



Keep it Pest-Free



This is a wire chewed by a rodent – estimated to cause up to 20% of all fires of unknown origin, in addition to those positively identified as rodent-caused.

Health Effects of Pests

- Asthma: rate has doubled in 20 years: 10%+
 - Main cause of lost school days
- Pests are main triggers of asthma in urban areas:
 - Dust mites – allergen in feces (Der p 1)
 - Cockroaches – allergens in feces (Blag 1 and 2)
 - Mice – allergen in urine (MUP)
- Spread infectious diseases
- Health effects greater on children

It is the health effects that are the main drivers for our concern about pests, and asthma tops that list. The asthma rate has doubled in the last 20 years, and is now over 10% of school age children nationwide; in many urban areas it is twice the national average. Asthma is the main cause of lost school days, which also means lost work days, since a parent must stay home with the sick child.

Cockroaches and mice have been identified as the major triggers for asthma in urban areas. In addition most homes have dust mites. All excrete potent allergens that can cause allergic effects, and trigger asthma attacks. This means that not only do we have to eliminate the pests, but we have to remove them, and clean up their mess.

- Start with People**
- House as a System**
- Keep It:**
 1. Dry
 2. Clean
 3. Pest-Free
 4. Ventilated
 5. Safe
 6. Contaminant-Free
 7. Maintained
- Making it Work**

Learning Objectives for this module

- Name three illnesses or injuries associated with pest infestation.
- Identify three clues of pest infestation.
- Identify the three strategies associated with an IPM approach.
- Name two illegal pesticides that may be used in the home.

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Pests are capable of spreading infectious disease – both roaches and rodents can carry dozens of infectious bacteria, viruses, and even fungi. Mice are a reservoir for, and can vector, salmonella. Children are the most vulnerable population – they are smaller, so smaller amounts can result in health effects. Children also eat more, drink more, and breathe more, pound for pound, than adults. Additionally, since they are growing, and critical body systems are still developing, “insults” to their bodies may have more profound effects.

More Health Effects of Pests

- Insect Bites – piercing the skin barrier (mosquitoes, ticks, bedbugs, flies)
- Rat bites
 - Up to 500,000 rodent bites per year
 - Mostly sleeping infants
 - Rat Bite Fever (>10% mortality)
- Rabies

The photo below is an enlarged detail of the inside back of a cabinet; the ‘dots’ are “FRASS:” insect poop, specifically cockroach feces.

Bottom line: each female (females are bigger, eat more and poop more, and expression of the allergen is linked to the reproductive cycle), can potentially trigger about 180 asthma attacks.

The photo is from Changlu Wang, a leading urban entomologist now at Rutgers. The relationship between number of bugs (bottom) to concentration of allergen (left) is basically straight-line. The 8-unit morbidity threshold is the red line: IF you have fewer than 10 cockroaches, allergen levels are sub-clinical. Of the residents you know who have roaches, do any of them have fewer than 10?

What’s a Pest?

“Any destructive or troublesome organism”

- Affects health.
- Destroys food or property.
- Creates a nuisance.

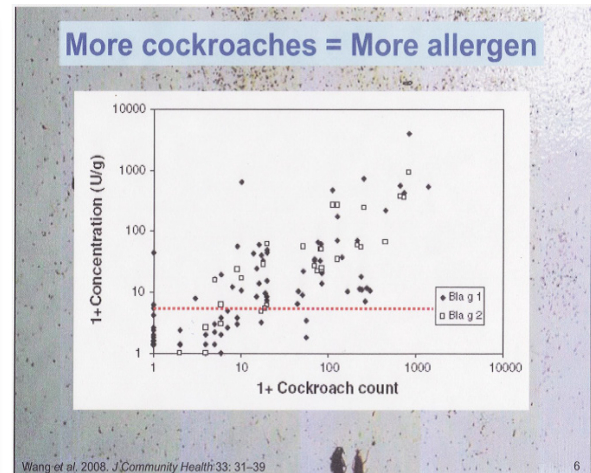
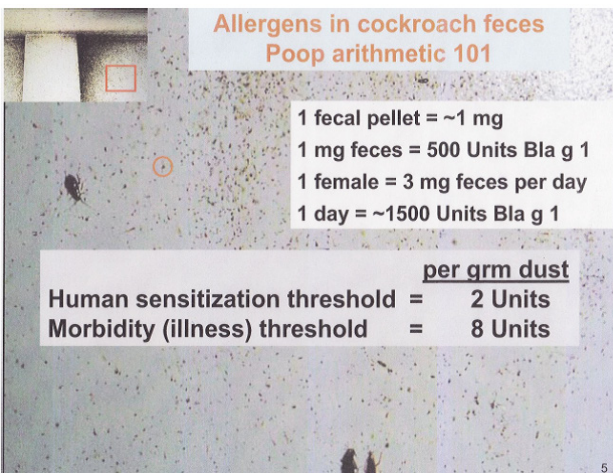
Something we don’t like, where we don’t want it!



Mosquito bites



Rat bites, multiple





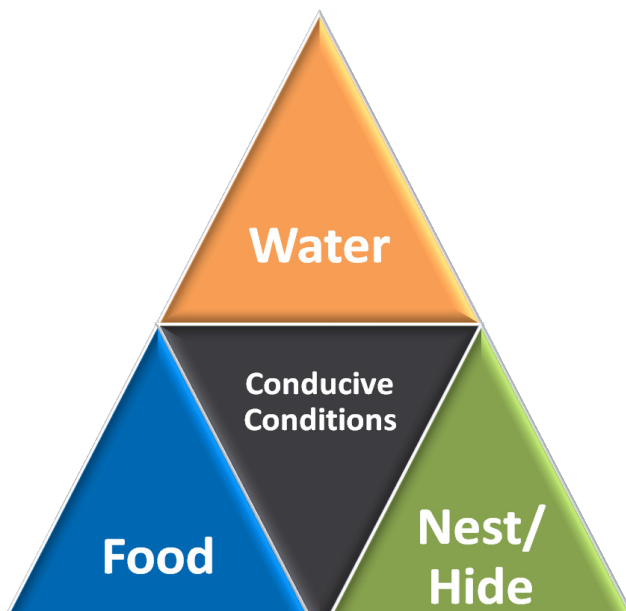
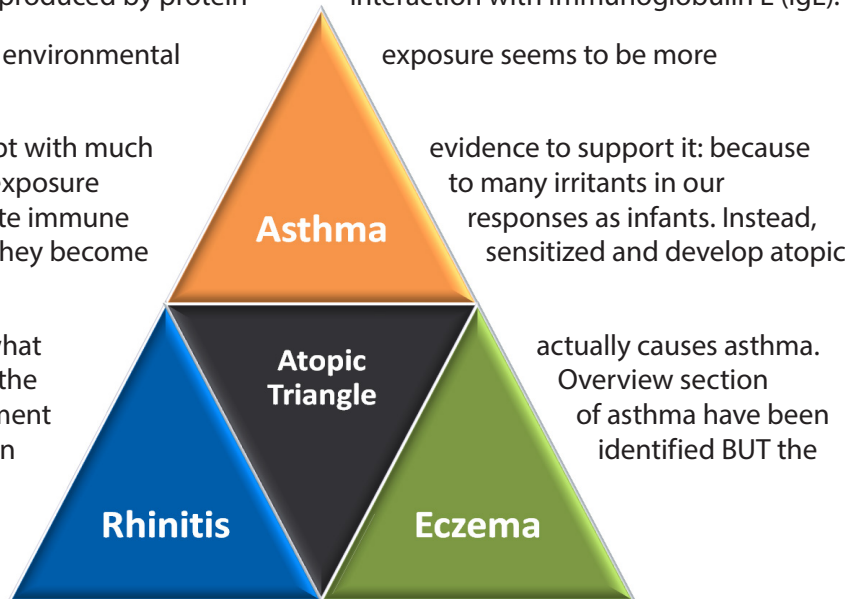
The Atopic Triangle of Asthma, Allergies, and Eczema

Allergens are part of the “Atopic Triangle,” including asthma, rhinitis, and eczema – all three are often (but not always) found together, and can cross-react. They are all produced by protein interaction with Immunoglobulin E (IgE).

Although genetic predisposition is part of atopy, environmental important.

The Hygiene Hypothesis is a controversial concept with much we have largely eliminated dirt, pathogens and exposure environment, children do not develop appropriate immune when they encounter “insults” as older children they become symptoms.

However, there is not a lot of understanding of what As the Institute of Medicine report referred to in the indicates, factors that contribute to the development identified and many triggers of asthma have been underlying causes of asthma remain unknown.¹



What Do Pests Want? Pest Triangle

- Food
- Water
- Harborage
 - Some place to hide and nest
 - Ideally warm

ALL pests need three things: food, water and a place to hide (harborage). Preventing, or removing these conditions conducive to infestation will prevent pests – they will go to where food, water and harborage are available. This is the essential concept behind Integrated Pest Management—remove the conditions and you prevent the pests.

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How Common are Pests?

American Housing Survey (2011):

- Rats—about 1.0% (1.8% below poverty)
- Mice—about 11.1% (12.5% below poverty)
- Rodents, unsure of type—about 0.6% (1.0% below poverty)

Community Asthma Prevention Program (Philadelphia, 2007):

- Mice—72%
- Cockroaches—62%

National Allergy and Asthma Surveys (2002-6):^{2,3}

- Mice allergens—63% (95% low-income)
- Cockroach allergens—85%
- Rat allergens—33% of inner-city homes

Integrated Pest Management (IPM)

Control measures in IPM – beyond prevention – include the factors listed to the right. Proper identification is essential – you need to know what the pest is in order to know if it is a critical pest, and how to control it. For instance, termites require different – and much more extensive controls – than ants. Assuming that ants are “termites” can lead to the unnecessary application of, and exposure to high toxicity pesticides. Know your pest before you start!

Other basic control principles in IPM are:

- **Exclusion and Denial** – keeping them out of a home, and sealing their harborage
- **Sanitation** – removing all food residues, filth, clutter and other food and protection
- **Water** – most pests need a source of water. Cockroaches, for instance, can live a month without food, but only a week without water. Mice do not need to drink – they get the water they need from their food. They will however, drink free water if it’s available. Bedbugs also do not water; they drink blood.
- **Physical controls** – include traps of all sorts – glue traps, pheromone-lures, snap traps, curiosity traps, etc.
- **Chemical controls** – are not the first choice of tool. If necessary, start with low risk pesticides, including cockroach baits and gel, boric acid, and insect growth regulators (IGR). Other pesticides may be used if essential, but rarely.
- **Ongoing monitoring** – is essential after control is established, in order to know if pests are reintroduced, so that new controls can be used before an infestation is reestablished.



Rat feces in insulation



Roach frass under sink

How Do We Control Them?

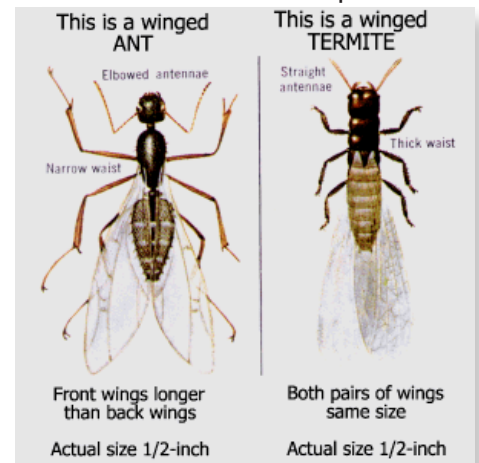
- Prevention
 - Identification
 - Exclusion & denial
- Sanitation
 - Food & water
- Physical controls
 - Chemical controls
- Ongoing monitoring

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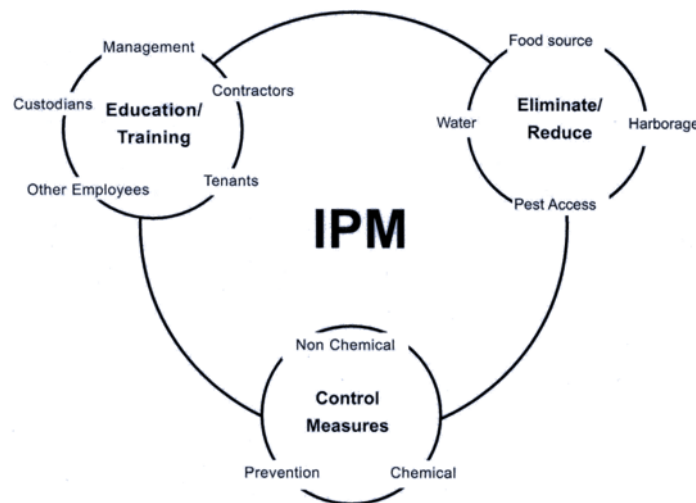


So—what is IPM? First, it is important to realize that Integrated Pest Management is considered **THE** best practice for pest control by HUD, EPA, CDC, the National Pest Management Association, and most academic researchers. It is not “new,” unproven, radical, or trivial. HUD and the Government Services Administration have implemented IPM since 1995; the National Park Service since the 1980’s. IPM should not be considered a “premium” service, marketed at a higher price point to pesticide-adverse residents.

Multiple tactics is one of the key elements of IPM: many tools are available and should be used, rather than reliance on a single method. Pesticides for instance, are one tool in the IPM tool box but they are not the only, or primary tool. However, effective control is the essential goal: methods that do not provide effective control – such as using glue boards as the only method for pest control in a school, are inadequate. At the same time, it is important to not affect “non-target organisms” – children, adults, pets, wildlife, etc.



It’s also important that control methods be economically sustainable – controls need to be maintained over time, and costs are a significant factor. Further, control measures should have minimal environmental impact for long-term sustainability (for instance, disposable traps should perhaps be paper or wood, not plastic).



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Reduce Pesticide Use

Pest pressure can drive people to unsafe use of pesticides and various health problems can be the result. One of the elements of IPM is a reduced use of pesticides. IPM does not exclude the use of pesticides, but the use of the other tactics reduces the need for pesticides. IPM also makes deliberate choices about the types of pesticides when they must be used, and makes least risky choices.

This is in contrast to conventional controls, particularly those most familiar to residents – aerosol sprays and foggers, and baseboard sprays by pest control operators (PCOs). Infestations drive residents to use pesticides in ways and amounts that risk compromising health, particularly that of their children.

Using too much pesticide (a common problem is using multiple foggers in a small apartment) can result in acute exposure – pesticide poisoning. In 2007, Poison Control Centers reported 16,000 pesticide exposures requiring treatment, over half to children under 5 years old. Ninety-three of these exposures occurred in their own home.

Much less understood are chronic exposures: the effects of exposure to small amounts of pesticide over a long period of time. Most pesticides leave residues that persist in homes indefinitely. Studies in Boston and New York City for instance, have found DDT residues still in homes, 30 years after being banned in this country. We simply do not know what effect on children's health these exposures may have.

High levels of pests may also lead people to use dangerous or illegal pesticides – “Tres pasitos” is common in Latino communities. It is manufactured overseas and illegally imported. Commonly sold in baggies in neighborhood stores or on the street, it is used to poison mice: “Tres pasitos” means “three little steps” – that’s as far as the mouse gets after eating it. There is actually a thriving black market for pesticides in this country – many people miss the old, now-banned pesticides – they “worked better” than those now available. However, they have very high risks associated with them. Chinese chalk is another product not registered with the EPA or legal for sale or use in this country. It is chalk impregnated with high-potency pesticide. You draw a line with it – when a bug walks across the line, it dies. But what happens when a kid uses it to draw a hopscotch grid and then puts her fingers in her mouth?



Insecticide Chalk

Pesticides and Poisonings

- In 2007, Poison Control Centers reported just under 16,000 pesticide exposures requiring treatment.
- Almost half of all households with children under five stored pesticides within reach of children.
- 95% of all of poisoning of children under age 6 occurred in their own home.

The American Association of Poison Control Centers reported 113,000 cases of pesticide poisonings in 2007.4 Surprisingly, it is estimated that this figure represents only 1/4 to 1/3 of the total since most incidents were not reported to their registry. Additionally, there were 96,307 pesticide exposures—44,644 involving children five years or younger. A total of 15,965 exposures required treatment in a health-care facility.

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In 1971, Mr. Yuk was created by the Pittsburgh Poison Center at Children's Hospital of Pittsburgh. Since then, Mr. Yuk has been used to educate children and adults about poison prevention and to promote poison center awareness. In addition, Mr. Yuk has raised awareness that poison centers are available 24 hours-a-day, every day of the year to assist in the management of poisoning emergencies.

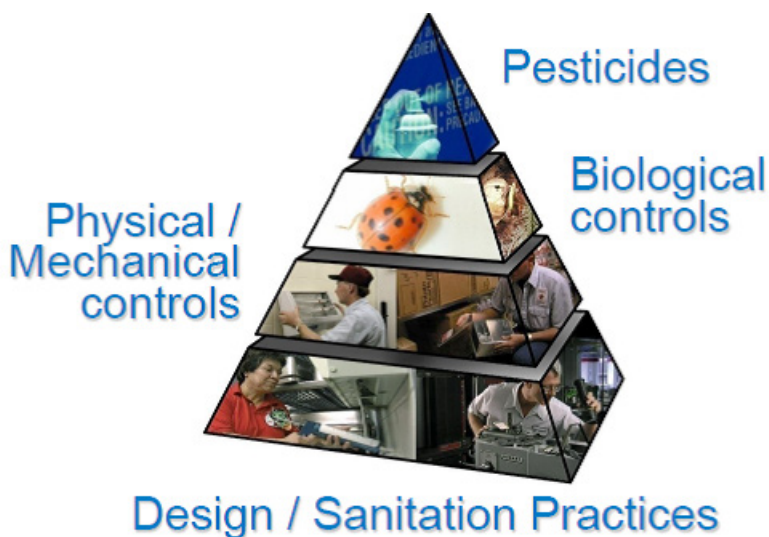
Other Pesticide Problems

Other possible problems with pesticide use include treating for the wrong pest – for instance, termite treatments for what turn out to be ants. Termiticides tend to be more potent, and are used in much larger quantities than anticides, and significant, and unnecessary exposure may occur. Similarly, people often assume that if “a little is good, more is better,” and use inappropriate chemicals, often in excessive amounts.



There is also the problem of resistance—insects can become tolerant of pesticides over time, and the chemicals lose their effect. This is a common and increasing problem, and is one of the factors that makes bed bug control difficult; they are resistant to many common pesticides including all the “old” pesticides that were once successfully used against them. DDT, for instance, was very potent when it was introduced to commerce in 1947. Within two years some bed bugs were exhibiting resistance—that is, surviving DDT applications, and by 1958 DDT was ineffective against them. Bed bugs subsequently developed resistance to Malathion, Diazinon, and each pesticide used when earlier ones lost their potency. The process continues today, with increasing resistance to pyrethroids, the most common currently used pesticide. Using less pesticide means less exposure to humans and other non-target organisms, and can also help preserve their effectiveness for when they must be used.

The IPM Pyramid



IPM is a process that balances the use of design, physical, biological and chemical controls to manage pests. Just like the food pyramid, the primary tools are lower on the pyramid; those higher up are used sparingly. In the IPM pyramid, lower risk interventions are lower down, and higher risks rise towards the top.

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The base of the pyramid is building design, sanitation, and communication: building the pests out, and monitoring for their presence. Mechanical controls—traps, such as light traps, mechanical traps, pheromone lures, etc. are preferred control methods. In some cases biological controls may be useful: cats are often used to control mice. However, modern American house cats are too well fed, in most cases, to be effective at rodent control, and will be simply unable to eliminate an extensive infestation; they are better as a deterrent to a “pioneer” seeking new territory.

Finally pesticides are at the top of the pyramid, which may have two layers: “biorational” pesticides, and “conventional.” “Biorational” pesticides minimize exposure and may have reduced toxicity (such as cockroach bait “pucks” and gels, or IGR’s). Conventional pesticides largely rely on contact with the pest to poison it, and include aerosols, foggers and conventional sprays. They have the highest risk of exposure, and usually higher toxicity.

The best practice is to make decisions that utilize choices low on the pyramid.

IPM vs. Conventional Pest Control

Activities	Conventional	IPM
Program Strategy	Reactive pest control	Preventive pest control
Resident Education	Minimal	Extensive
Spraying & Fogging	Extensive	Rare
Rodent/bird control	Poisons	Exclusion/ Trapping

This table helps draw out the differences between IPM and conventional pest control. Spraying and fogging are discouraged because of the lack of control and potential for greater exposures.

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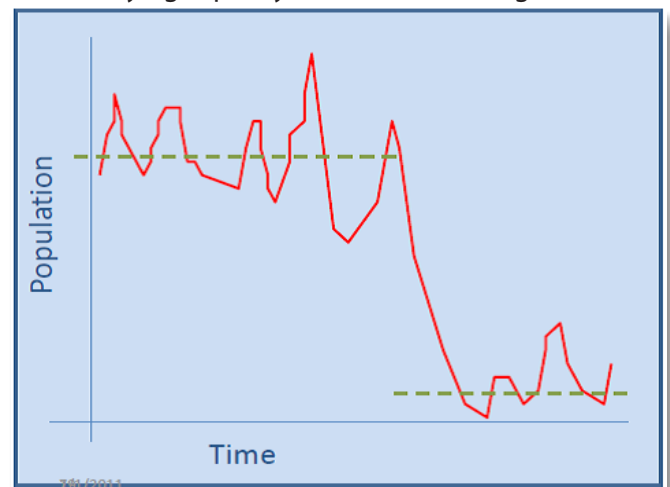
HUD Guidance on IPM (2011)⁵

Here is a summary of the important guidance elements that the U.S. Department of Housing & Urban Development has put out on IPM:

- a) Communicate policies and procedures
- b) Identify environmental conditions conducive to pests
- c) Identify and report pests
- d) Establish ongoing monitoring, reporting and tracking systems
- e) Determine action levels
- f) Improve waste management
- g) Select appropriate pesticides; beware of MCS and other sensitivities
- h) Ongoing exclusion and denial
- i) Educational outreach; use resident educators
- j) Understand state laws on used furnishings
- k) Use least-risk pesticides, when necessary
- l) Post pesticide-use notification signs

Change the Habit

Think of a building as having a carrying capacity for a given species. Carrying capacity is defined as enough food, shelter and water at the right temperatures to sustain some maximum number. If colonized for long enough, the population will hover around the carrying capacity. If pesticides or trapping alone are used to decrease the population, the numbers will spring back to carrying capacity when the trapping or pesticide use stops. If, however, the entry points to the building, nest sites, food and water locations are sealed, the carrying capacity has been lowered. Removing pest food or storing human food (and food waste) in pest proof containers further lowers the carrying capacity. In a pest proofed building, pesticide use can be drastically reduced.





IPM: Step-by Step

1. Inspection and Identification
2. Exclusion and Denial
3. Education and Action
4. Sanitation
5. Physical control
6. Monitoring

1. Inspection and Identification

- Thorough inspection
 - Exterior
 - Interior
 - Focus Areas
- Identification of pests found
 - Experienced field personnel
 - Field guides
 - Urban entomologist



Applying IPM starts with a thorough inspection; beginning with the exterior of buildings, looking for ways that pests can enter, such as under doors, through unscreened open windows, through pipe penetrations—in fact, through any penetration of walls, especially any hole $\frac{1}{4}$ " in diameter or wider—the minimum size for a mouse to squeeze through.

Interior inspection is looking for the same points of entry, plus harborages (cracks and crevices behind cabinets and baseboards, inside appliances, etc.), food sources (crumbs, litter, garbage, pet food or feces), and water sources (leak, drips – under the kitchen sink, for instance).

Focus areas are areas of concentrated pest activities. In apartments this may be stoves, refrigerators, or trash cans. In multi-unit buildings some units may be the source of infestations in other units. Trash chutes, compactor rooms, or foodservice facilities are other common focus areas.

As noted, correct identification of pests is essential. Cooperative Extension services in each state will identify insects for free; many universities or pest control companies have a Board Certified Entomologist (BCE).



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See the Creature, Be the Creature: What to look for and where to look

- The creature
- Creature droppings
- Nests and burrows
- Good food – under sinks, kitchens, trash bins
- Source of water
- Hidden places – inside walls, under/behind cabinets, basements/crawlspace/attics, waste bins, under baseboards
- Near entry holes (from exterior inspection)
- Warm cavities for insects (inside TV's, computers, smoke alarms)

Look for signs that a building is colonized by pest species during an assessment. All of them are looking for food, shelter, water and a date. Most of them are prey species, so they are uncomfortable when out in the open. The more you are able to think like the creature, the more you are able to identify signs that they are present.

“See the creature, be the creature”

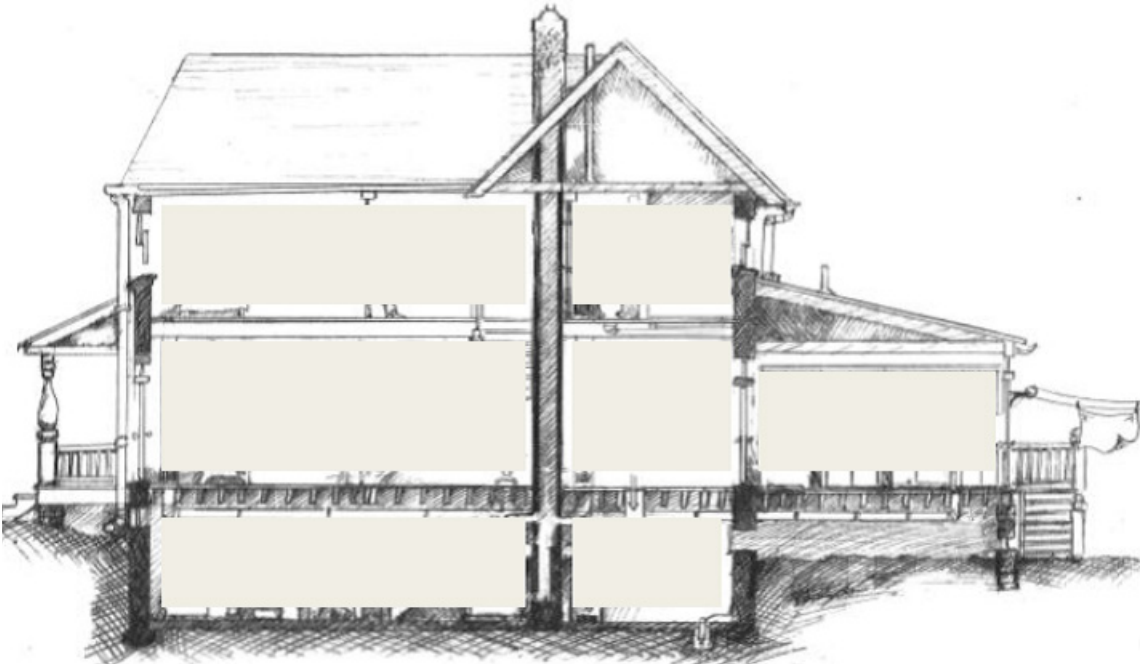
A person's View



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A Cockroach's View



A Cockroach's View



A Rat's View



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In this picture, rat proofing did not work. You need to get down on the ground and peer under the pipe to see the rat burrow entrance. Look for evidence of burrows or nests. Notice an ineffective effort to block the original entry point. Burrowing rodents may tunnel downward for several feet.

Look for mouse droppings in the hidden places where they may go. Mouse droppings are allergens. Mice are creatures of habit. You can move furniture and disrupt their patterns to see more of them. Move and bait.



Power cord on desk

Mouse droppings



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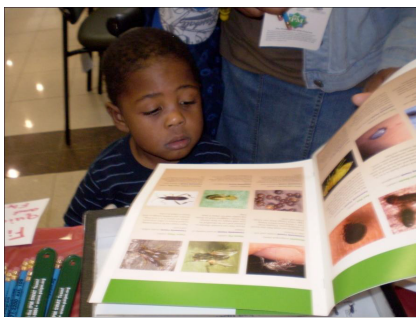


2. Exclusion and Denial

Exclusion is addressing penetrations and harborages found during inspection. Door sweeps are an easy fix – without them, mice will squeeze right under doors. They do need periodic replacement. All cracks and crevices should be sealed with silicone caulk (more durable than acrylic or latex, and also water-proof, heat-resistant, and gnaw-resistant). Any crevice more than ¼” wide will need to be packed with copper or stainless steel (rust resistant) mesh before sealing with caulk, spackle, patching concrete, sheet metal, or other material. This helps prevent rodents from gnawing through the patch. Expanding spray foam (“Stuff-It” or other brands) can help fill larger holes, such as in basement walls or behind kitchen cabinets.

For information on designing buildings that are more resistant to common pests, see Pest Prevention by Design Guidelines produced by the San Francisco Department of the Environment in November 2012. (www.sfenvironment.org/sites/default/files/fliers/files/final_ppbd_guidelines_12-5-12.pdf)

We can build them out, but it’s what people do that determines whether pest control is successful. Every person is part of the IPM Team. IPM is a team approach, and requires communication and education – of residents, facilities staff, and possibly of PCO’s as well. Residents—especially children—can often pinpoint pest runways and nest sites. Everyone should understand what the pests are, how they are being controlled, and why. Uninformed residents may, for instance disturb or even throw out glue boards, strap traps, and other control measures. They may use inappropriate chemicals that interfere with control—for instance spray pesticides act as repellents, and will keep cockroaches from feeding on baits, such as Combat. This can be a major cause in the failure of baits and gels to eliminate cockroaches.



Residents and building staff should understand why IPM methods are being used, and that the safety of their family, pets and home are primary decision factors. They should also understand that the more familiar methods have higher risks, and may interfere with IPM controls. Foggers are a good example of a very high risk product (they both coat the inside of the home with pesticides, and are explosive) that can send people to the hospital, as well as make other controls ineffective.

4. Sanitation

Most pests rely on our sloppiness to live. How much food does a cockroach need? A mouse? A drop of grease will feed 20 roaches. A mouse eats only 1/10th of an ounce a day. Potato chip crumbs in front of the TV? Yum.

They eat our crumbs, our pet’s food, our garbage. Most require water – dishes left in the sink overnight is their paradise – lots of food and water. Pet food and water left down overnight (when our cats and dogs are mostly sleeping anyway) is a constant source of high quality food. Even feces in uncleaned cat boxes can be food for pests.

Education and Action

- Understand pests
- What needs to be controlled, how, when
- Safe control –vs. unsafe practices
- Educating residents
- Choosing PCO’s
- Training PCO’s

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Counters and floors must be clean and grease free; grease is a preferred, and superior, food source for cockroaches, mice and rats. Trash cans are another huge food source for pests. In many cases, residents may not have covered kitchen trash cans or even have trash cans at all. Outdoor garbage cans should have tight fitting lids, and ideally should be metal—rats and squirrels easily gnaw through plastic. These are essential items, and providing them to residents who lack proper trash and garbage cans should be a basic element of IPM programs.

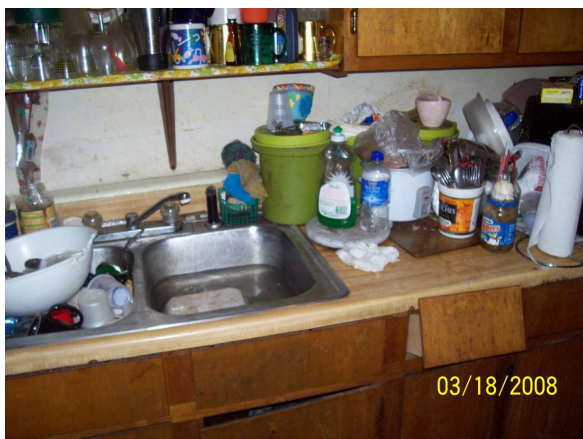


Photo: City of Houston Bureau of Children's and Environmental Health



Photo: City of Houston Bureau of Children's and Environmental Health

Again, most pests must have a source of water. Leaving a meat-tray in the sink is not good hygiene. Leaks from plumbing and condensation are major sources of water for pests. Many sinks drip from the drainpipe under the sink—the result of simple condensation. Warm air in the cabinet holds moisture which condenses on the cold pipe, just as water droplets form on a cold drink in summer. These drips can rot the plywood bottom of the cabinet, providing harborage as the plywood buckles, and food—the rotting cellulose and glue of the plywood. This can be fixed simply: cut a piece of pipe insulation (usually black foam, usually used to maintain hot water temperature in pipes) to fit.

Mosquitoes are, of course, dependent on standing water outdoors—eliminate sources, or, if that's not possible, use mosquito "dunks" which are "pucks" or briquettes impregnated with *Bacillus thuringiensis israelensis* (Bti)—a bacteria that parasitizes mosquito and fly larvae exclusively. Nontoxic to fish, or anything except insects, Bti is a very effective and low-risk control.

Water damage is the biggest threat to the integrity of any structure; leaks must be eliminated and damage repaired. Water damage can attract pests, both for water and shelter. Check roof gutters, ground slope (grade), and other possible sources of moisture.

Water

- Essential for insects & rats
 - Not for mice or bed bugs
- Mosquitoes
 - Standing water
- Structural damage
 - Gutter and roofs
 - Leaks from outside
 - Plumbing and interior leaks
- Sink trap; plumbing entry

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5. Physical Control

After basic prevention – that is removal of conditions conducive to pests: food, water and shelter, control efforts begin.



The methods used will be specific to the pest. Traps, ranging from glue traps for roaches to snap or “curiosity” traps for mice, are a vital tool.

Cockroach control was transformed in the early 1990’s by the availability of baits and gels, which can be 100% effective in two weeks or so, as opposed to conventional spray pesticides which only affect cockroaches in the open—no more than 20% of any given population. Baits and gels

are carried back into walls where cockroaches live, and poison all of the roaches through a domino-effect: roaches eat each other’s feces, and dead roaches, spreading the poison. When eggs hatch, the babies (nymphs) feed on the dead adults and the colony crashes, usually within two weeks.

Inert dusts are dusts that do not contain an active pesticide, including boric acid and diatomaceous earth (DE) and are also effective control for most bugs. They work by drying out (“desiccating”) the insect; DE also scratches the cuticle (skin) of the insects, accelerating desiccation. Dusts are very fine, and although inert dusts have low toxicity to mammals, they can cause respiratory problems, especially for people with asthma or other respiratory problems. Dusts should never be used in exposed piles, lines, cups, or on mattresses; they should instead be puffed into enclosed voids (behind cabinets, into walls, etc), where they will contact the bugs, not us.

Insect Growth Regulators (IGRs) interfere with an insects’ ability to shed its skin, which is necessary for it to grow. They therefore cannot mature or reproduce and colony collapse occurs. The immature and affected bugs continue to grow inside their too-small skin, and are crushed by their own growth.

To reduce exposure, choose safer products such as:

- Enclosed, tamper-proof roach baits
- Gels applied in small dabs in cracks
- Some dusts (boric acid)

Remember that baits are attractive when there are no competing food sources.

Watch out for illegal and dangerous pesticides:

- Pesticides that look like candy or mothballs
- “Miraculous” Chinese insecticide chalk
- “Tres Pasitos”

Physical Control

- Identify and assess problem
- Same strategy
 - Food, water, horborage
- Different tactics—pest specific
 - Traps
 - Baits for insects (not rodents)
 - Dusts
 - Biorational chemicals: IGR’s

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When conducting your assessment, you should also look for illegal pesticides in the home. Illegal pesticides are often much more toxic than registered pesticides (those that EPA has approved).

To the right is a picture of illegal naphthalene moth repellent products. Mothballs pose a hazard to young children. Mothballs can be easily mistaken for candy, or simply tempt young children to touch and play with them. Recent studies have linked naphthalene to illnesses, including nasal cancer. Widespread sale and distribution of these products make illegal mothballs a particular concern.



To the left is a picture of an illegal insecticide chalk known as “Miraculous Chalk” or “Chinese Chalk.” You may have seen the chalk in a neighborhood store or sold on the street for about \$1



a box. It is mostly imported illegally from China and often bears a label in both English and Chinese. Sometimes the manufacturer claims that the chalk is “harmless to human beings and animals” and “safe to use.” These claims are untrue and dangerous. Similarly, “Tres Pasitos” is imported illegally from Mexico and other Latin American countries. Its name means “three little steps” in English, because after eating it, this is all mice can

muster before dying. The active ingredient (or the chemical that actually kills the pest) in “Tres Pasitos” is a chemical called aldicarb. EPA considers aldicarb to be a very toxic chemical - and one that should never be used in your home. Children are especially vulnerable to poisoning by aldicarb when it is sprinkled around the home to control roaches, mice and rats. Exposure to high amounts of aldicarb can cause weakness, blurred vision, headache, nausea, tearing, sweating, and tremors in people. Very high doses can kill people, because it can paralyze the respiratory system. What “Tres Pasitos” does to pests, it can also do to you.

Federal Pesticide Law

The most important pesticide law is the Federal Insecticide, Fungicide, and Rodenticide Act (FIFRA) administered by Environmental Protection Agency. Keep in mind that the term pesticide includes anything that kills or repels:

- Insects
- Fungus
- Plants
- Mold
- Rodents
- Microbes

Also keep in mind that no pesticides are safe—some are low-risk but cannot be defined as safe. The label on a pesticide is the law regarding that pesticide.

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Pesticide Registration

Here is a summary of important points related to pesticide registration:

- Manufacturer must apply for each formulation
- EPA approval required before sale or distribution
- EPA ensures that if label is followed, there is reasonable certainty of no harm to human health and the product does not pose unreasonable risks to the environment
- “Restricted Use” pesticides are most hazardous
- EPA registration number is key
- Unregistered pesticides have unknown “active ingredients” (AI) and are not safe to use

See <http://www.epa.gov/pesticides/about/aboutus.htm> for more information.

Are these labels?



No, they provide information about the product but they are not the labels that EPA reviews and approves. Labels should have a signal word such as Caution, Warning, Danger, Poison (usually with skull and crossbones).



This is a label:



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And this is a label:



EPA approves the language and layout for the label on every pesticide. Copies of all labels are available on-line at www.epa.gov/pesticides/pestlabels/. For labeling requirements, see www.epa.gov/oppfead1/labeling/lrm/.

EPA requires that the front panel include the information identified above. Back panel typically includes:

- EPA Registration Number - identifies the manufacturer/formulator and the product.
- Company Name and Address
- Precautionary Statements
- Hazards to Humans and Domestic Animals
- First Aid
- Environmental Hazards
- Physical or Chemical Hazards
- Directions for Use
- Storage and Disposal
- Warranty Statement (voluntary)
- Worker Protection Labeling

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Monitoring

Monitors are glue traps that are used to check for pests, to identify pests, and to identify the extent of an infestation. The second photo down to the right shows an example: German cockroaches, in a large breeding population, with a nest near to where the bottom edge of the monitor (or trap) was placed.

Insect monitors come in many styles; most fold up into a covered shape to protect the sticky trap from dust. Monitors should always be dated, and have the trap location marked. They should be placed against walls, in corners, behind & under cabinets, appliances, etc. They should be used at a rate of 3-6 per kitchen, and at least one in each other room, including bedrooms. Check all monitors within 48 hours during initial clean-out operations; replace as needed. When the population is controlled, monitors should be checked monthly to be sure re-infestations are not happening. If new pests are observed on the monitors, control actions should begin again. Do not apply controls unless the monitors show the need.



Monitoring for Rodents

This is a similar process to insect monitoring. You can use snap traps or glue-boards. Remember though, glue-boards do not kill; mice may vocalize or escape. Traps should be placed in corners, along runways, and in tight dark spaces.

Traps should be checked daily and increased if monitors indicate activity.



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Applicator Licensing

Make sure that you understand requirements for applicator licensing in your state. Many states require pesticide applicators to be licensed if they are:

- Applying pesticide onto another person's property
- Charging a fee
- Using Restricted Use Pesticides (certain high-risk pesticides not available except to licensed professionals)
- Applying onto Public places, including schools, child care facilities, playgrounds and parks, etc.
 - For example, a brochure outlining Pennsylvania's regulations is at:
<http://extension.psu.edu/pests/pesticide-education/applicators/certification/pennsylvania-pesticide-applicator-certification-brochure>

Licensing

The licensing process is regulated by each state, and varies. For specific information on each state see: <http://npic.orst.edu/mlr.html>. Written testing is always required. There are usually at least two sets of written testing—*General* (basic safety and use information everyone must know) and *Category* (information on specific types of service, e.g. termite, household pests, schools, etc.). Actual tests vary by state. Usually states have some reciprocity with adjacent states, but a license **MUST** be had for each state in which an applicator works (i.e., a NJ applicator cannot go to NY without an NY license).

Insurance

Insurance is required! Costs of cleanup, damage and penalties for misapplication can be substantial.

- A 2014 example from NJ: "TRENTON—The Department of Environmental Protection (DEP) has fined Zapp Termite and Pest Control, a Neptune City pesticide business, and its owner, Vincent K. Taylor, \$495,000 for misapplying pesticides at numerous locations in Monmouth and Middlesex counties, including Red Bank Housing Authority properties and various restaurants. The DEP has also revoked the firm's pesticide applicator business license and Taylor's commercial pesticide applicator license." http://www.nj.gov/dep/newsrel/2014/14_0008.htm

Hypersensitivity Registry

A Hypersensitivity Registry is a periodically updated list that identifies people medically sensitive to pesticides. People listed on this registry **MUST** be contacted before any application of pesticides near their registered locations.

- At least two states, Pennsylvania and Louisiana, maintain Pesticide Hypersensitivity Registries

Unlicensed People

Supervision of unlicensed people by licensed applicators is usually allowed:

- Direct—most people may apply pesticides if they are under direct supervision, and within direct sight of a licensed applicator ("Pest Management Professional").
- Indirect—Registered technicians, trained by a licensed applicator, may apply treatment, if they are supervised by the licensed applicator who can be on site with-in a short period of time.

See <http://www.epa.gov/pesticides/enforcement/enforcement.htm> for more information.

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Know Your Pests

Here is some basic information to help you identify pests correctly.

It is important that you are able to identify the four common species of cockroaches, and that you understand their basic life cycle.

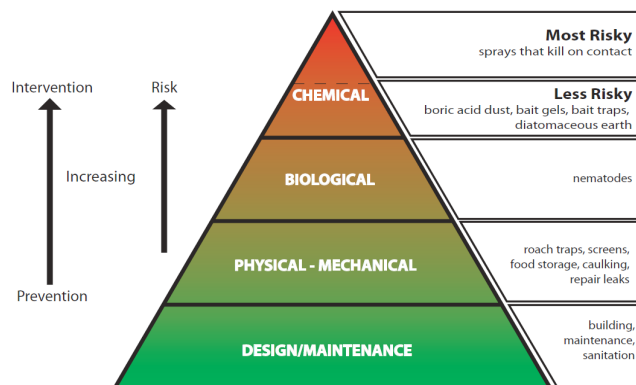
The first roach from the left is an American cockroach. About 1-1/2" long, this roach has wings and files. Often called a "waterbug," or in the South a "palmetto bug", they usually live in sewers and drains, and appear in basements, kitchens and other places where there are drains and it is warm and damp.

The black roach is an Oriental cockroach—also often (and confusingly) called a "waterbug." They live primarily in the ground, and prefer cool and damp places. They surface mostly in crawl spaces and basements, and sometimes in potted plants, especially those brought indoors for winter.

On the far right is the Brown-banded cockroach. They prefer high and dry habitats, often found in common areas, offices, and other areas where carbohydrates are available (usually merely crumbs, or sugar syrup—from sodas, for instance).

The German cockroach (third from left, top picture, and family portrait in the bottom picture) is the basic kitchen cockroach: brown, 3/4" long, with "racing stripes" down its back. On the left in the lifecycle picture, is the adult male. The larger female to his right carries her egg case almost until it hatches (it's protruding from her abdomen), at which point she drops it (see the brown, curved object below). Within 48 hours it hatches: up to 40 babies (nymphs) emerge. The nymphs go through five molts in a month or so, depending on food, warmth and other conditions, to reach adulthood. Adults have wings (but do not fly); nymphs do not have wings. German roaches are the most prolific roach, and eat almost anything, although grease is their favorite food.

Handling Roaches – The IPM Way



Pyramid of IPM Tactics for Roaches



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The basis of effective cockroach control is at the base of the pyramid: making the structure roach-proof, and ensuring sanitation to deny the roaches food. The second stage is eliminating sources of moisture, and keeping up with new repairs, proper food storage, and other standard procedures; “deferred maintenance” should not be practiced.

There are no good biological controls for cockroaches indoors—except in the semi-tropics, where lizards are fond of them. While the pyramid lists nematodes, introducing microscopic parasitic worms into buildings has not been popular in practice.

Biorational controls for cockroaches include the use of inert dusts in enclosed spaces (usually within walls where the insects nest), baits, gels, and insect growth regulators. The conventional kill—on contact sprays, aerosols and foggers in the tip of the pyramid are seldom used in IPM, except for “emergency” applications. An aerosol might be appropriate to eliminate a stinging insect nest over a school door. A liquid spray crevasse application might be used in a boiler room to eliminate a population before the crevasse is sealed. All pesticide applications must be done only by licensed pest control applicators.

Frass

Frass along the top of a door, under a shelf, and on a wall behind where a clock was hung. You have to know where to look to find signs.



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Cockroach Control

Cockroach control involves removing their food, their water, and their hiding places, as already discussed. In addition to the dusts, glue boards, baits, gels and IGR's already mentioned, vacuum cleaners are an excellent tool for removing large infestations immediately.

A HEPA (High Efficiency Particulate Air filter) vacuum must be used to prevent the potent cockroach allergen from being blown out of the vacuum and widely dispersed into the living space. A vacuum can suck up thousands of roaches; but be sure to remove, double bag, and dispose of it immediately to prevent infestation of the vacuum.



Rodent Control

Like us, rodents are mammals; they need the same conditions we do and will eat anything that we do. Rats need water; mice get their water from their food, and don't need, but will drink, free water. Rats and mice have another difference – apart from their size – mice are curious, while rats are extremely cautious.

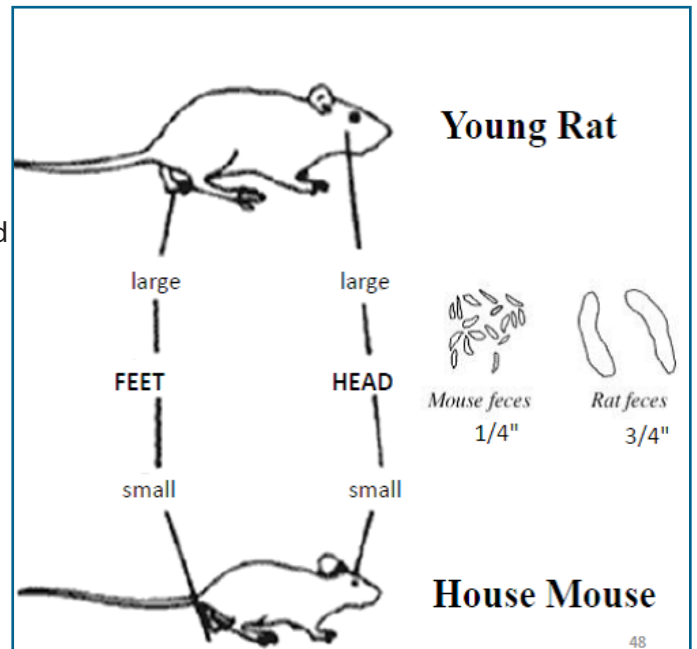
Squirrels are difficult to remove from buildings. However they are rodents, and are attracted to rodent baits: if rodenticides are not properly secured, squirrels are a frequent non-target kill. This can be a public relations problem, particularly in parks or other public areas.



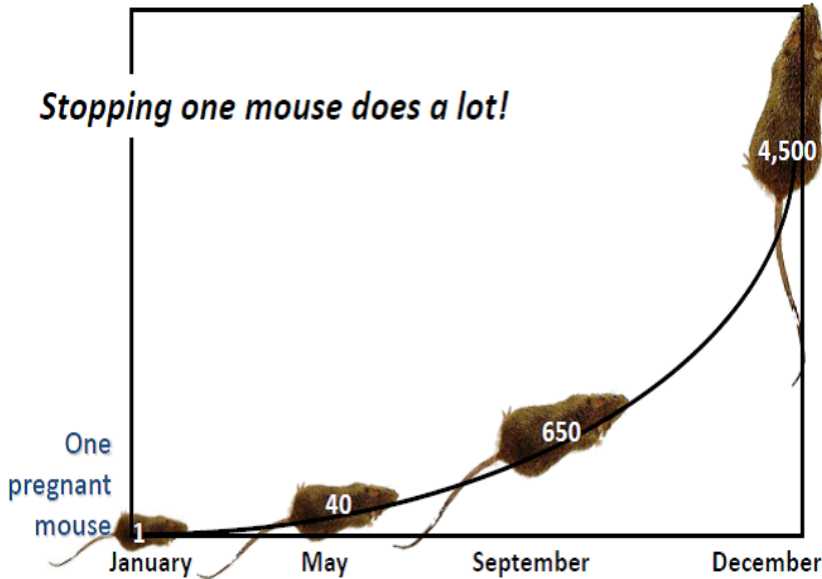
Rodent Identification

The droppings (feces) of mice differ from those of rats. Knowing the difference can help determine if the pest in question is a mouse or rat; control of each will differ.

Droppings can help you find nests or burrows because they are left in areas of high activity. Rodents communicate by smelling chemicals in droppings. Adults can be distinguished by size, but it can be difficult to tell an adult mouse from a baby rat. The feet and head of mice seem in proportion to their bodies and their tails are thin and long, while the rats have hind feet and heads that seem larger than they should be and thick tails that are shorter than their bodies. Mice are not small rats and mice do not become rats when they go outdoors.



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Rodent Reproduction, One mouse, one year...

Mice mate at 1 month of age; gestation is 19 days; there are 4 - 7 young per litter; 8 litters per year = 30 - 35 young weaned per female per year.

This is the same as cockroaches. This graph assumes 6 litters of 6 young per year with 50% females in each litter. Gestation takes 1 month. Reproductive maturity is reached at 1 month.

Signs of Rodents



Top left shows rat droppings in a wall cavity. This causes an odor for years. Top right illustrates rat burrows in a clay wall in a basement. The bottom left picture is a stained ceiling tile below a mouse nest. Bottom right is an open, unsecured poison bait for rodents (note mouse droppings nearby). This picture illustrates that there is evidence that there is a pest problem.

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Remember that mice explore new things, and are readily trapped, while rats avoid new things in their environment—traps, for instance. Any bait may be used, and in fact, various baits should be tried. While peanut butter is the “standard”, almost anything attractive, including bits of bacon, hot dog or cookie, or nesting material, such as cotton balls, can be tied to the trap and can be effective



Rat traps must be pre-baited, that is baited, but not set, allowing the rat to feed freely. It may take several days before he is comfortable with this new addition to his environment. Once fed from, rebait the trap and allow the rat to feed again, at least once. Then rebait and set the trap.



Rodenticides should never be used inside a residential space; the National Pest Management Association concurs with this recommendation. The risk of poisoning, especially of children, is high: 63% of all children’s pesticide poisoning reported to the Poison Control Centers are by rodenticides. Rodents who die in the walls also smell for 6–8 weeks. Since January 2009 the use of loose rodent bait in residences has been illegal: rodenticides must be in an enclosed tamper-resistant bait station.

Loose, pesticide-treated seed based baits are effective in treating outdoor rat burrows. The bait should be introduced into the burrow so that it appears natural (use a long funnel or piece of garden hose); do not attempt to collapse burrows until no rat activity is evident for a week.

Things That DON'T Work on Pests

- Contact sprays
- Foggers
- Mothballs
- Ultrasonic devices
- Dryer sheets

Conventional sprays and aerosols must contact insects to kill them. They do not penetrate into the walls where cockroaches live and where about 80% of the population are hiding. The sprays are also ineffective against the eggs. Therefore, the population recovers quickly.

Foggers have the same limitations, and do not penetrate deeply into wall structures, in spite of some marketing claims. They also distribute their toxic contents over all of the surfaces in the home. While most users know to wash their dishes and pots and pans, they do not think about other surfaces. For example, couches become covered with pesticide, and when people sit on the couch they can absorb it into their skin. Think about all the surfaces that you touch in your house: light switches, door knobs, cabinet doors...and what about the floor, where the “fog” eventually settles. Are pets and children exposed because of this?



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Ultrasonic devices have no effect on insects. While they do affect rodents in a laboratory, they are not effective in most residences. The signals are too directional, do not provide wide area coverage, and mice quickly become used to them.

Finally, dryer sheets and other similar remedies are not proven, and may in fact result in exposure to chemicals with unknown health effects. These products are not intended for pest control, and may be neither safe nor effective.

Things That May Work, but...

- Essential oils and cleaners
- Carbon dioxide traps
- Kerosene
- Homemade traps and gadgets

Essential oils are also not studied for effectiveness or safety. They are indeed potent and may kill insects on contact, but they may have unexpected effects, including triggering allergic or asthma reactions in sensitive people. Many essential oils contain solvents, and may contain other unknown ingredients. While they may be safe in contained uses, the health effects of exposure to essential oils used for pest control are unknown. Anecdotal reports have included damage to property and finishes, as well as triggering choking and wheezing.

Carbon dioxide traps can be effective monitors for bed bugs – but only in unoccupied rooms. Bed bugs are able to distinguish between a live person and a trap, and avoid the traps. They can, however, be very useful for determining that no bed bugs are present in unoccupied space, such as vacant apartments. The trap shown to the right did catch bedbugs, but there are commercial traps available as well.



Kerosene will indeed kill bed bugs, and many other insects and animals. It is both a solvent (that can dissolve the insects' cuticle) and a poison hazardous to most animals, including mammals. It is also highly flammable and is a known carcinogen. Kerosene should never be used indoors.

Bed Bugs–Don't Panic!!



Bed bugs are on the rise, but can be controlled. You can avoid getting them. Not every red mark is a bite, and not every bite is from a bed bug. They are not invisible – you can see them. They do not carry or spread disease, but they are a nuisance, and can seriously affect mental health.

Although control can be challenging, as we'll see, simple heat will kill bed bugs and their eggs.

From an agency perspective, protocols, cooperation and coordination are the most important factors to prevent movement of bed bugs in multi-family housing, and between residents in shelters, foster care, homes and group living.

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Bed Bug Basics

- Identify properly – don't assume!
 - Bat bugs and swallow bugs look similar
 - Cockroaches, ticks and lice can be mistaken for bedbugs as well
- Life cycle
 - Must feed to move from nymph to adult
 - Poppy to apple-seed size
 - 6-12 eggs laid @ 2-3 days
 - Eggs are resistant to pesticides

While bed bugs are spreading rapidly, they are NOT everywhere and even in beds not every bug will be a bed bug. Careful identification is important to be sure that you are actually treating the correct pest, and to make sure that it won't come back. Closely related species that infest bats and birds may bite humans, and will require treatment of the primary host – bats or birds.



Photo credit: Changlu Wang & John Obermeyer/Rutgers University

Bed bugs lay 6-12 eggs at a time, every two to three days, gluing them into cracks and holes. About ten days later each group hatches, meaning that new sub-colonies are constantly appearing in different places and new eggs are being laid constantly. This makes control difficult, especially since the eggs are resistant to the chemical pesticides. Even direct contact with most pesticides will not kill the eggs. Heat, on the other hand, kills all stages of bed bugs, including eggs.

How and Why Bed bugs Spread

Bed bugs are mostly hitchhikers; climbing onto clothing and into backpacks and luggage to find new homes. One of the reasons bed bugs spread is because of how they reproduce. Unique in the animal world, the male bed bug engages in "traumatic insemination" and pierces the female's abdomen randomly to inseminate her. This is painful and multiple matings can kill a female – so they leave and hide, going off to start a new colony away from the existing males; someplace accessible down the wiring or plumbing is a ready destination. A single insemination provides all of the sperm she needs for the 200-500 eggs she lays over her life.

Because wild bed bugs have demonstrated resistance to most of the over-the-counter (OTC) pesticides available to residents, these chemicals act as repellents, causing bed bugs to disperse. If foggers are used, they primarily drive the bugs into neighboring units. Residents should not use aerosols or foggers.

Since travel is the main way bed bugs spread, anyone can pick up a bug, at anytime, anywhere. Pest control professionals and others working with residents should be aware, and prevent transfer and infestation.



Essentials for Healthy Homes Practitioners



Protect Yourself When Visiting Clients' Homes

- Only take necessary items into the home. Do not set anything on the floor or on furniture.
- Sit on folding, kitchen, or other hard (un-upholstered) chairs.
- Avoid sitting on couches, beds, stuffed chairs
- If possible, bring your own folding stool
- Wear light colored clothing, shoes and socks that can be thrown in the dryer
- Take along an extra set of clothes and plastic bags so you can change if you suspect infestation

When you visit homes, take in only what you need: clipboard, tool bag, etc. Leave everything else behind. Never sit, or put your belongings on, upholstered furniture: choose hard kitchen chairs; ask if you can meet around the kitchen table rather than on the couch. Some agencies are supplying visiting staff with folding stools. Wear clothing that can be thrown into a dryer—when you get home put all clothes in a hot dryer for 30 min. This will kill bed bugs and their eggs. You may wish to keep a spare set of clothes sealed in your car.

Bedbugs – Outline of Control

- Exclusion
 - Clutter elimination, use bins
- Preparation
 - Wash bedding
 - Seal mattress using encasements
 - **Do not** put pesticide on mattresses
- Use traps that act as interceptors
 - Make the bed an island
 - Monitor
 - Prevention

Getting rid of the bugs means getting rid of the places they hide; this is where clutter is important. Sanitation is not an issue with bed bugs, per se, because they only feed on us, not our garbage. Clutter provides harborage and de-cluttering is a necessary first step.

Pest control operators (PCOs) will provide instruction for unit preparation; some residents may require assistance. Residents should wash and dry bedding and other items on hot water settings, use dissolvable laundry bags, or dispose of “dirty” bags and use new bags or plastic bins to return clothes to home.

Mattresses should be encased, not discarded or pesticide treated. Discarded mattresses simply pass their bugs along to someone else when the mattress is picked up of the street. While very few pesticide labels may allow application to mattresses, this is not ever recommended, especially on children’s mattresses. The possible long term effect of sleeping on a pesticide-treated sponge has never been studied. Instead: use an encasement designed to stop bed bugs. Encasements are designed to prevent bedbugs from getting out of the mattress and prevent bed bugs from being able to live on the mattress. Use only



Essentials for Healthy Homes Practitioners

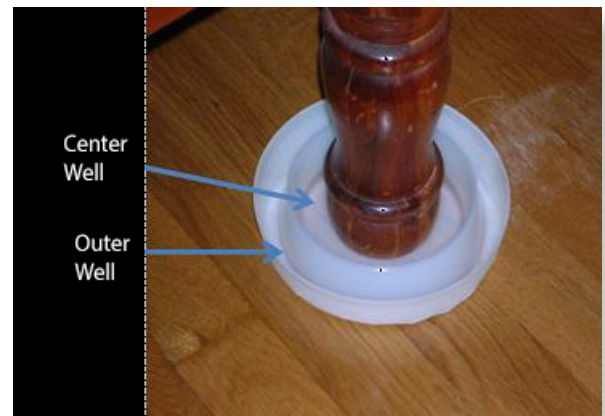


encasements rated for bedbugs. While bed bug encasements will also contain dust mites and their allergens, allergen-only encasements will not stop bed bugs.

Simple interceptor traps, placed under the legs, can isolate the bed and make it a “safe island” within a still active treatment zone. (Mattress encasement must be used, and the bed must not touch the walls or any other object; bedclothes must not touch the floor). Encasements and interceptors are also excellent prevention – they allow you to monitor for insects, and see and eliminate them before an infestation can be established.

Bed bug – Treatment Outline

- Inspection
 - Crack and crevice
 - Treatment
- Vacuum
- Heat or cold
- Pesticides by PCO only
 - Dusts
 - Crack and crevice treatment
- Re-inspection and retreatment
- Encasements and interceptors



Inspection is the key to bed bug treatment and control. Bedbugs hide and finding them is a challenge. They prefer cracks and crevices as thin as a credit card; their eggs are only 1 millimeter—1/28th of an inch long. Inspection means examining and disassembling, as necessary, the bed and associated systems, bedside furniture, baseboards and carpets, and possibly closets, clothes, etc. Remember that beds are not the only place people sleep—recliners, couches, wheel chairs, and all upholstered furniture will need checking. Inspection— and only inspection—guides treatment.

Vacuuming is very useful for removing lots of bugs quickly. Because the eggs are glued into remote and tiny locations, vacuuming is unlikely to remove all the eggs, and is not effective for total control, but it is very useful.

Heat–or–cold–treatments are the current “gold standard.” Temperatures below freezing (32 ° F) or over 120°F, for more than twenty minutes will kill bedbugs and their eggs. Remember to consider insulation, and how much time you may need – but anything you can put in a hot dryer for 30 minutes will be fine. Steamers are also effective, but need to be professional-grade, low pressure and low vapor; application rate is 4 feet a minute – or 1 foot every 15 seconds! Bed bug treatment takes time, and labor; that’s why it’s expensive.



Pesticides, if necessary should be applied only by a licensed pest management professional; aerosols and foggers should never be used. Most control requires at least two, usually three treatments two to three weeks apart: reinspection needs to be part of every treatment plan. Follow through on decluttering, laundering, and other PCO recommendations is essential. While reinfestation is possible at any time, encasements and interceptors are important prevention and monitoring tools and should be left in place.



Code Requirements Related to Pests

EXTERMINATION. The control and elimination of insects, rats or other pests

- by eliminating their harborage places;
- by removing or making inaccessible materials that serve as their food;
- by poison spraying, fumigating, trapping or by any other approved pest elimination methods.

INFESTATION. The presence, within or contiguous to, a structure or premises of insects, rats, vermin or other pests.

308.1 Infestation.

- All structures shall be kept free from insect and rodent infestation.
- All structures in which insects or rodents are found shall be promptly exterminated by approved processes that will not be injurious to human health.
- After extermination, proper precautions shall be taken to prevent reinfestation.

302.5 Rodent harborage.

- All structures and exterior property shall be kept free from rodent harborage and infestation.
- Where rodents are found, they shall be promptly exterminated by approved processes which will not be injurious to human health.
- After extermination, proper precautions shall be taken to eliminate rodent harborage and prevent reinfestation.

304.14 Insect screens.

- During the period from [DATE] to [DATE], every door, window and other outside opening required for ventilation of habitable rooms, food preparation areas, food service areas or any areas where products to be included or utilized in food for human consumption are processed, manufactured, packaged or stored, shall be supplied with approved tightly fitting screens of not less than 16 mesh per inch (16 mesh per 25 mm) and every swinging door shall have a self-closing device in good working condition.

308.2 Owner.

- The owner of any structure shall be responsible for extermination within the structure prior to renting or leasing the structure.

308.3 Single occupant.

- The occupant of a one-family dwelling or of a single-tenant nonresidential structure shall be responsible for extermination on the premises.

308.4 Multiple occupancy.

- The owner of a structure containing two or more dwelling units, a multiple occupancy, a rooming house or a nonresidential structure shall be responsible for extermination in the public or shared areas of the structure and exterior property. If infestation is caused by failure of an occupant to prevent such infestation in the area occupied, the occupant shall be responsible for extermination.

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308.5 Occupant.

- The occupant of any structure shall be responsible for the continued rodent and pest-free condition of the structure.
- Exception: Where the infestations are caused by defects in the structure, the owner shall be responsible for extermination.

Resources

- Cooperative Extension Services
- State Pesticide Regulator for Pest Control Applicators/Operators
 - Often at universities
- www.ehw.org
- www.healthyhomestrainin.org/ipm/

Go to www.csrees.usda.gov/Extension/ to find your local cooperative extension system office.

Key Messages

- Pests can create allergens and be vectors of disease.
- Control of pests through pesticides can lead to poisonings and other neurological problems.
- Some pesticides found in homes have been banned.
- Make houses less hospitable for pests. Prevent entry, control food, water, and places for shelter.
- Integrated Pest Management is the recommended strategy.

Learning Objectives

- Practitioners are able to restate three key IPM messages:
 - Reduce risk by reducing pesticide use, and choosing pesticides carefully.
 - Use multiple tools to get effective control
 - Clean up food, water and places to hide
- Practitioners understand how cockroaches and mice trigger asthma
- Practitioners can demonstrate how to exclude pests
- Practitioners can explain why not to use aerosols, foggers and rodenticides in homes.