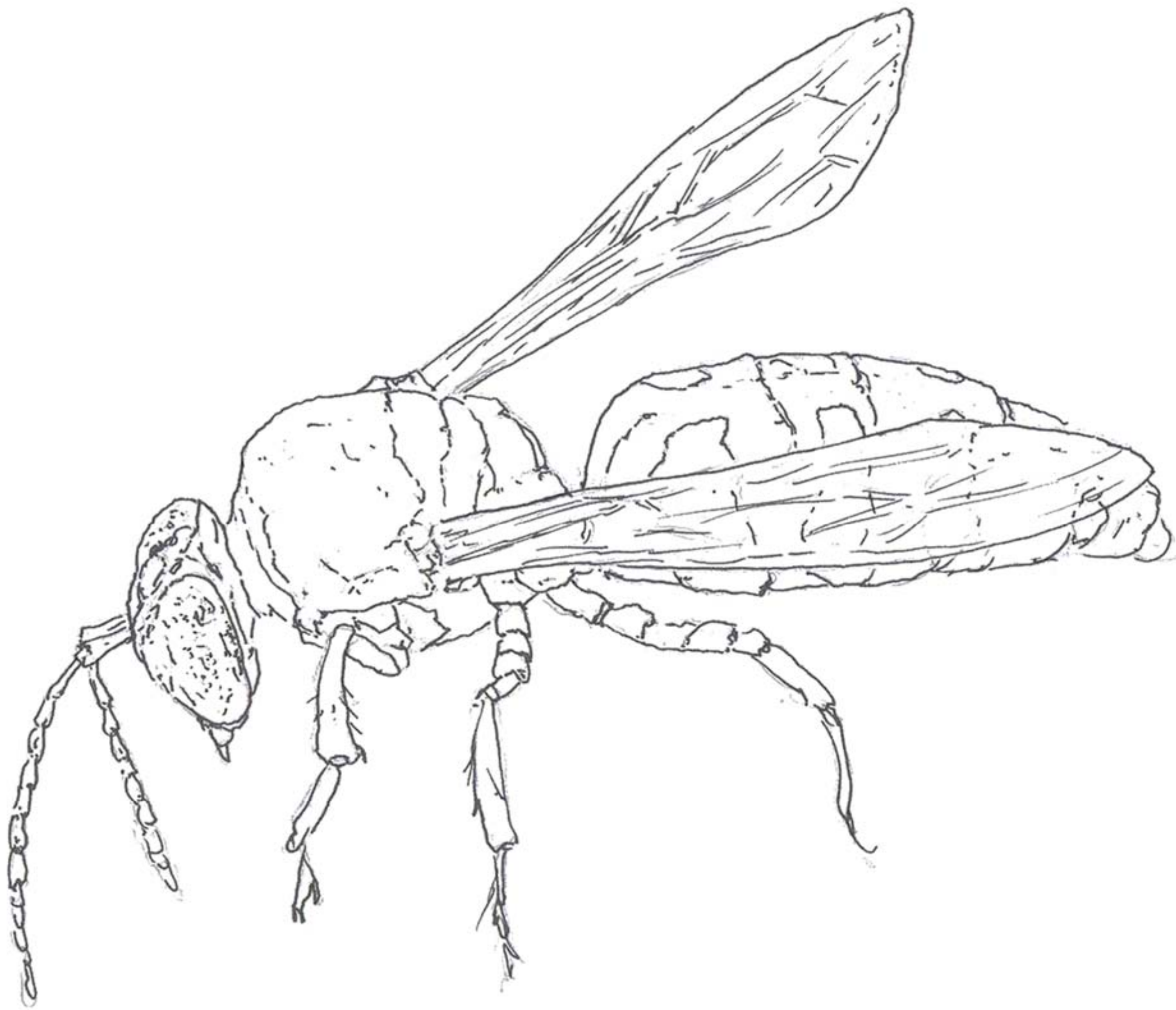
Mud Dauber *(Sceliphron caementarium)*
This is a common wasp. Females build a mud nest of cells laid side by side usually in a series of two to six, on the sides and eaves of buildings. The adults are mostly black with a yellow waist and legs. Many solitary wasps fall into the group of 'Mud daubers' and what distinguishes them is that they build nesting sites out of mud. There is the black and yellow dauber, blue, potter's wasp, organ pipe and many more. Usually their name depicts the shape of the nest they build but sometimes it simply refers to their colors or marking.

The dauber may carry its construction material quite a distance in the form of a wet mud ball and then use her mandibles to shape the nest. This mud nest will be a chamber where she will lay her eggs and place paralyzed insects inside for food when the egg hatches. Most are single cell nests so only one egg is laid but she may pack in as many as 15 spiders for the newly emerged larva to eat. Daubers can be quite selective in the insects they gather but their main prey of choice is spiders and it may depend on size or kind. The blue dauber is keen on black or brown widows that are not full size yet. When a dauber finds its prey she does not kill them but her sting paralyses the insect so that it is fresh when the eggs hatch.

Other daubers such as the blue may not build a nest at all rather they will invade another nest in which to lay their egg. Daubers also will rebuild or reshape old abandoned nests at times which may be for convenience or perhaps particularly dry weather may mean a shortage of mud. It's very rare for a dauber to sting a person even if it's present while you are removing the nest. Stings usually occur when you handle the wasp or accidently put your hand on one. The nest itself is easily removed by hand or with a trowel but may leave a distinctive outline. In hard surfaces water and a brush will remove this but if it is on your drywall ceiling this might create more of a mess. You may wish to use a small putty knife to scrape away the mud outline being careful to cause as little excess marring of the drywall.

Very little can be done to prevent or control a mud dauber. They are known to build their nests just about anywhere. Tail pipes of cars, under patio furniture, porches, lamps, doorways, storage items in garages or sheds and even in airplane instruments on stored planes. The best you can hope for is to catch them early in the process and remove the nest while treating the area with an aerosol or spray that will chase them away to hopefully a less intrusive spot.

SAND WASP NEST

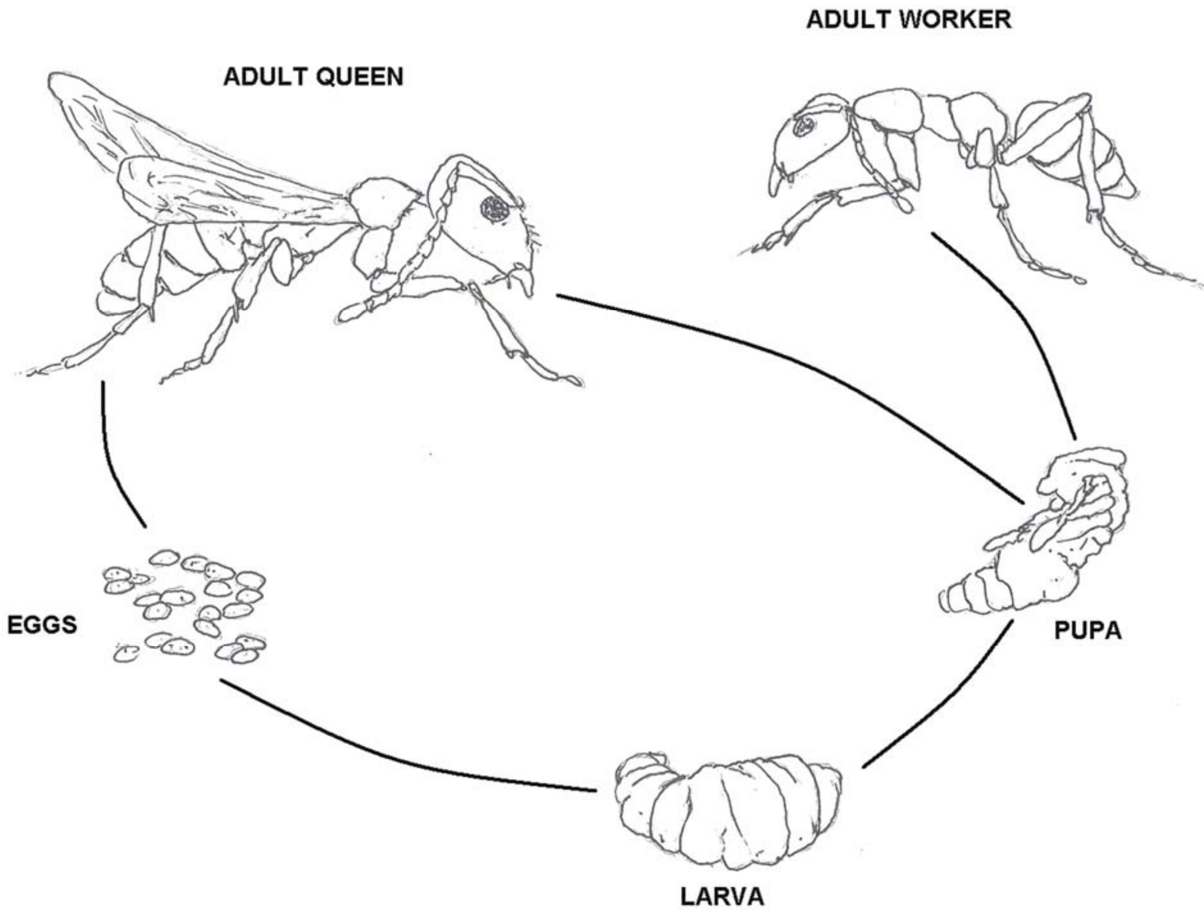


SAND WASP

Sand Wasps *(Bembix sp.)*
Can usually be found in sandy areas as their name suggests. The females build large tunnels and feed on flies. The adults are stout-bodied; gray or black with pale to bright yellow markings. Sand hornets, or cicada killers, are the most common species of sand wasp.

They make nests in the ground, in dirt or sand, and hunt cicadas. Sand hornets are frequently found in the Rocky Mountains and Mexico, but are an uncommon wasp.

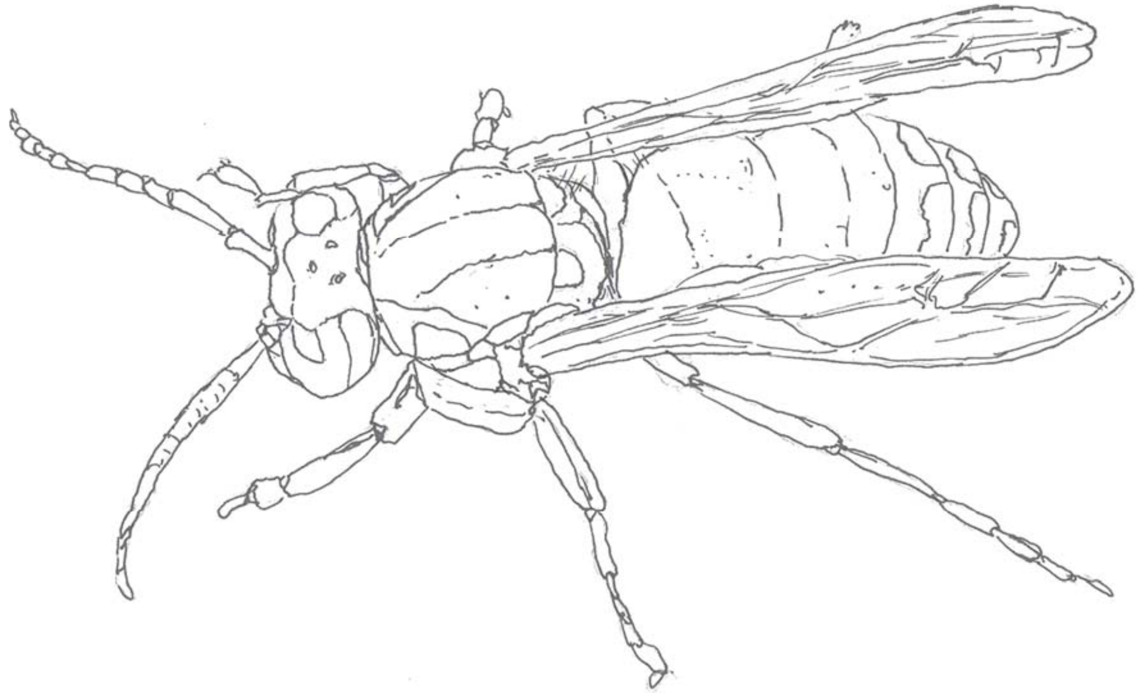
Most other wasps have nests in trees or against a structure. If they are threatened, sand hornets are very aggressive, but rarely sting otherwise. Because their nests are in the ground, it is easy to step in a nest, aggravating the wasps.



LIFECYCLE OF A WASP

Umbrella Wasps *(Polistes spp. and Mischocyttarus flavitarsis)*
Umbrella wasps are also commonly referred to as paper wasps. These wasps have been named umbrella wasps because their nests are the shape of an inverted umbrella. They usually have small nests and are usually inhabited by about 250 wasps. Unlike many other wasps and yellowjackets, Umbrella wasps do not have a worker caste. All female wasps are capable of becoming the queen.

Umbrella wasp nests do not have a paper envelope around them and are only a single comb. Umbrella wasps usually hang their nests in eaves, attics, and sheds. Knocking down the nest is a waste of time because the wasps will rebuild it. Therefore, the wasps themselves must be destroyed.



BALD FACED HORNET

Bald-faced Hornet
These insects resemble a yellow-jacket but are larger, up to 3/4 inch in length. They have large heads with black and white markings and long wings that extend to the end of their abdomen. These "insect hawks" are fascinating to watch as they pounce upon many pests including crane flies and other flies. Bald faced hornets may also act as pollinators of some plants. Dolichovespula maculata is a North American insect commonly called the bald-faced hornet (or white-faced hornet or white-tailed hornet). Its well-known features include its hanging paper nests and the females' habit of defending them with repeated stings. These insects build large paper nests that can measure up to 14 inches in diameter and 24 inches long! If disturbed these hornets will sting humans.

Every year, queens that were born and fertilized at the end of the previous season begin a new colony. The queen selects a location for its nest, begins building it, lays a first batch of eggs and feeds this first group of larvae. These become workers and will assume the chore of expanding the nest — done by chewing up wood which is mixed with a starch in their saliva. This mixture is then spread with their mandibles and legs, drying into the paper-like substance that makes up the nest.

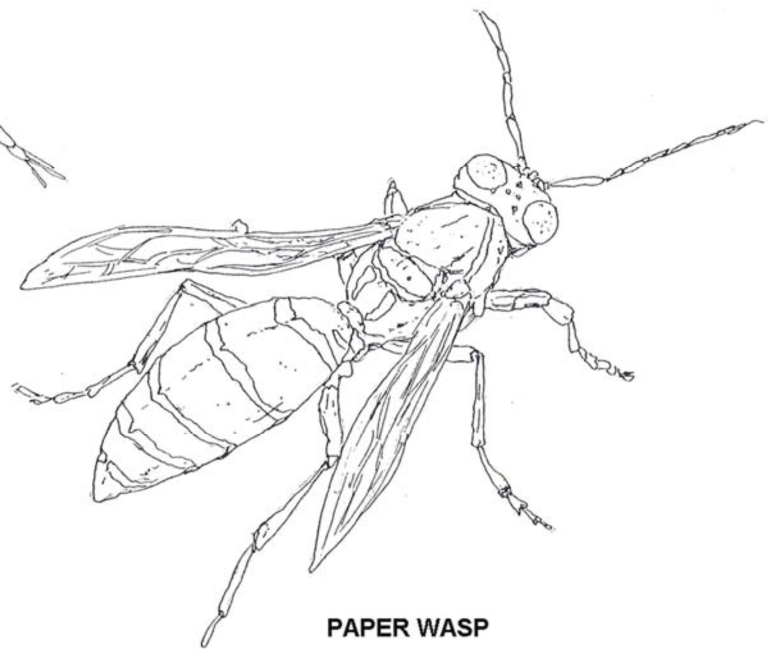
The workers also guard the nest and feed on nectar, tree sap and fruit pulp. They also capture insects and arthropods, which are chewed up to be fed to the larvae. In addition, Bald-Faced Hornets have been observed scavenging raw meat. This continues through summer and into fall. Near the end of summer, or early in the fall, the queen begins to lay eggs which will become drones and new queens. After pupation, these fertile males and females will mate, setting up next year's cycle of growth.

Hibernate Underground
As winter approaches, the wasps die – except any just-fertilized queens. These hibernate underground, under logs or in hollow trees until spring. The nest itself is generally abandoned by winter, and will not be reused. When spring arrives, the young queens emerge and the cycle begins again. Bald-faced hornets visit flowers, especially in late summer, and can be minor pollinators.

Like other social wasps, bald-faced hornets have a caste system made up, in one nest, of the following:
1. Queen – the fertile female which starts the colony and lays eggs.
2. Workers – infertile females which do all work except laying eggs.
3. Drones – males, which have no stingers, and are born from unfertilized eggs.
4. New queens – fertile females, each of which, once fertilized, may start its own nest in the spring.

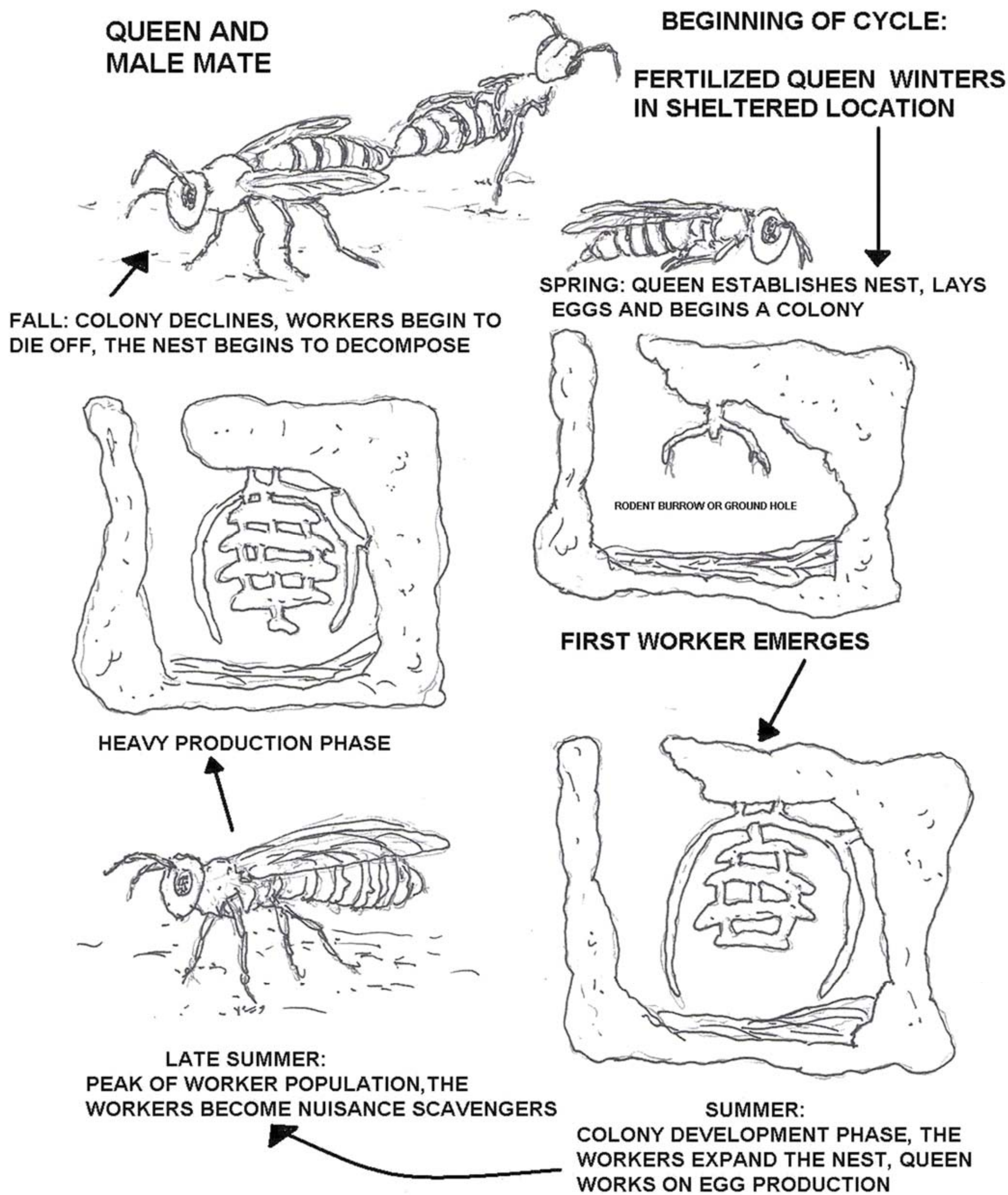
Bald-face hornets will sting repeatedly if the nest is disturbed. Like other stinging wasps, they can sting repeatedly because the stinger does not become stuck in the skin. Some suggest putting baking soda or meat tenderizer on the area of the sting, but others say such treatments do not work.

YELLOWJACKET WASP



PAPER WASP

LIFECYCLE OF A YELLOWJACKET

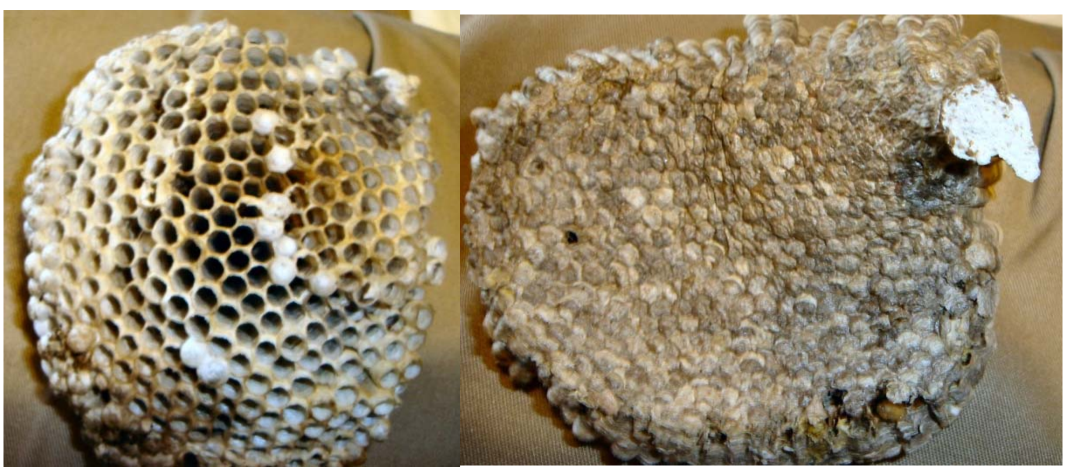


Wasp Freeze

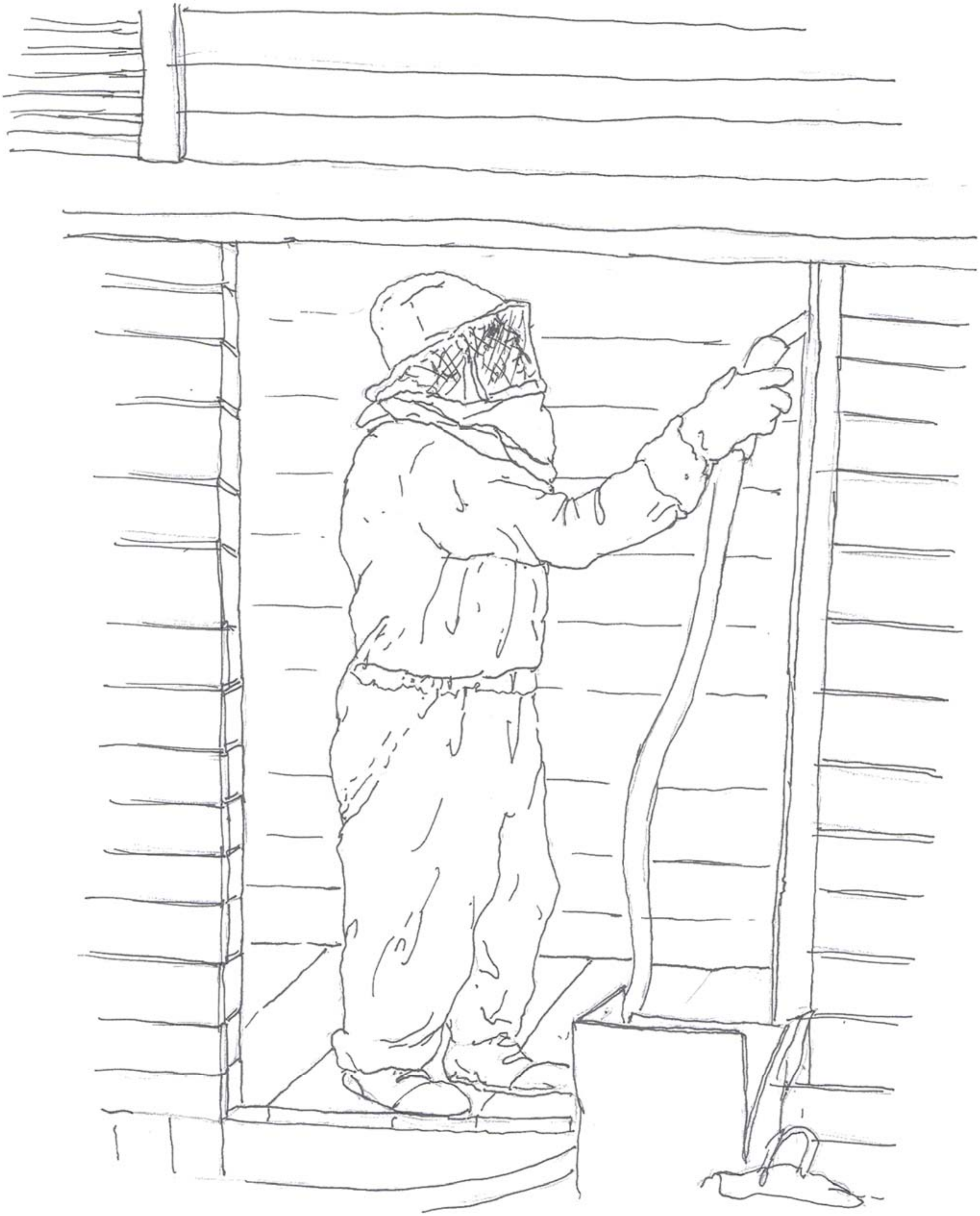
Here is one of my favorite products and I am not trying to promote the brand name but any one that mixes a freezing agent with a pesticide is either crazy or a genius, either way the two are very close and this is a wonderful product. I wish I would have thought of it. By the way, the 40 giant wasps can destroy a honey bee hive and kill the entire hive in less than four hours. Wasps are nasty by nature. They can bite or sting. They were designed by God as the prefect winged attach insect. Think about the wasp that will attach tarantulas. This professional outdoor aerosol projects a long stream of quick knock-down insecticide, for killing wasps or hornets. Use this product for a quick kill of visible stinging insects as they rest on their nests.

For best results, use Wasp Freeze at dusk when stinging insects are at rest. If necessary, re-apply your wasp spray the following day. The nests of Paper Wasps are usually located under eaves or other high places where wasp killing aerosols are needed.

Wasp Freeze is designed for quick kill of stinging wasps and hornets but does not leave a long term residual. If longer residual is desired, use a double strength solution of Demon WP after using Wasp Freeze insecticide aerosols. If dealing with ground hornets, yellow jackets or other in-ground nests you will have poor results using any aerosol or wasp freeze.



Front and rear sides of a paper wasp's nest. A great way to make money is for a panicked customer to call you about wasps or scorpions.



REMOVING WASP NEST

Tarantula Hawk Wasp

The tarantula hawk is the common name for species in the genera Pepsis and Hemipepsis of the family Pompilidae, in the insect order Hymenoptera. These two genera are limited to the Western Hemisphere, and “tarantula hawks” in the Eastern Hemisphere belong to different genera. These genera of wasps are called tarantula hawks due to their hunting of tarantulas as food for their larvae.

Spider Wasps *(Pepsis sp., Priocnemis sp.)*
As their name suggests these species feed on spiders. In California there are approximately 130 species that are mostly small and black or steel blue, with slender long legs and antennae. The tarantula hawk is just one spider wasp; it is a large, hard-bodied wasp that actually attacks kills tarantulas (**Aphonopelma**) in southern California and Arizona. The female wasp stings the tarantula on the underside between the legs, in a vulnerable unprotected area. With her powerful mandibles, she drags the paralyzed tarantula to her burrow and lays a single egg on its body.

The egg hatches into a larva which feeds on the tarantula. At maturity, the larva spins a cocoon and undergoes metamorphosis. The adult wasp may emerge from the burrow during the same year or the following spring, depending on when the cocoon was spun. The sting of a female tarantula hawk is described as "excruciating."

Tarantula hawks are up to two inches (50 mm) long with a blue-black body and bright rust-colored wings. The bright rust coloring that they have on their wings is also known as aposematic coloring; this warns potential predators that they are dangerous. Their long legs end with hooked claws for grappling with their victims. The stinger of a female tarantula hawk can be up to 1/3 inch (7 mm) long.

Female tarantula hawks may hunt for wandering male tarantulas. However, during the insect's reproductive season, male tarantulas are usually emaciated from ignoring food while searching for females. The tarantula hawks prefer female tarantulas and seek them in their burrows. They capture (often following a dramatic battle), sting, and paralyze the spider. Next they either drag the spider back into her own burrow or transport their prey to a specially prepared nest where a single egg is laid on the spider's body, and the entrance is covered.

The wasp larva, upon hatching, begins to suck the juices from the still-living spider. After the larva grows a bit, the spider dies and the larva plunges into the spider's body and feeds voraciously, avoiding vital organs for as long as possible to keep it fresh. The adult wasp emerges from the nest to continue the life cycle. Tarantula hawks are "nectarivorous."

The consumption of fermented fruit sometimes intoxicates them to the point that flight becomes difficult. While the wasps tend to be most active in daytime during summer months, they tend to avoid the very highest temperatures. The male tarantula hawk has an interesting behavior: many act in a behavior called "hill-topping," where they sit on top of tall plants and look out for females who are ready to reproduce.

These wasps are usually not aggressive, but the sting, particularly of Pepsis formosa, is among the most painful of any insect. Commenting on his own experience, one researcher described the pain as "...immediate, excruciating pain that simply shuts down one's ability to do anything, except, perhaps, scream." Mental discipline simply does not work in these situations."[2] It is listed near the top of the list in Schmidt Sting Pain Index. Although the sting is quite painful, the effect is reported to last only a few minutes and is fatal less often than the honey bee. Because of their stingers, very few animals are able to eat them; one of the few animals that can is the roadrunner.

What is a Wasp?
A wasp is any insect of the order Hymenoptera and suborder Apocrita that is not a bee or ant. The suborder Symphyta includes the sawflies and wood wasps, which differ from members of Apocrita by having a broader connection between the mesosoma and metasoma. In addition to this, Symphyta larvae are mostly herbivorous and "caterpillarlike", whereas those of Apocrita are largely predatory or "parasitic" (technically known as parasitoid).

Wasp Management and Control

Problems with wasps (Yellowjackets and similar wasps) occur mainly when:
•Humans step on or jar a colony entrance.
•A colony has infested a wall void or attic and has either chewed through the wall into the house or the entrance hole is located in a place that threatens occupants as they enter or leave the building.
•Worker wasps are no longer driven to feed larvae in the late summer months, and they wander, searching for nectar and juices -- finding ripe, fallen back yard fruit, beer, soft drinks and sweets at picnics, weddings, recreation areas, sporting events and other human gatherings.

Yellowjackets are sometimes responsible for injections of anerobic bacteria (organisms that cause blood poisoning). When wasps (Yellowjackets and similar wasps) frequent wet manure and sewage they pick up the bacteria on their abdomens and stingers. In essence, the stinger becomes a hypodermic needle. A contaminated stinger can inject the bacteria beneath the victim's skin. Blood poisoning should be kept in mind when wasp stings are encountered.

Inspection
Sting victims often can identify the location of yellowjacket nests. Where the nest has not been located look in shrubbery, hedges, and low tree limbs for the Bald Faced hornet. Soil nests are often located under shrubs, logs, piles of rocks and other protected sites. Entrance holes sometimes have bare earth around them. Entrance holes in structures are usually marked by fast flying workers entering and leaving. Nests high in trees should not be problems. Be sure to wear a bee suit or tape trouser cuffs tight to shoes.

Habitat Alteration
•Management of outdoor food is very important.
•Clean garbage cans regularly and fit them with tight lids.
•Empty cans and dumpsters daily prior to periods of heavy human traffic at zoos, amusement parks, fairs and sporting events.
•Remove attractive refuse, such as bakery sweets, soft drink cans, and candy wrappers, several times a day during periods of wasp and yellowjacket activity.
•Locate food facilities strategically at late summer activities so that yellowjackets are not lured to dense crowds and events. [The National Park Service in their IPM programs found that stings were dramatically reduced when drinks are served in cups with lids.]
•Clean drink dispensing machines; screen food dispensing stations, and locate trash cans away from food dispensing windows.
•To limit wasps (Yellowjackets and similar wasps) infestations in wall voids and attics, keep holes and entry spaces in siding caulked; screen ventilation openings.

Pesticide Application
When possible, treat ground and aerial nests after dark [Workers are in the nest at that time]. More often than not, because of traditional work schedules, treatment will be scheduled for the daytime.

Begin with the entrance hole in view and a good plan in mind.
•Wear a protective bee suit. Unless these insects can hold on with their tarsal claws, they cannot get the leverage to sting. Bee suits are made with smooth rip-stop nylon which does not allow wasps and bees to hold on. A bee veil and gloves are part of the uniform. Wrist and ankle cuffs must be taped or tied to keep the insects out of sleeves and pant legs.
•Move slowly and with caution. Quick movements will be met with aggressive behavior. Move cautiously to prevent stumbling or falling onto the colony.
•Have equipment handy so one trip will suffice.

Application
•Insert the plastic extension tube from a pressurized liquid spray or aerosol generator in the entrance hole; release the pesticide for 10 to 30 seconds. Resmethrin is most effective.
•If the pressurized liquid spray includes chemicals that rapidly lower nest temperature (freeze products), be aware that it will damage shrubbery.
•Plug the entrance hole with dusted steel wool or copper gauze. Dust the plug and area immediately around the entrance. Returning yellowjackets cue on entrance holes using surrounding landmarks and

seeing the shadowed opening. They will land at the entrance and pull at the plug picking up toxic dust. Any still alive inside will also work at the dusted plug.

Aerial Nests

•Cut aerial nests down and seal them in a plastic bag. The queen and workers inside will be dead, and larvae will fall out of their cells and die from either insecticide poisoning or starvation. Pupae in capped cells may escape the treatment, however, and emerge later.

•Be especially cautious when using ladders to get at aerial nests or wall void nests. Set the ladder carefully and move slowly.

Wall Voids

•Approach the entrance hole cautiously; stay out of the normal flight pattern.

•Watch first. Observe whether yellowjackets entering the nest go straight in or to one side or the other.

•Insert the narrow diameter plastic tube in the hole in the observed direction of entrance and release pesticide for 10-30 seconds.

•Dust inside the entrance and plug it as with underground nests.

•Remember, German yellowjacket nests may remain active into December.

•Use care not to contaminate food surfaces.

Spraying trash cans and the outside of food stands will reduce or repel yellowjackets at sporting events; the treatment will not last more than one day. Honey bees are also killed with this control measure. Remember, do not contaminate food surfaces.

Treating Nests beneath Grass, Mulch

Treating nests in covered or over-grown areas is best done by first broadcasting an insecticide over the area. This is especially important when the entrance hole is not visible due to loose materials. The area should be fairly well drenched both on and around the suspected entrance to the nest. Products containing Cypermethrin work well for this job. Cypermethrin is available in both liquid and wettable powder concentrates.

Either formulation can be used; Demon EC, Cynoff EC are professional liquid concentrates and Demon WP, Cynoff WP are professional wettable powder concentrates.

Once you have sprayed the area (or areas), make note of the wasp population over the next 10 to 14 days. A repeat application might be necessary. If you think that you are dealing with multiple nests, pushing an insecticide dust into the entrance holes might also be necessary. This is especially important during the time of year when there could be many wasp grubs or larvae that will soon be hatching out, producing even more wasp. Dusting wasp colonies is discussed in the section where elimination of underground bee nests is explained.

Dust and wettable powder pesticides tend to be more hazardous to bees than solutions or emulsifiable concentrates for contact pesticides. Actual damage to wasp populations is a function of toxicity and exposure of the compound, in combination with the mode of application.

A systemic pesticide, which is incorporated into the soil or coated on seeds, may kill soil-dwelling insects, such as grubs or mole crickets as well as other insects, including wasps that are exposed to the leaves, fruits, pollen, and nectar of the treated plants

Pesticides

Pesticides can affect wasps in different ways. Some kill wasps on contact in the field; others may cause brood damage or contaminate pollen, thus killing wasps. Before dying, poisoned bees can become irritable (likely to sting), paralyzed or stupefied, appear to be 'chilled' or exhibit other abnormal behavior.

Only one readily recognized symptom is good evidence of pesticide damage; the presence of many dead or dying wasps near a colony's entrance. In a short period of time, however, these dead wasps may dry up and the remains be blown away and eaten by ants or other scavengers.

Apply Pesticide when Bees are not Flying
Wasps fly when the air temperature is above 55-60°F and are most active from 8 a.m. to 5 p.m. Always check a field for wasp activity immediately before application. Wasp pesticides are very hazardous to honey bees and must be applied when bees are not working, preferably in the early evening. Evening application allows time for these chemicals to partially or totally decompose during the night.

Notify beekeepers: If beekeepers are notified in advance of application, colonies can be moved or loosely covered with burlap or coarse cloth to confine the bees and yet allow them to cluster outside the hive under the cloth. Repeated sprinkling each hour with water prevents overheating. Never screen or seal up colonies and do not cover with plastic sheeting. This can result in overheating, leading to bee suffocation and death. Law requires every apiary or bee yard to be plainly marked with the owner's name, address and telephone number.

Besides wasps any of these products can be used for general purpose pest control in and around the home. Liquid concentrates are more cost effective for this particular job. If you are positive that you are dealing with only one nest, a 4 ounce bottle of Cypermethrin concentrate may be all that you will need, especially if you have no other pest control needs. Pump type sprayers can be used for this type of pest control job but most people feel safer using a hose end sprayer.

A hose end sprayer will give you the ability to treat the targeted area from a better distance and will also provide a more thorough soaking of the nest area. When using a hose end sprayer, liquid concentrate insecticides work better than wettable powder concentrates. The type and amount of loose materials covering the entrance to the nest will dictate the amount of spray needed. If cover is heavy, more than one application is often called for. Always follow the label instructions.

There are three different sizes of liquid concentrate Cypermethrin: 4 ounce, 16 ounce, and 32 ounce. If you do not intend on doing your own general household pest control, you will usually not need the larger containers. Only when there is a great deal of landscape area to deal with will you need larger volumes of liquid insecticides. In this case, Demon Max (Demon EC) is your best bet. For smaller jobs, buy one or two 4 ounce bottles of Cypermethrin. Always follow the label instructions.

Keep pets and children off of any treated area until the area has been allowed to dry thoroughly. Once dry, the area will be safe for re-entry - unless wasps are still noted flying in the area. Wasps do not always die as quickly as we would like; they are tough and stubborn. Always follow the label instructions.

Treating Nests beneath Rocks, Tarps, Decks
When the entrance to a wasp nest is easy to locate and is not covered with tall grass or mulch, the best control method is dusting. A professional grade insecticide dust is formulated with tiny particles that will float through the targeted area, almost like smoke. When properly applied into the nest entrance hole with a good hand bellows duster, the dust will travel deep into the nest.

Choosing Pest Products
There are two different dusts that will work: Drione Dust and Delta Dust. The advantage of Drione Dust is that it has a very fast knock-down or kill of targeted pests. Delta Dust has the advantage of being water-proof, an asset that is very attractive when treating soil that might contain any type of moisture. Delta Dust is the more popular of the two insecticides.

Pest control technicians who have more products at their disposal have reported great results when combining the two dusts for a single application. This combination gives them a quick knock-down of existing bees and fewer call-backs when young bees can emerge. Always follow the label instructions. Apply insecticide dust with a hand bellows duster. There are two good hand bellows dusters to choose from: 360 DustWand and Crusader Duster. Either of these dusters will do a good job. The advantage of the Dust Wand is that the extensions provide a longer reach. Always follow the label instructions.

Application of Pest Products
When applying pesticide dusts into cracks, crevices or entry points, proper filling of the dusting device is of utmost importance. When a hand bellows duster is completely filled to its capacity, or when dust is packed down inside the duster, dust does not come out in proper form. Never overfill a hand-bellows type insecticide duster. Fill duster 1/2 to 2/3 from top. After replacing the fill plug, gently shake the duster just prior to application. The small area inside the duster (created by NOT over-filling the duster) creates a space that is sorely needed. When the duster is shaken, a small "cloud" of insecticide dust is formed in the empty space.

By gently shaking a properly filled duster, the dust particles will exit the duster nozzle in a thin, smoke-like cloud as the hand bellows duster is squeezed. This thin cloud of dust will travel further through the targeted area (in this case, an underground bumble bee nest), reaching far more adults, eggs and larvae. The next effect of proper application is overall coverage. If large amounts of Deltamethrin (Delta Dust or Drione Dust) are merely "dumped" into the nest entrance, the majority of the dust will merely pile up in one place. Properly applied dust will "float" through the chambers and most of the particles will tend to stick to top, bottom and sides of the tunnel as well as the nest itself.

Treatment of a wasp nest involves coating the nest entrance, nest, eggs, grubs and adults. For most nests, you will need to apply two applications: partially fill your duster, shake thoroughly, empty contents into nest; repeat. This double application will assure better control over all stages of the wasp and will contaminate the nest and void, which will kill bees returning to the nest area. As mentioned previously, the best time to kill wasps is when they are at rest or as they sleep. Avoid treatment during daylight hours; treat the wasp nest at dusk or when it is dark enough for the bees to cease their activity but just light enough for you to see what you are doing. You can kill bees at night (using a flashlight) but there are a couple of possible hazards that you might run into: stumbling over unseen objects and actually attracting angry wasps.

The first possible hazard listed is mainly common sense. If you trip and fall over any unseen object in the area, you not only risk possible harm from the fall but also risk waking up the resting wasps. Using a flashlight to navigate to the sight or while treating the nest can be a problem.

If the wasps are disturbed and exit the nest, they could very well be attracted to light emitted from your flashlight. (If light is needed, try setting your flashlight in one area before you approach the nest from another area.)

Not all insecticides have the same effects when prepared in different formulations. Research and experience indicate:

- New microencapsulated insecticides are much more toxic to honey bees than any formulation so far developed. Because of their size, these capsules are carried back to the colony and there can remain poisonous for long periods. These insecticides should never be used if there is any chance bees might collect the microcapsules. Always consider using another formulation first.
- Dusts are more hazardous than liquid formulations.
- Emulsifiable concentrates are less hazardous than wettable powders.
- Ultra-low-volume (ULV) formulations are usually more hazardous than other liquid formulations.

Always follow label instructions and take steps to avoid exposure. If any exposures occur, be sure to follow the First Aid instructions on the product label carefully. For additional treatment advice, contact the Poison Control Center at 1-800-222-1222. If you wish to report a pesticide problem, please call 1-800-858-7378.

NOTE: When pesticides are used, it is the applicator's legal responsibility to read and follow directions on the product label. Not following label directions, even if they conflict with information provided herein, is a violation of federal law.

Great Wasp Chemical Treatments

More on Pyrethroids
Pyrethrins and pyrethroids are insecticides included in over 3,500 registered products, many of which are used widely in and around households, including on pets, in mosquito control, and in agriculture. The use of pyrethrins and pyrethroids has increased during the past decade with the declining use of organophosphate pesticides, which are more acutely toxic to birds and mammals than the pyrethroids. This change to less acutely toxic pesticides, while generally beneficial, has introduced certain new issues. For example, residential uses of pyrethrins and pyrethroids may result in urban runoff, potentially exposing aquatic life to harmful levels in water and sediment.

Pyrethrins are botanical insecticides derived from chrysanthemum flowers most commonly found in Australia and Africa. They work by altering nerve function, which causes paralysis in target insect pests, eventually resulting in death. Pyrethroids are synthetic chemical insecticides whose chemical structures are adapted from the chemical structures of the pyrethrins and act in a similar manner to pyrethrins. Pyrethroids are modified to increase their stability in sunlight. Most pyrethrins and some pyrethroid products are formulated with synergists, such as piperonyl butoxide and MGK-264, to enhance the pesticidal properties of the product. These synergists have no pesticidal effects of their own but enhance the effectiveness of other chemicals.

To mimic the insecticidal activity of the natural compound pyrethrum another class of pesticides, pyrethroid pesticides, has been developed. These are non-persistent, which is a sodium channel modulators, and are much less acutely toxic than organophosphates and carbamates. Compounds in this group are often applied against household pests.

Most pyrethroid metabolites are promptly excreted, at least in part, by the kidney. In response to dermal exposure, some persons may experience a skin sensitivity called paresthesia. The symptoms are similar to sunburn sensation of the face and especially the eyelids. Sweating, exposure to sun or heat, and application of water aggravate the disagreeable sensations. This is a temporary effect that dissipates within 24 hours. For first aid, wash with soap and water to remove as much residue as possible, and then apply a vitamin E oil preparation or cream to the affected area.

Pyrethroids include:
Allethrin stereoisomers, Bifenthrin, Beta-Cyfluthrin, Cyfluthrin, Cypermethrin, Cyphenothrin, Deltamethrin, Esfenvalerate, Fenpropathrin, Tau-Fluvalinate, Lambda-Cyhalothrin, Gamma Cyhalothrin, Imiprothrin, 1RS cis-Permethrin, Permethrin, Prallethrin, Resmethrin, Sumithrin (d-phenothrin), Tefluthrin, Tetramethrin, Tralomethrin, and Zeta-Cypermethrin

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Resmethrin

Resmethrin is a pyrethroid insecticide with many uses, including control of the adult mosquito population. The resmethrin molecule has four stereoisomers determined by cis-trans orientation around a carbon triangle and chirality. Technical resmethrin is a mixture of (1R,trans)-, (1R,cis)-, (1S,trans)-, (1S,cis)-isomers, typically in a ratio of 4:1:4:1. The 1R isomers (both trans and cis) show strong insecticidal activity, while the 1S isomers do not. The (1R,trans)- isomer is also known as Bioresmethrin,(+)-trans-Resmethrin, or d-trans-Resmethrin; although bioresmethrin has been used alone as a pesticide active ingredient, it is not now registered as a separate Active Ingredient (AI) by the U.S. EPA. The (1R,cis)- isomer is known as Cismethrin, but this is also not registered in the U.S. for use alone as a pesticide AI. Commercial trade names for products that contain resmethrin are Chrysron, Crossfire, Pynosect, Raid Flying Insect Killer, Scourge, Sun-Bugger #4, SPB-1382, Synthrin, Syntox, Vectrin and Whitmire PT-110

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Deltamethrin (Delta Dust or Drione Dust)

Deltamethrin is an insecticide belonging to the pyrethroid family. Pyrethroids are the man-made versions of pyrethrins, natural insecticides from chrysanthemum flowers. Deltamethrin is used outdoors on lawns, ornamental gardens, golf courses, and indoors as a spot or crack and crevice treatment. In its purest form, deltamethrin is colorless or white to light beige crystals that have no odor.

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IPM Methods (Types of Pest Control)

Integrated Pest Management (IPM) is an effective and environmentally sensitive approach to pest management that relies on a combination of common-sense practices. IPM programs use current, comprehensive information on the life cycles of pests and their interaction with the environment. This information, in combination with available pest control methods, is used to manage pest damage by the most economical means, and with the least possible hazard to people, property, and the environment.

The IPM approach can be applied to both agricultural and non-agricultural settings, such as the home, garden, and workplace. IPM takes advantage of all appropriate pest management options including, but not limited to, the judicious use of pesticides. In contrast, organic food production applies many of the same concepts as IPM but limits the use of pesticides to those that are produced from natural sources, as opposed to synthetic chemicals.

IPM is not a single pest control method but, rather, a series of pest management evaluations, decisions and controls. In practicing IPM, growers who are aware of the potential for pest infestation follow a four-tiered approach.

The four steps include:
Set Action Thresholds
Before taking any pest control action, IPM first sets an action threshold, a point at which pest populations or environmental conditions indicate that pest control action must be taken. Sighting a single pest does not always mean control is needed. The level at which pests will either become an economic threat is critical to guide future pest control decisions.

Monitor and Identify Pests
Not all insects, weeds, and other living organisms require control. Many organisms are innocuous, and some are even beneficial. IPM programs work to monitor for pests and identify them accurately, so that appropriate control decisions can be made in conjunction with action thresholds. This monitoring and identification removes the possibility that pesticides will be used when they are not really needed or that the wrong kind of pesticide will be used.

Prevention
As a first line of pest control, IPM programs work to manage the crop, lawn, or indoor space to prevent pests from becoming a threat. In an agricultural crop, this may mean using cultural methods, such as rotating between different crops, selecting pest-resistant varieties, and planting pest-free rootstock. These control methods can be very effective and cost-efficient and present little to no risk to people or the environment.

Control
Once monitoring, identification, and action thresholds indicate that pest control is required, and preventive methods are no longer effective or available, IPM programs then evaluate the proper control method both for effectiveness and risk.

Effective, less risky pest controls are chosen first, including highly targeted chemicals, such as pheromones to disrupt pest mating, or mechanical control, such as trapping or weeding. If further monitoring, identifications and action thresholds indicate that less risky controls are not working, then additional pest control methods would be employed, such as targeted spraying of pesticides. Broadcast spraying of non-specific pesticides is a last resort.

Six Basic Components

An IPM system is designed around six basic components: The US Environmental Protection Agency has a useful set of IPM principles.

1. Acceptable pest levels: The emphasis is on control, not eradication. IPM holds that wiping out an entire pest population is often impossible, and the attempt can be economically expensive, environmentally unsafe, and frequently unachievable. IPM programs first work to establish acceptable pest levels, called action thresholds, and apply controls if those thresholds are crossed. These thresholds are pest and site specific, meaning that it may be acceptable at one site to have a weed such as white clover, but at another site it may not be acceptable. By allowing a pest population to survive at a reasonable threshold, selection pressure is reduced. This stops the pest gaining resistance to chemicals produced by the plant or applied to the crops. If many of the pests are killed then any that have resistance to the chemical will form the genetic basis of the future, more resistant, population. By not killing all the pests there are some un-resistant pests left that will dilute any resistant genes that appear.

2. Preventive cultural practices: Selecting varieties best for local growing conditions, and maintaining healthy crops, is the first line of defense, together with plant quarantine and 'cultural techniques' such as crop sanitation (e.g. removal of diseased plants to prevent spread of infection).

3. Monitoring: Regular observation is the cornerstone of IPM. Observation is broken into two steps, first; inspection and second; identification. Visual inspection, insect and spore traps, and other measurement methods and monitoring tools are used to monitor pest levels. Accurate pest identification is critical to a successful IPM program. Record-keeping is essential, as is a thorough knowledge of the behavior and reproductive cycles of target pests. Since insects are cold-blooded, their physical development is dependent on the temperature of their environment. Many insects have had their development cycles modeled in terms of degree days. Monitor the degree days of an environment to determine when is the optimal time for a specific insect's outbreak.

4. Mechanical controls: Should a pest reach an unacceptable level, mechanical methods are the first options to consider. They include simple hand-picking, erecting insect barriers, using traps, vacuuming, and tillage to disrupt breeding.

5. Biological controls: Natural biological processes and materials can provide control, with minimal environmental impact, and often at low cost. The main focus here is on promoting beneficial insects that eat target pests. Biological insecticides, derived from naturally occurring microorganisms (e.g.: Bt, entomopathogenic fungi and entomopathogenic nematodes), also fit in this category.

6. Responsible Pesticide Use: Synthetic pesticides are generally only used as required and often only at specific times in a pests life cycle. Many of the newer pesticide groups are derived from plants or naturally occurring substances (e.g.: nicotine, pyrethrum and insect juvenile hormone analogues), but the toxophore or active component may be altered to provide increased biological activity or stability. Further 'biology-based' or 'ecological' techniques are under evaluation.

Main Focus of IPM Programs

An IPM regime can be quite simple or sophisticated. Historically, the main focus of IPM programs was on agricultural insect pests. Although originally developed for agricultural pest management, IPM programs are now developed to encompass diseases, weeds, and other pests that interfere with the management objectives of sites such as residential and commercial structures, lawn and turf areas, and home and community gardens.

IPM is applicable to all types of agriculture and sites such as residential and commercial structures, lawn and turf areas, and home and community gardens.

Reliance on knowledge, experience, observation, and integration of multiple techniques makes IPM a perfect fit for organic farming (sans artificial pesticide application). For large-scale, chemical-based farms, IPM can reduce human and environmental exposure to hazardous chemicals, and potentially lower overall costs of pesticide application material and labor.

1. Proper identification of pest - What is it?
Cases of mistaken identity may result in ineffective actions. If plant damage due to over-watering are mistaken for fungal infection, spray costs can be incurred, and the plant is no better off.

2. **Learn pest and host life cycle and biology.**
At the time you see a pest, it may be too late to do much about it except maybe spray with a pesticide. Often, there is another stage of the life cycle that is susceptible to preventative actions. For example, weeds reproducing from last year's seed can be prevented with mulches. Also, learning what a pest needs to survive allows you to remove these.

3. Monitor or sample environment for pest population - How many are here?
Preventative actions must be taken at the correct time if they are to be effective. For this reason, once the pest is correctly identified, monitoring must begin before it becomes a problem. For example, in school cafeterias where roaches may be expected to appear, sticky traps are set out before school starts. Traps are checked at regular intervals so populations can be monitored and controlled before they get out of hand. Some factors to consider and monitor include: Is the pest present/absent? What is the distribution - all over or only in certain spots? Is the pest population increasing or decreasing?

4. Establish action threshold (economic, health or aesthetic) - How many are too many?
In some cases, a certain number of pests can be tolerated. Soybeans are quite tolerant of defoliation, so if there are a few caterpillars in the field and their population is not increasing dramatically, there is not necessarily any action necessary.

Conversely, there is a point at which action must be taken to control cost. For the farmer, that point is the one at which the cost of damage by the pest is more than the cost of control. This is an economic threshold. Tolerance of pests varies also by whether or not they are a health hazard (low tolerance) or merely a cosmetic damage (high tolerance in a non-commercial situation).

Different sites may also have varying requirements based on specific areas. White clover may be perfectly acceptable on the sides of a tee box on a golf course, but unacceptable in the fairway where it could cause confusion in the field of play.

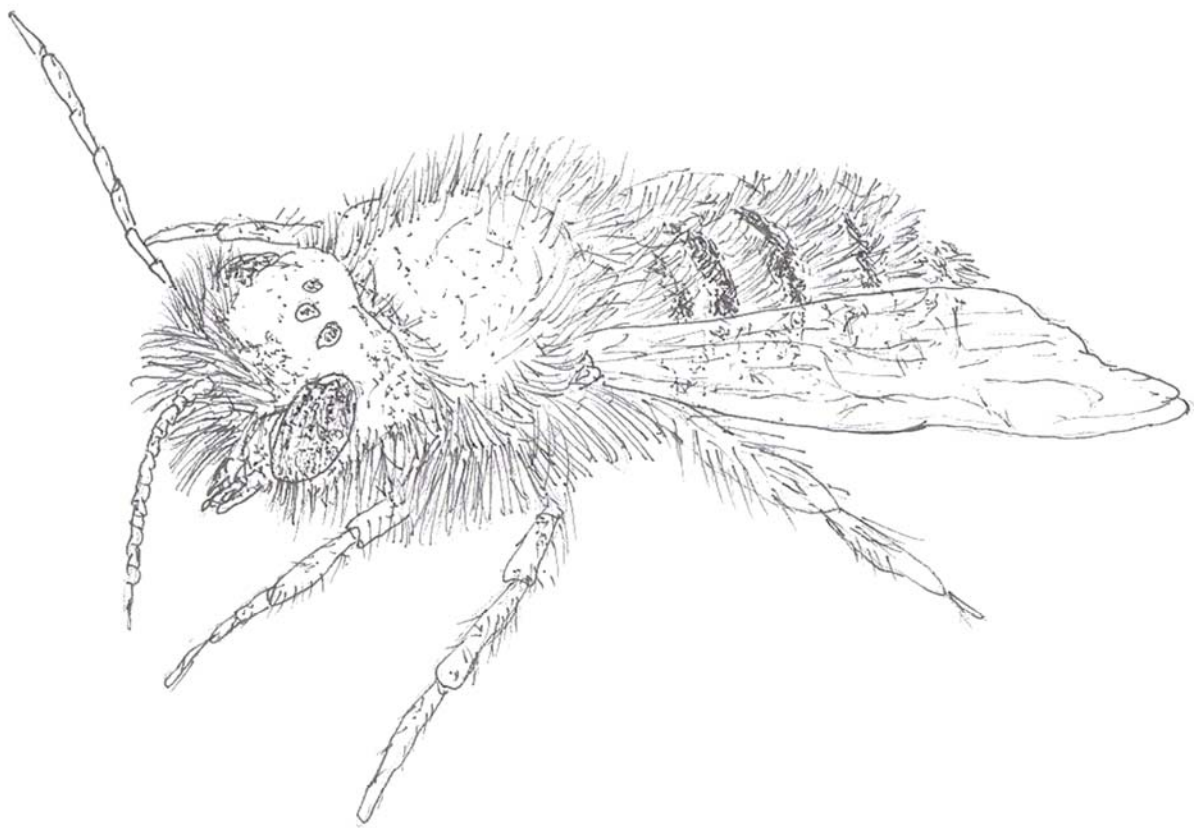
5**. Choose an appropriate combination of management tactics**
For any pest situation, there will be several options to consider. Options include mechanical or physical control, cultural controls, biological controls and chemical controls. Mechanical or physical controls include picking pests off plants, or using netting or other material to exclude pests such as birds from grapes or rodents from structures. Cultural controls include keeping an area free of conducive conditions by removing or storing waste properly, removing diseased areas of plants properly.

Biological controls can be support either through conservation of natural predators or augmentation of natural predators.

Augmentative control includes the introduction of naturally occurring predators at either an inundative or inoculative level. An inundative release would be one that seeks to inundate a site with a pest's predator to impact the pest population. An inoculative release would be a smaller number of pest predators to supplement the natural population and provide ongoing control.

Chemical controls would include horticultural oils or the application of pesticides such as insecticides and herbicides. A Green Pest Management IPM program would use pesticides derived from plants, such as botanicals, or other naturally occurring materials.

6. Evaluate results - How did it work?
Evaluation is often one of the most important steps. This is the process to review an IPM program and the results it generated. Asking the following questions is useful: Did actions have the desired effect? Was the pest prevented or managed to farmer satisfaction? Was the method itself satisfactory? Were there any unintended side effects? What can be done in the future for this pest situation? Understanding the effectiveness of the IPM program allows the site manager to make modifications to the IPM plan prior to pests reaching the action threshold and requiring action again.



MASON BEE

2017 Changes to EPA's Farm Worker Protection Standard

In late 2015 the Environmental Protection Agency issued the long awaited revision to the Worker Protection Standard (WPS). Although it is now technically active it will not be enforced until 2017 but the original WPS will still be enforced until the end of 2016. Please keep in mind that the WPS covers both restricted use AND general use pesticides.

This course contains EPA's federal rule requirements. Please be aware that each state implements pesticide regulations that may be more stringent than EPA's regulations and these frequently are changed. Check with your state environmental/pesticide agency for more information.

More on Insecticides

An insecticide is a pesticide used against insects. They include ovicides and larvicides used against the eggs and larvae of insects respectively. The use of insecticides is believed to be one of the major factors behind the increase in agricultural productivity in the 20th century. Nearly all insecticides have the potential to significantly alter ecosystems; many are toxic to humans; and others are concentrated in the food chain. This course contains pesticide recommendations that are subject to change at any time. These recommendations are provided only as a guide. It is always the pesticide applicator's responsibility, by law, to read and follow all current label directions for the specific pesticide being used. Due to constantly changing labels and product registration, some of the recommendations given in this writing may no longer be legal by the time you read them. If any information in these recommendations disagrees with the label, the recommendation must be disregarded. No endorsement is intended for products mentioned, nor is criticism meant for products not mentioned. The author and Technical Learning College (TLC) assume no liability resulting from the use of these recommendations.

Evaluating Pesticides EPA
All pesticides sold or distributed in the United States must be registered by EPA, based on scientific studies showing that they can be used without posing unreasonable risks to people or the environment.

Because of advances in scientific knowledge, the law requires that pesticides which were first registered before November 1, 1984, be reregistered to ensure that they meet today's more stringent standards.

In evaluating pesticides for reregistration, EPA obtains and reviews a complete set of studies from pesticide producers, describing the human health and environmental effects of each pesticide. The Agency develops any mitigation measures or regulatory controls needed to effectively reduce each pesticide's risks. EPA then reregisters pesticides that can be used without posing unreasonable risks to human health or the environment. When a pesticide is eligible for reregistration, EPA explains the basis for its decision in a Reregistration Eligibility Decision (RED) document.

Classes of Agricultural Insecticides

The classification of insecticides is done in several different ways:

- Contact insecticides are toxic to insects brought into direct contact. Efficacy is often related to the quality of pesticide application, with small droplets (such as aerosols) often improving performance.
- Inorganic insecticides are manufactured with metals and include arsenates, copper compounds and fluorine compounds, which are now seldom used, and sulfur, which is commonly used.
- Mode of action—how the pesticide kills or inactivates a pest—is another way of classifying insecticides. Mode of action is important in predicting whether an insecticide will be toxic to unrelated species, such as fish, birds and mammals.
- Natural insecticides, such as nicotine, pyrethrum and neem extracts are made by plants as defenses against insects. Nicotine based insecticides have been barred in the U.S. since 2001 to prevent residues from contaminating foods.
- Organic insecticides are synthetic chemicals which comprise the largest numbers of pesticides available for use today.
- Plant-Incorporated Protectants (PIP) are insecticidal substances produced by plants after genetic modification. For instance, a gene that codes for a specific Baccilus thuringiensis biocidal protein is introduced into a crop plant's genetic material. Then, the plant manufactures the protein. Since the biocide is incorporated into the plant, additional applications at least of the same compound are not required.
- Systemic insecticides are incorporated by treated plants. Insects ingest the insecticide while feeding on the plants.
- Heavy metals, e.g. arsenic have been used as insecticides; they are poisonous and very rarely used now by farmers.

Organochlorine Compounds

The insecticidal properties of the best known representative of this class of insecticides, DDT, was made by the Swiss Scientist Paul Müller. For this discovery, he was awarded the Nobel Prize for Physiology or Medicine in 1948. DDT was introduced on the market in 1944. With the rise of the modern chemical industry, it was possible to make chlorinated hydrocarbons. DDT works by opening the sodium channels in the nerve cells of the insect. A number of the organochlorine pesticides have been banned from most uses worldwide, and globally they are controlled via the Stockholm Convention on persistent organic pollutants. These include: aldrin, chlordane, DDT, dieldrin, endrin, heptachlor, mirex and toxaphene.

Penta or Pentachlorophenol

Penta or Pentachlorophenol (PCP) is an organochlorine compound used as a pesticide and a disinfectant. First produced in the 1930s, it is marketed under many trade names. It can be found in two forms: PCP itself or as the sodium salt of PCP, which dissolves easily in water.

In the past, PCP has been used as an herbicide, insecticide, fungicide, algaecide, disinfectant and as an ingredient in antifouling paint. Some applications were in agricultural seeds (for nonfood uses), leather, masonry, wood preservation, cooling tower water, rope and paper mill system. Its use has been significantly declined due to the high toxicity of PCP and its slow biodegradation. There are two general methods for preserving wood. The pressure process method involves placing wood in a pressure-treating vessel where it is immersed in PCP and then subjected to applied pressure. In the non-pressure process method, PCP is applied by spraying, brushing, dipping, and soaking. Utility companies save millions of dollars in replacement poles, because the life of these poles increases from approximately 7 years for an untreated pole to about 35 years for a preservative-treated pole.

PCP has been detected in surface waters and sediments, rainwater, drinking water, aquatic organisms, soil, and food, as well as in human milk, adipose tissue, and urine. As PCP is generally used for its properties as a biocidal agent, there is considerable concern about adverse ecosystem effects in areas of PCP contamination.

Releases to the environment are decreasing as a result of declining consumption and changing use methods. However, PCP is still released to surface waters from the atmosphere by wet deposition, from soil by run off and leaching, and from manufacturing and processing facilities. PCP is released directly into the atmosphere via volatilization from treated wood products and during production. Finally, releases to the soil can be by leaching from treated wood products, atmospheric deposition in precipitation (such as rain and snow), spills at industrial facilities and at hazardous waste sites.

Since the early 1980s, the purchase and use of PCP in the U.S has not been available to the general public. Nowadays most of the PCP used in the U.S is restricted to the treatment of utility poles and railroad ties. In the United States, any drinking water supply with a PCP concentration exceeding the MCL, 1 ppb, must be notified by the water supplier to the public. Disposal of PCP and PCP contaminated substances are regulated under RCRA as an F-listed hazardous waste.

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Organophosphates
The next large class developed was the organophosphates, which bind to acetylcholinesterase and other cholinesterases. This results in disruption of nerve impulses, killing the insect or interfering with its ability to carry on normal functions. Organophosphate insecticides and chemical warfare nerve agents (such as sarin, tabun, soman and VX) work in the same way. Organophosphates have an accumulative toxic effect to wildlife, so multiple exposures to the chemicals amplify the toxicity.

Carbamates
Carbamate insecticides have similar toxic mechanisms to organophosphates, but have a much shorter duration of action and are thus somewhat less toxic.

Organophosphates and Carbamates Pesticides
Organophosphates are phosphoric acid esters or thiophosphoric acid esters. When developed in the 1930s and 1940s, their original compounds were highly toxic to mammals. Organophosphates manufactured since then are less toxic to mammals but toxic to target organisms, such as insects. Malathion, dibrom, chlorpyrifos, temephos, diazinon and terbufos are organophosphates. Carbamates are esters of N-methyl carbamic acid. Aldicarb, carbaryl, propoxur, oxamyl and terbucarb are carbamates.

Although these pesticides differ chemically, they act similarly. When applied to crops or directly to the soil as systemic insecticides, organophosphates and carbamates generally persist from only a few hours to several months. However, they have been fatal to large numbers of birds on turf and in agriculture, and negatively impacted breeding success in birds. Many organophosphates are highly toxic to aquatic organisms.

These are two very large families of insecticides. Indeed, they have been the primary insecticides for the past 25 to 30 years. They range in toxicity from slightly to highly toxic. They are formulated in all kinds of ways from highly concentrated emulsifiable concentrates (ECs) to very dilute granular (G) formulations.

These insecticide families are similar in their modes of action—they are all nervous system poisons. Insects and all other animals, including humans, have nervous systems that are susceptible. Both insecticide families are efficiently absorbed by inhalation, ingestion, and skin penetration. To a degree, the extent of poisoning depends on the rate at which the pesticide is absorbed. Organophosphates break down chiefly by hydrolysis in the liver; rates of hydrolysis vary widely from one compound to another. With certain organophosphates whose breakdown is relatively slow, significant amounts may be temporarily stored in body fat. The organophosphates and carbamates replaced the chlorinated hydrocarbons (e.g., chlordane, aldrin, and heptachlor) for all uses, including termite control. Examples of organophosphates are chlorpyrifos for termite control and diazinon for other household pests. An example of a carbamate is carbaryl, also used for household and lawn pests.

How can people be exposed to organophosphate and carbamate pesticides?
People can be exposed to organophosphates and carbamates pesticides through accidental exposure during use. People can accidentally inhale the pesticides if they are in an area where they were recently applied. The chemicals can be ingested with food or drinks that are contaminated.

How can these pesticides exhaust affect my health?
Acetylcholinesterase is an enzyme found in the nervous system, red blood cells and blood plasma. These pesticides damage nerve function by acting as acetylcholinesterase inhibitors in the nervous system.

Breathing - Short-term exposure can produce muscle twitching, headache, nausea, dizziness, loss of memory, weakness, tremor, diarrhea, sweating, salivation, tearing, constriction of pupils, and slowed heartbeat.

Long-term exposure can produce delayed neurotoxicity, such as tingling and burning in the extremities. This delayed neurotoxicity can progress to paralysis and is seldom reversible. Damage to the liver, kidney, immune system and bone marrow may occur. Some carbamates are also suspected carcinogens.

What should I do if exposed to these pesticides?
If you think you were exposed to these pesticides, contact your doctor.

Is there a medical test to show whether I was exposed to these pesticides?
The level of cholinesterase activity in red blood cells or plasma helps physicians determine exposure to these pesticides. However, other chemicals or disease states can alter acetylcholinesterase activity. Urine or blood tests only apply if a person was exposed to a large quantity. Persons who will use these pesticides regularly should ask their physician to establish a baseline value prior to prolonged use, followed by monthly monitoring.

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Neonicotinoids

Neonicotinoids are synthetic analogues of the natural insecticide nicotine (with a much lower acute mammalian toxicity and greater field persistence). These chemicals are nicotinic acetylcholine receptor agonists. Broad-spectrum—systemic insecticides, they have a rapid action (minutes-hours). They are applied as sprays, drenches, seed and soil treatments—often as substitutes for organophosphates and carbamates. Treated insects exhibit leg tremors, rapid wing motion, stylet withdrawal (aphids), disoriented movement, paralysis and death.

Biological Insecticides
Recent efforts to reduce broad spectrum toxins added to the environment have brought biological insecticides back into vogue. An example is the development and increase in use of Bacillus thuringiensis, a bacterial disease of Lepidopterans and some other insects. Toxins produced by different strains of this bacterium are used as a larvicide against caterpillars, beetles, and mosquitoes. Because it has little effect on other organisms, it is considered more environmentally friendly than synthetic pesticides. The toxin from B. thuringiensis (Bt toxin) has been incorporated directly into plants through the use of genetic engineering. Other biological insecticides include products based on entomopathogenic fungi (e.g. Beauveria bassiana, Metarhizium anisopliae), nematodes (e.g. Steinernema feltiae) and viruses (e.g. Cydia pomonella granulovirus).

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Anti-feedants

Many plants have evolved substances, like polygodial, which prevent insects from eating, but do not kill them directly. The insect often remains nearby, where it dies of starvation. Since anti-feedants are nontoxic, they would be ideal as insecticides in agriculture. Much agrochemical research is devoted to make them cheap enough for commercial use.

Polygodial is an active constituent of Dorrigo Pepper, Mountain Pepper, Horopito, Canelo, Paracress and Water-pepper. It elicits a warm and pungent flavor.

The biological activity of polygodial has been reported in the scientific literature to include antifungal and antimicrobial activities, antihyperalgesia, potent attachment-inhibitory activity, insect antifeedant activity, antinociception, vasorelaxation action in vessels of rabbit and guinea pig, anti-inflammatory and anti-allergic activities.

Polygodial's primary antifungal action is as a nonionic surfactant, disrupting the lipid-protein interface of integral proteins nonspecifically, denaturing their functional conformation. It is also likely that polygodial permeates by passive diffusion across the plasma membrane, and once inside the cells may react with a variety of intracellular compounds. It is also used as an insecticide for its antifeedant property, which causes insects to starve.

Rotenone

Rotenone is an odorless chemical that is used as a broad-spectrum insecticide, piscicide, and pesticide. It occurs naturally in the roots and stems of several plants such as the jicama vine plant. In mammals, including humans, it is linked to the development of Parkinson's disease.

Rotenone is used in solution as a pesticide and insecticide, or in emulsified liquid form as a piscicide. People catch fish by extracting rotenone from plants and releasing it into water. Poisoned fish come to the surface and are easily caught. This method was first practiced by various indigenous tribes who smashed the roots. Fish caught this way can be eaten because rotenone is very poorly absorbed by the gastrointestinal tract of humans, whereas it is lethal to fish because it readily enters the blood stream of the fish through the gills.

Small-scale sampling with rotenone is used by fish researchers studying the biodiversity of marine fishes to collect cryptic, or hidden, fishes, which represent an important component of shoreline fish communities. Rotenone is the most effective tool available because only small quantities are necessary. It has only minor and transient environmental side-effects. Rotenone is also used in powdered form to reduce parasitic mites on chickens and other fowl. In the United States and in Canada, all uses of rotenone except as a piscicide (fish killer) are being phased out.

Rotenone is sold as an organic pesticide dust for the garden. Unselective in action, it kills potato beetles, cucumber beetles, flea beetles, cabbage worms, raspberry bugs, and asparagus bugs, as well as most other arthropods. Rotenone rapidly bio-degrades under warm conditions so there is minimal harmful residue. A light dusting on the leaves of plants will control insects for several days.

It is not known to be harmful to humans when used properly. However, a recent report from the National Institutes of Health finds statistically significant associations between use of either rotenone or paraquat with Parkinson's disease. Rotenone is produced by extraction from the roots and stems of several tropical and subtropical plant species, especially those belonging to the genus Lonchocarpus or Derris.

Some of the plants containing rotenone:

- Hoary Pea or Goat's Rue (Tephrosia virginiana) – North America
- Jícama (Pachyrhizus erosus) – North America
- Cubé Plant or Lancepod (Lonchocarpus utilis) – South America. The root extract is referred to as Cubé resin.
- Barbasco (Lonchocarpus urucu) – South America. The root extract is referred to as Cubé resin
- Tuba Plant (Derris elliptica) – southeast Asia & southwest Pacific islands. The root extract is referred to as Derris or Derris root.
- Jewel Vine (Derris involuta) – southeast Asia & southwest Pacific islands. Among the Mizo tribes of India (Derris walchii/D. thyrsiflora) the tender root is eaten as vegetable. The root extract is referred to as Derris or Derris root.
- Duboisia – This shrub grows in Australia and bears white clusters of flowers and berry like fruit. The crushed plants were used by the Aboriginals for poisoning fish for food.
- Verbascum Thapsus
- Cork-Bush (Mundulea sericea) – southern Africa
- Florida fishpoison tree (Piscidia piscipula) – southern Florida, Caribbean

This course contains pesticide recommendations that are subject to change at any time. These recommendations are provided only as a guide. It is always the pesticide applicator's responsibility, by law, to read and follow all current label directions for the specific pesticide being used.

Due to constantly changing labels and product registration, some of the recommendations given in this writing may no longer be legal by the time you read them. If any information in these recommendations disagrees with the label, the recommendation must be disregarded. No endorsement is intended for products mentioned, nor is criticism meant for products not mentioned. The author and Technical Learning College (TLC) assume no liability resulting from the use of these recommendations.

Always follow label instructions and take steps to avoid exposure. If any exposures occur, be sure to follow the First Aid instructions on the product label carefully. For additional treatment advice, contact the Poison Control Center at 1-800-222-1222. If you wish to report a pesticide problem, please call 1-800-858-7378.

NOTE: When pesticides are used, it is the applicator's legal responsibility to read and follow directions on the product label. Not following label directions, even if they conflict with information provided herein, is a violation of federal law.

2017 Changes to EPA's Farm Worker Protection Standard

In late 2015 the Environmental Protection Agency issued the long awaited revision to the Worker Protection Standard (WPS). Although it is now technically active it will not be enforced until 2017 but the original WPS will still be enforced until the end of 2016. Please keep in mind that the WPS covers both restricted use AND general use pesticides.

This course contains EPA's federal rule requirements. Please be aware that each state implements pesticide regulations that may be more stringent than EPA's regulations and these frequently are changed. Check with your state environmental/pesticide agency for more information.

Topic 4 Wasp Section Post Quiz
Answers at rear of Glossary
Fill-In-the-blank

Yellowjackets

1. ____________________ build a hard nest out of mud, usually on ceilings, walls or eaves of buildings. The nests are attended by a single female wasp. The mud dauber's favorite food is a spider meal.

2. There are two distinct types of social wasps—yellowjackets and paper wasps. Yellowjackets are by far the most troublesome group, especially ground- and cavity-nesting ones such as the________________, which tend to defend their nests vigorously when disturbed.

3. _____________ranges across Canada and the northeastern United States. Common in higher elevations, it nests in shady evergreen forests around parks and camps in the western mountains and the eastern Appalachians. This species also is one of the most important stinging insects in Europe.

Wasp Pesticides

4. Wasps and bees are beneficial insects, although they are generally considered to be pests because of their ability to sting. Wasps, in particular, can become a problem in ________________when they may disrupt many outdoor activities.

Nests

5. Yellowjackets commonly build nests in rodent burrows, but they sometimes select other protected cavities, such as voids in walls and ceilings of houses, as nesting sites. Colonies, which are begun each spring by a single reproductive female, can reach populations of between ________________individuals, depending on the species.

Paper Wasp

6. The paper wasp is made up of mostly the Polistes genus. They are easy to distinguish from other bees, hornets and yellowjackets as they are less aggressive and they build a________________. Markings and colors vary but include yellows, browns and blacks. The nest is constructed in protected areas above the ground. Common areas their nests can be found include on walls or under eaves of homes and other buildings.

Underground Nesters

7. The stinging wasp, often identified as a yellowjacket, is black and yellow. Primarily yellow bands cover a dark abdomen. These species are in the genus______________________.

Other Wasps

Blue Mud Wasp *(Chalybion californicum)*

8. This wasp is a “poor relative” of the Mud Dauber. The females use vacant mud wasp nests. They hunt on the ground, preying mainly on_________________. Adults are metallic blue, blue green or bluish black.

Mud Dauber *(Sceliphron caementarium)*

9. This is a common wasp. Females build a mud nest of cells laid side by side usually in a series of two to six, on the sides and eaves of buildings. The adults are mostly black with a yellow waist and legs. Many solitary wasps fall into the group of 'Mud daubers' and what distinguishes them is that they build nesting sites___________________. There is the black and yellow dauber, blue, potter's wasp, organ pipe and many more. Usually their name depicts the shape of the nest they build but sometimes it simply refers to their colors or marking.

Umbrella Wasps *(Polistes spp. and Mischocyttarus flavitarsis)*

10. Umbrella wasps are also commonly referred to as paper wasps. These wasps have been named umbrella wasps because their nests are the shape of an inverted umbrella. They usually have small nests and are usually inhabited by about ______________ wasps. Unlike many other wasps and yellowjackets, Umbrella wasps do not have a worker caste. All female wasps are capable of becoming the queen.

Bee Glossary

Abscond: When an entire colony of bees leaves an established hive.

Anaphylactic Shock: A life-threatening condition that may be brought on by a severe reaction to bee stings.

Anther: Part of a plant that contains and develops pollen.

Apiary: A group of bee colonies kept in one location (bee yard).

Bee bread: Pollen stored in cells of the comb.

Bee gum: Usually a hollow log hive.

Bee space: A space (1/4-5/16 inch) big enough to permit free passage for a bee but too small to encourage comb building. Leaving a bee space between parallel beeswax combs and between the outer comb and the hive walls is the basic principle of hive construction.

Bee tree: A hollow tree occupied by a colony.

Bee venom: Poison injected by a bee sting.

Brood: Immature or developing stages of bees, including eggs, larvae (unsealed brood), and pupae (sealed brood).

Cell: The six-sided compartment of a honey comb, used to raise brood or to store honey and pollen. Worker cells approximate five to the linear inch; drone cells are larger, averaging four to the linear inch.

Chromosomes: The structures in an animal or plant cell that carry the genes.

Colony: Social community of several thousand worker bees, usually containing one queen, with or without drones.

Comb foundation: Thin sheet of beeswax impressed by mill to form bases of cells; some foundation is also made of plastic and metal.

Drone: Male honey bee.

Feral: Wild, unmanaged.

Frame: Rectangular, wooden honeycomb supports, suspended by top bars in hive bodies.

Honey stomach (honey sac): An enlargement of the posterior end of the oesophagus in the bee abdomen. It is the sac in which the bee carries nectar from the flower to the hive.

Hybrid: Offspring from two unrelated (usually inbred) lines.

Hymenoptera: Insect order to which all bees belong, as well as ants and wasps.

Hyper-allergic: Prone to severe allergic reaction; hyper-allergic persons may be at risk from a single sting.

Inbred: A homozygous organism usually produced by inbreeding.

Inbreeding: Matings among related individuals.

Incident: Any contact between bees and humans, or at-risk animals.

Langstroth: A minister from Pennsylvania who patented the first hive incorporating a bee space, thus providing for removable frames. The modern hive frequently is termed the Langstroth hive and is a simplified version of similar dimensions as patented by Langstroth.

Larva: Stage in life of bee between egg and pupa; "grub" stage.

Mead: A wine made with honey. If spices or herbs are added, the wine is usually termed metheglin.

Migratory beekeeping: Movement of apiaries from one area to another to take advantage of honey flows from different crops.

Nectar: A sweet secretion of flowers of various plants, some of which secrete enough to provide excess for the bees to store as honey.

Package bees: A quantity of bees (2-5 lb) with or without a queen, shipped in a wire and wood cage to start or boost colonies.

Pheromones: Chemicals secreted by animals to convey information or to affect behavior of other individuals of the same species.

Pollen: Male reproductive cells of flowers collected and used by bees as food for rearing their young. It is the protein part of the diet. Frequently called bee bread when stored in cells in the colony.

Pollination: Transfer of pollen from the anthers of one flower to the stigma of another flower.

Pollinator: The agent that transfers pollen, e.g., a bee, wasp, or wind.

Propolis: A glue or resin collected from trees or other plants by bees and used to close holes and cover surfaces in the hive. Also called bee glue.

Queen: Sexually developed female bee; the mother of all bees in a colony.

Race: A population of bees that has become geographically isolated and adapted to specific regional conditions.

Requeen: To place a queen in a hive; usually to replace an old queen with a young one.

Skep: A dome-shaped beehive, usually of straw, that lacks movable frames.

Smoker: Device used to blow smoke on bees to reduce stinging.

Social insects: Insects that live in a family society, with parents and offspring sharing a common dwelling place and exhibiting some degree of mutual cooperation; e.g., honey bees, ants, termites.

Spermatheca: Small saclike organ in queen's abdomen in which sperm are stored.

Sting: Modified ovipositor, the egg-laying structure of female Hymenoptera developed into an organ of defense.

Super: Any hive body placed above the brood chamber for the storing of surplus honey.

Supersedure: The replacement of a weak or old queen in a colony by a daughter queen - a natural occurrence.

Swarm: Natural division of a colony of bees.

Worker bee: Sexually undeveloped female bee (largest percentage of bees found in a hive).

Post Quiz Answers

Topic 1 Bee Introduction Answers

1. Venom, 2. Apis, 3. Often incapable, 4. Eastern tropical Africa, 5. Many environments, 6. 100 feet, 7. Waggle dance, 8. All honey bees, 9. Hunger swarms, 10. Hybrid

Topic 2 Bees and Related Bee-Like Insects Answers

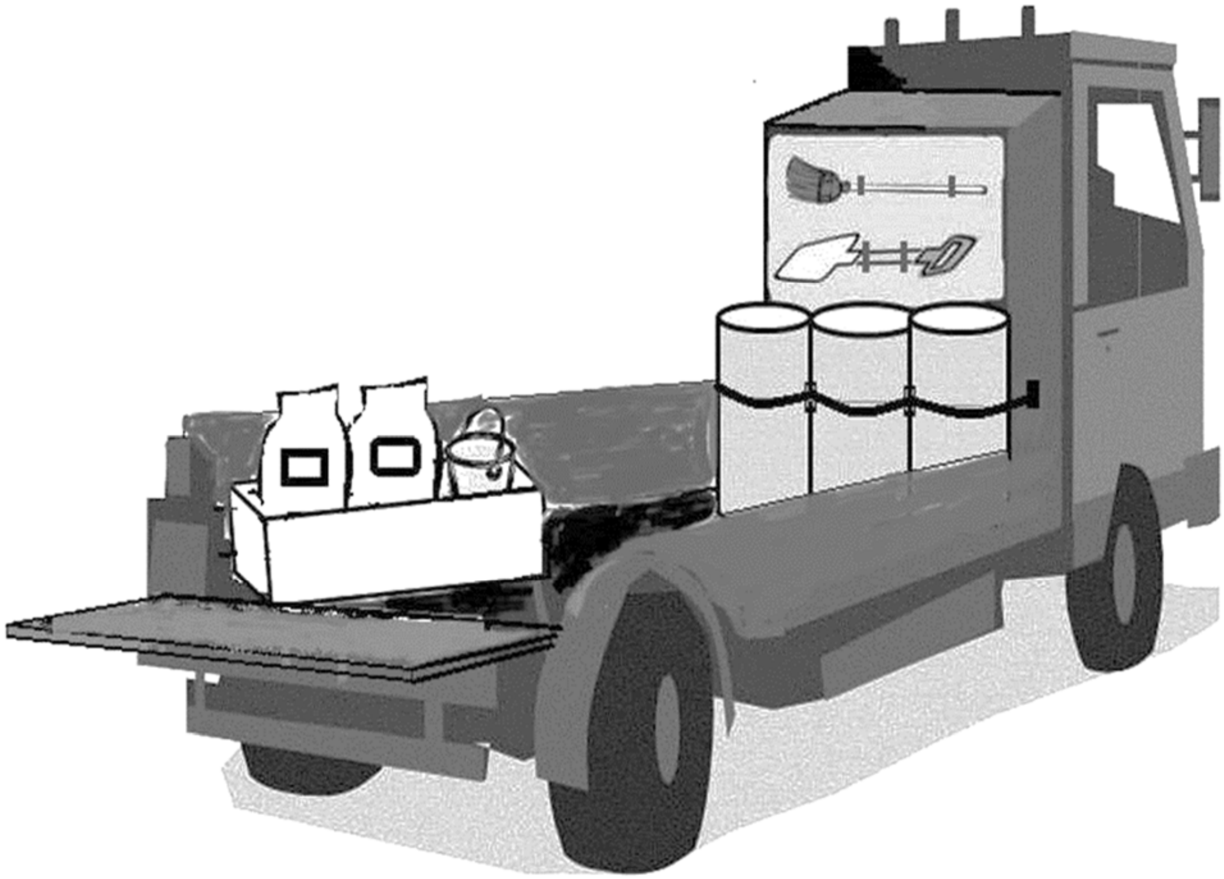
1. Halictidae, 2. No pollen baskets, 3. House flies, 4. Euglossine males, 5. Insecticide DDT, 6. The scopa, 7. Emery's Rule, 8. Carpenter bee, 9. Spring, 10. Very important, beneficial insects

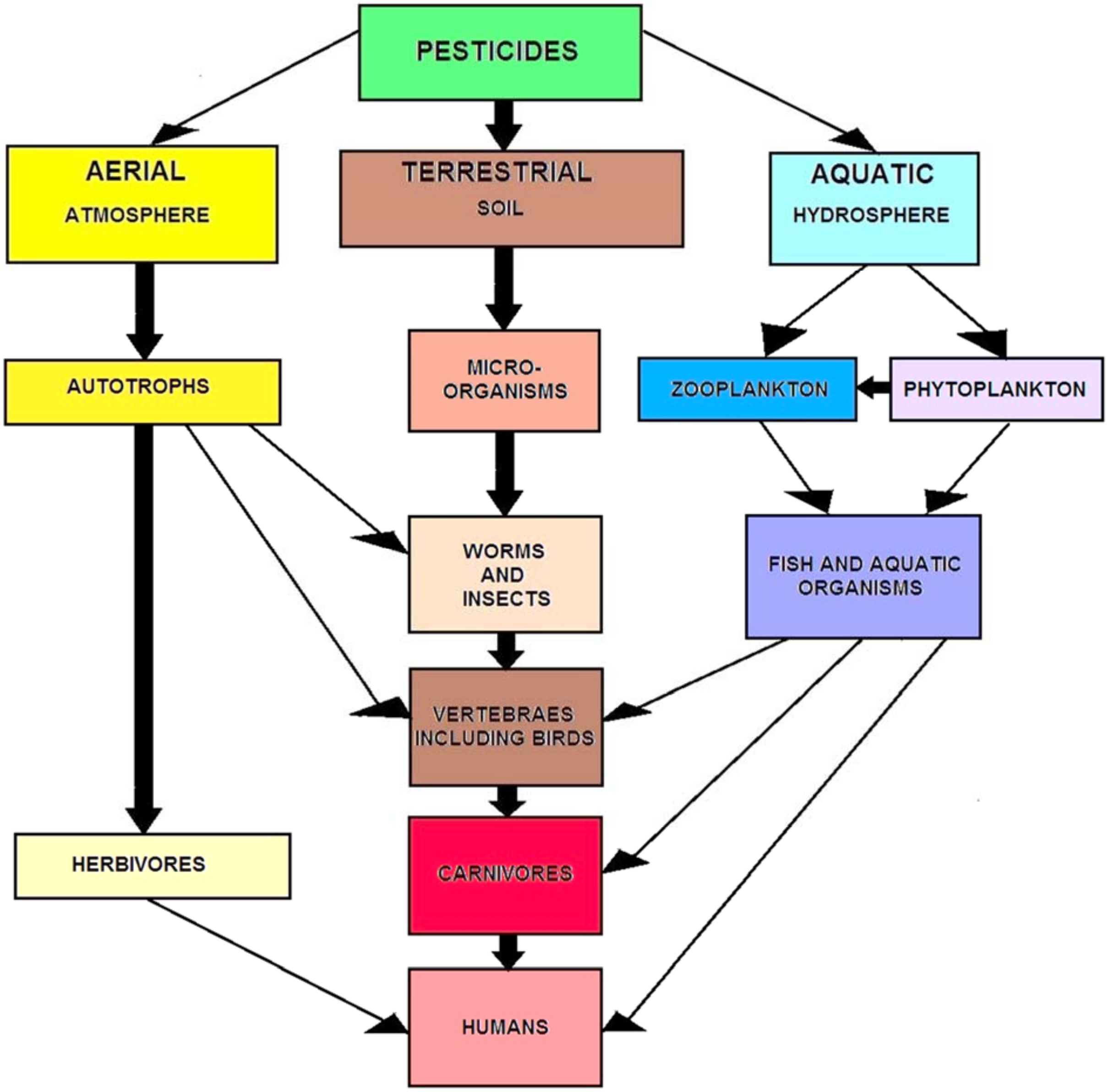
Topic 3 Bee Control Section Answers

1. Capturing swarms, 2. AHB, 3. Bee colonies, 4. No easy, convenient method 5. Check the container label for proper concentration, safe use, and area requirements, 6. Locating and removing, 7. Foam insulation, 8. AHB, 9. Dust and wettable powder formulations, 10. Meats and sweet liquids

Topic 4 Wasp Section Answers

1. Mud Daubers, 2. Western yellowjacket, 3. V. vulgaris, 4. Autumn, 5. 1,500 and 15,000, 6. Hexagonal, open paper nest, 7. Vespula, 8. Black Widow spiders, 9. Out of mud, 10. 250




PESTICIDES
AERIAL
ATMOSPHERE
TERRESTRIAL
SOIL
AQUATIC
HYDROSPHERE
AUTOTROPHS
MICRO-
ORGANISMS
ZOOPLANKTON
PHYTOPLANKTON
WORMS
AND
INSECTS
FISH AND AQUATIC
ORGANISMS
VERTEBRAES
INCLUDING BIRDS
HERBIVORES
CARNIVORES
HUMANS

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Dealing with Bug Bites and Stings

Bug bites and stings usually are just nuisances. They bring momentary alarm, temporary discomfort and pain, but no serious or lasting health problems. But on occasion, they can cause infections that require treatment and allergic reactions that can be serious, even fatal.

Parents should know the signs of an infection or allergic reaction, and when to get medical attention. Inform all caregivers if a child has any history of complications so they know what to do in the event of a bug bite or sting.

What to Do About:

Bee and Wasp Stings

- A bee will leave behind a stinger attached to a venom sac. Try to remove it as quickly as possible. (Wasps don't leave their stingers in the skin after stinging, which means they can sting more than once.)
- Wash the area carefully with soap and water. Do this two to three times a day until the skin is healed.
- Apply an ice pack wrapped in a cloth or a cold, wet washcloth for a few minutes.
- Give acetaminophen or ibuprofen for pain.
- For pain and itching, give an over-the-counter oral antihistamine if your child's doctor says it's OK; follow dosage instructions for your child's age and weight. You could also apply a corticosteroid cream or calamine lotion to the sting area.
- A sting anywhere in the mouth warrants immediate medical attention because stings in oral mucous membranes can quickly cause severe swelling that may block airways.
- Seek medical care if you notice a large skin rash or swelling around the sting site, or if swelling or pain persists for more than 3 days, which could indicate an infection.
- Get medical help right away if you notice any of the following signs, which may indicate a serious or potentially life-threatening allergic reaction:
    - wheezing or difficulty breathing
    - tightness in throat or chest
    - swelling of the lips, tongue, or face
    - dizziness or fainting
    - nausea or vomiting

Spider Bites

- Wash the area carefully with soap and water. Do this two to three times a day until skin is healed.
- Apply cool compresses.
- Give acetaminophen or ibuprofen for pain.
- To protect against infection, apply an antibiotic ointment and keep the child's hands washed. If you have any reason to suspect a bite by a black widow or brown recluse spider, apply ice to the bite site and take your child to the emergency room. Even if a child doesn't show any symptoms, get medical attention right away.

  Most spiders found in the United States are harmless, with the exception of the black widow and the brown recluse spider. The brown recluse spider — a tiny oval brown spider with a small shape like a violin on its back — is found mostly in midwestern and southern parts of the United States. The bites usually don't hurt at first, and a child might not even be aware of the bite, but in some cases they cause swelling and changes in skin color and a blister.

The black widow spider, which is found all over North America, has a shiny black body and an orange hourglass shape on its underbelly. The venom (poison) in a black widow bite can cause painful cramps that show up within a few hours of the bite. The cramps can start in the muscles around the bite and then spread. The bite may also lead to nausea, vomiting, chills, fever, and muscle aches. If your child has any of these symptoms — or you know that he or she has been bitten — go to the emergency room right away.

In the southwest United States, an unidentified bite may be caused by a scorpion. Take your child to the emergency room immediately.

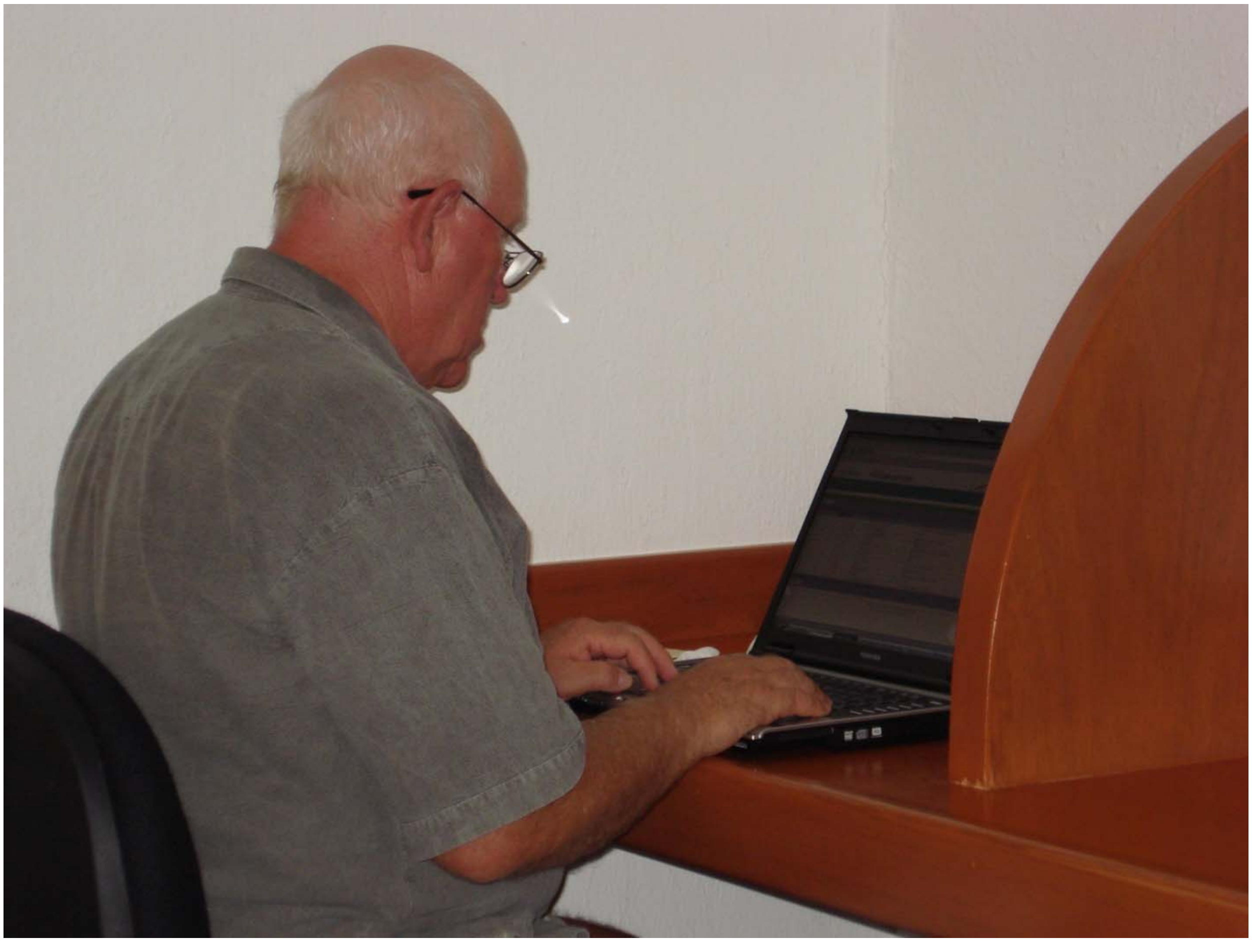
Tick Bites

Check kids and pets for ticks carefully after you've been in or around a wooded area. Common types of ticks include dog ticks and deer ticks (deer ticks may be carriers of Lyme disease).

If you find a tick on your child:

- Call your doctor, who may want you to save the tick after removal (you can put it in a jar of alcohol to kill it).
- Use tweezers to grasp the tick firmly at its head or mouth, next to the skin.
- Pull firmly and steadily on the tick until it lets go, then swab the bite site with alcohol.
- Don't use petroleum jelly or a lit match to kill and remove a tick.

Reviewed by: Elana Pearl Ben-Joseph, MD



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