

 THE UNIVERSITY OF ARIZONA  
 Agriculture, Life & Veterinary Sciences & Cooperative Extension

 THE UNIVERSITY OF ARIZONA  
 COLLEGE OF AGRICULTURE & LIFE SCIENCES  
 Entomology

## Urban Pests

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### Pests in community environments

Bats      Weeds      Cockroaches      Ticks  
                  Spiders      Wasps  
 Flies      Ants      Head lice      Snakes      Birds  
                  Bed bugs      Wild animals  
 Rodents      Bees      Mites  
 Scorpions      And many more.....

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### Why should we care about pest management?

Pests!!!

- Bite / sting
- Damage food by entering and feeding
- Contaminate food and surfaces
- A nuisance when they invade buildings
- Cause allergies, asthma and other reactions
- Vector disease microbes
- Cause structural damage
- Cause plant damage



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### The Incredible Urban Pests



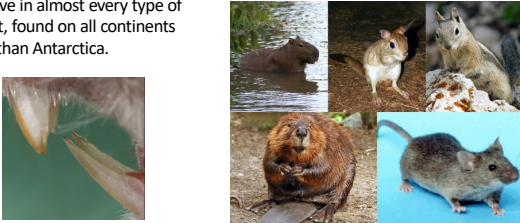
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## Rodents

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- The term rodent means "to gnaw". Characterized by two continuously-growing incisors (open roots) in the upper and lower jaws.
- 40% of mammal species are rodents.
- They live in almost every type of habitat, found on all continents other than Antarctica.



Credit: Maqne Flaten      Credit: Jonas Maravalhas, Wikipedia

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### Problems due to rodents

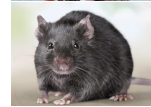
- Spread diseases directly by rodents
- Cause allergies, asthma and other reactions
- Damage food by entering and feeding
- Contaminate food and water with their droppings, saliva, and urine
- Host ectoparasites that vector pathogens
- Cause property/structural damage
- Rodent bite, physical injury and **rodenticide** related risks
  - Infants, elderly are defenseless
  - >20,000 bites reported annually



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### Commensal Rodents

- **Three species of commensal rodents of most concern**
  - ✓ House mouse, *Mus musculus*
  - ✓ Roof rat, *Rattus Rattus*
  - ✓ Norway rat, *Rattus norvegicus*
- Urban rats and mice are experts at exploiting our resources.



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### The House Mouse

- Number 1 rodent pest
- Origin-central Asia, transported on ships by merchants and immigrants
- Most numerous and widespread mammal on the planet



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- Light brownish to gray, colors can vary
- Adult: relatively small, 0.5-1 ounce (15-30 grams)
- An adult is 5-7 inches long (including tail)
- Slender body
- Large ears, small black eyes
- Almost hairless tail, as long as the head and body together



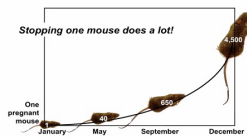
30 grams



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### Biology and Reproduction

- Breed year round when conditions are favorable
- Females produce 4-7 pups per litter, 5-10 litters a year
- A female will produce ~8 litters in her lifetime
- Outside mice are seasonal breeders
- Gestation period ~19 days
- Sexual maturity within 6 to 10 weeks
- Wild mice live 6 months - 1 year old



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### Behavior

- House mice are generally nocturnal.
- They often utilize corners.
- They do not hibernate.
- In cities mice can spend entire life within buildings.
- Suburban and rural areas:
  - ✓ Live within buildings and outdoors
  - ✓ Outdoors: feed on wild weeds, insects
  - ✓ Cold climates move indoors in the winter
  - ✓ Buildings: nest in walls, voids, furniture
- House mice generally make very short excursion from their nests (10-30 ft).
- They are not neophobic and are generally curious and very active explorers.
- They can travel at speeds of up to 12 ft per second.



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### Diet

- Omnivorous.
  - ✓ Prefer seeds and grain
  - ✓ Often consumes dog food in urban areas
- Non neophobic about new foods
- May prefer foods that are
  - ✓ Fat
  - ✓ Protein
  - ✓ Sugar
- Survive with very little water



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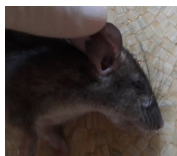
### The Roof Rat

- Black rat, ship rat, gray bellied rat, white bellied rat
- Origin - forests of Southeast Asia, adapted for efficient climbing vines, narrow ledges, and wires
- Arrived in the Americas around 1607



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- Light brownish to gray (highly variable!)
- Sleek and agile, up to 12 ounces.
- Large ears, large black eyes
- Snout is pointed
- Uniformly dark hairless tail covered with fine scales
- An adult is ~6-8 inches long
- Tail is 7-8 inches long, as long or longer than head and body together
- Adult: smaller and sleeker than the Norway rat



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### Behavior

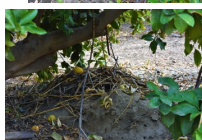
- Nocturnal
- Mostly forage at dawn and dusk
- Typically forage in family groups (10)
- Can commonly travel up to 300 ft
- Feed in areas that afford good protection
- Can carry food back to more secluded area or nest
- Tend to eat small amounts of food in several places



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### Nest and Resting

- Outside, they like to establish nests in dense shrubs, bushes and other types of lush vegetation, and utilize vegetation for movement
  - ✓ Accumulating dead fronds of unmanaged palm trees
  - ✓ Fence ledges behind thick overgrown vines and vegetation
  - ✓ Under cavities of garden sheds
  - ✓ Within thick brush
  - ✓ Behind or within yard trash piles
  - ✓ Wood piles
  - ✓ Lumber stacks

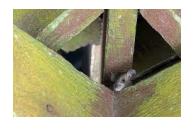


Credit: UCIPM

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### Nest and Resting

- In buildings
  - ✓ Attics
  - ✓ Soffits
  - ✓ Ceilings and wall voids
  - ✓ Corners of car port roof
  - ✓ Storage boxes and racks
  - ✓ Overhead electrical junction boxes
  - ✓ On or behind large structural beams
  - ✓ Silos
- In high rise buildings, roof rats can be from the basement to the penthouse!



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### Diet

- Natural foods
  - ✓ All types of seeds
  - ✓ Nuts, fruits, berries
  - ✓ Slugs and snails
  - ✓ Cockroaches
  - ✓ Fish and shellfish



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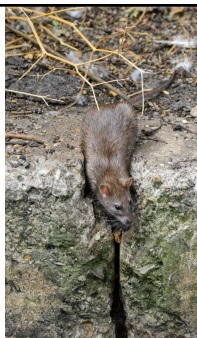
### The Norway Rat

- House rat, wharf rat, sewer rat, water rat, gray rat, brown rat
- Introduced to the US by European settlers & trading ships ~ 1775
- The most widely distributed rat species in the US
- Found in all 50 states



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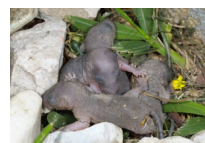
- Adult: stocky, large, 12-16 ounces, 8-10 inches long
- Fur: coarse, reddish to grayish brown with white belly, colors can vary
- Nose is blunt
- Small ears, small eyes
- Tail is scaly, 7-10 inches, shorter than the body and head combined. Dark above and pale below
- Peak foraging and feeding periods occur at dusk or prior to dawn
- May forage for food several times over the course of 24-h period



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### Biology and Reproduction

- Breed year round when indoors
- Outside, peak breeding in spring and fall of the year
- 4-7 litters a year
- Female produces 8-12 pups/litter
- Gestation period ~22 days
- Sexual maturity within 12 weeks, earlier if resources are abundant
- Wild rats live 6 months – 1 year old
- Many rats are killed by predators, other rats and disease



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### Home Range

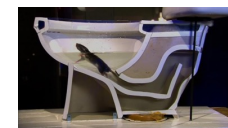
- Home range is between 25-100 ft, generally much less than roof rat but can be very variable
- Greatest when there are less resources
- When resources are plentiful, home range is closer to 25 ft
- This can differ with season, sex and population density
- Extremely territorial



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### Behavior

- Norway rats commonly hoard and can carry off and store food in other safer locations
- Often feed in one place when a good food source is present
- Excellent swimmers
- Social animals and live in ground-dwellings
  - ✓ Outdoors: in underground burrows
  - ✓ Farms: silos, barns granaries, livestock buildings
  - ✓ Buildings: food facilities, stores, sewers, etc.
  - ✓ By ponds, lakes, near steam in the wild



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- Burrowing is related to protection
- Norway rats often burrow underneath hardscape, like roads, pavement, footpaths, walls, permanent junk
- Active burrows have entrances with very smooth edges that have a well-worn appearance
- Inactive burrows can be covered in vegetation and have cobwebs covering them



Credit: N. Quinn

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## Diet

- Tolerate crowded environments & readiness to eat almost anything
- Peak feeding is adaptable based on the food source and over population, often observed at dusk and dawn
- 1 ounce (30 g) food per day. Prefer foods with high carbs and protein
- Need free clean water**, drink 15-30 ml/day

### Urban

- ✓ Garbage
- ✓ Bird seed from feeders
- ✓ Dog food
- ✓ Vegetable garden
- ✓ Compost
- ✓ Backyard livestock



Credit: N. Quinn

### Natural and semi-natural

- ✓ Insects
- ✓ Birds (nestlings and eggs)
- ✓ Carrion
- ✓ Nuts
- ✓ Berries
- ✓ Fruit
- ✓ Seeds
- ✓ Cereals and corns
- ✓ Aquatic animals



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## Integrated approach

### Integrated Pest Management (IPM)



## Rodent IPM

- Proper ID
- Inspection
- Monitoring
- Sanitation
- Habitat modification
- Exclusion
- Trapping
- Baiting

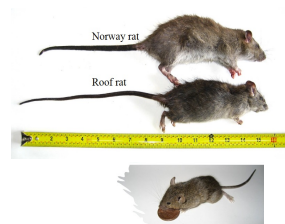
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## Rodent ID

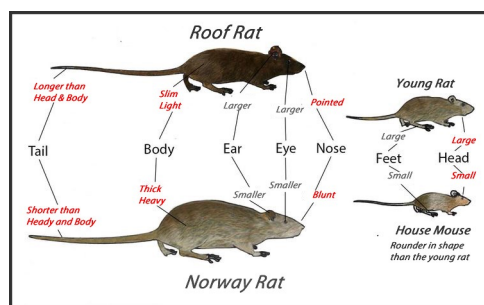
- Norway rat
- Roof rat
- House mouse



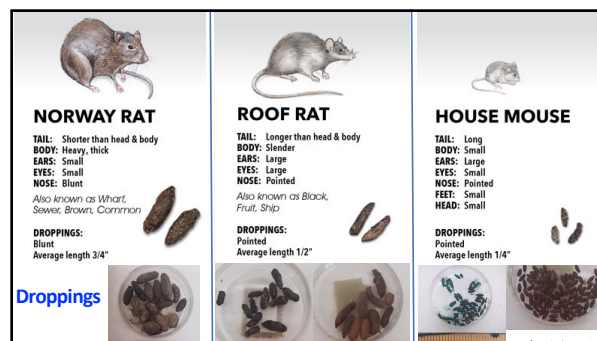
Deer mouse



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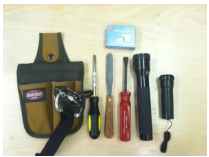

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### Inspection

- Effective rodent control begins with a thorough inspection
- Signs
  - ✓ Live or dead rodents
  - ✓ Droppings
  - ✓ Tracks and runs
  - ✓ Urine stains
  - ✓ Rub marks
  - ✓ Gnawing damage
  - ✓ Burrows

Who? Why? Where? How? What?

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### Live or dead rodents





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### Droppings

**Roof rat**

- 50 droppings/day
- 1/8-1/4 inch diameter
- 1/2-1 inch long
- Generally have at least one pointed end

**Norway rat**

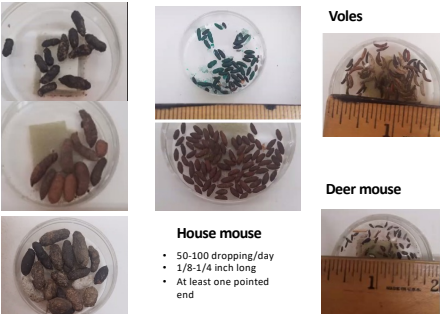
- 50 droppings/day
- 1/8-1/4 inch diameter
- 1/2-1 inch long
- Generally capsule shape
- Rounded ends

**House mouse**

- 50-100 droppings/day
- 1/8-1/4 inch long
- At least one pointed end

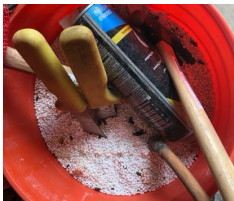



**Voiles**

**Deer mouse**



Credit: N. Quinn

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### Tracks

3/4 to 5/4 inch = rats    3/8 to 3/4 inch = mice

**Norway rat**

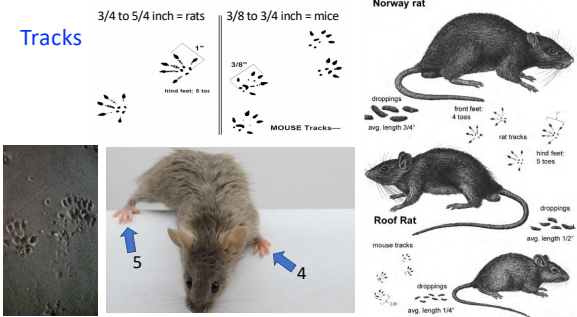
droppings: hind feet: 4 toes, avg. length 3/4"

**Roof Rat**

droppings: hind feet: 5 toes, avg. length 1/2"

**House Mouse**

droppings: hind feet: 5 toes, avg. length 1/4"



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### Urine stains





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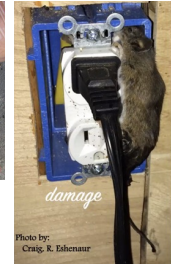
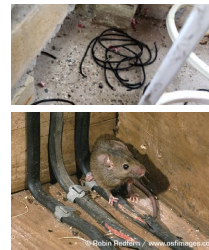
### Rub marks

- Rub marks are made from repeated rubbing of fur and body parts on a surface.
- Oil and dirt from the rat or mouse accumulates on the surface.



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### Gnawing damage



Fire

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### Gnawing damage

1 to 2 mm = mice



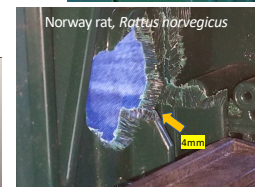
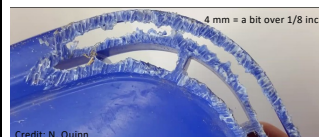
2 mm = just over 1/16 inch

House mouse, *Mus musculus*

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### Gnawing damage

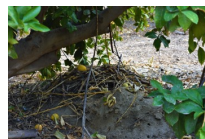
3.5 to 4 mm = rats

Roof rat, *Rattus rattus*Norway rat, *Rattus norvegicus*

4 mm = a bit over 1/8 inch

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### Burrows



Credit: C. Riegel &amp; N. Quinn

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### Monitoring

- Monitoring is more than devices.



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### Sanitation

- Sanitation and trash handling are essential for success managing rodents.
- De-cluttering.



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### Habitat modification

- Outside: remove fallen, diseased or pest-infested leaves, branches and fruit to reduce pathogen and insect populations



Credit: M. Frye

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### Exclusion

- Seal primary entry point
  - ✓ Observed pest evidence
  - ✓ Near food, water and heat sources
  - ✓ Temporary at first?
  - ✓ Other openings as funds permit



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- Select right tools and materials



Stainless steel metal mesh fibers are abrasive for chewing rodents and do not rust

Credit: M. Frye

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### Trapping

- Box or cage (live) traps are designed to catch an animal and keep it unharmed until it can be removed for disposal.
- Snap traps are among the most common traps used for commensal rodent control.
- Place the trap against the wall where rodents travel
- Trap set correctly so it snaps towards the wall

Catch Animals Alive  
Great for rats, chipmunks, mice and other similar size animals



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### Selecting the correct trap

- Size matters
- Expanded trigger
- Easy to set
- Electric trap
  - ✓ Be careful
  - ✓ Areas with high fire risk
  - ✓ Still need to pre-bait



Credit: N. Quinn

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## Baiting

- Understand the difference between a rodenticide and rodent bait.
  - ✓ A rodenticide is a pesticide or other agent used to kill rats and other rodents or to prevent them from damaging food, crops, or forage.
  - ✓ The term 'rodent bait' is something pest management technicians refer to as the product they place into the rodent bait stations.
  - ✓ For further clarification, bait can be toxic (rodenticide) or non-toxic in which it is bait that tells the applicator if the rodents are in the area and should be fed toxic bait.

### Non-toxic types of baits



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## Bait station

- Safe and cost-effective choice
- Tamper proof
- Easy to install

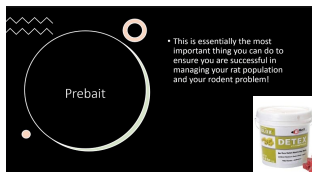


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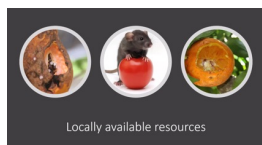
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## Choose the right attractant

- Rats can learn from their mother's milk what foods are safe to eat.
- This is important to consider when choosing rodenticides and attractants for traps.



This is essentially the most important thing you can do to ensure you are successful in managing your rat population and your rodent problem!



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## Rodenticide Formulations

Blocks

Soft Bait

Soft Block

Grain

Pellets

Tracking Powder

Liquids

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## Formulations

- Toxicants
  - Anticoagulant
  - Rodenticides
  - Bromethalin
  - Cholecalciferol
  - Tracking powder

Active ingredients	Product examples	Formulation
Chlorophacinone	BorderLine, Flatline, Rozol, CDFA baits	Pellet, soft, powder, grain, treated artichoke bracts
Diphacinone	Ditrac, Liqua-Tox, CDFA baits, PCQ	Block, powder, liquid, pellet
Brodifacoum	Weatherblok, Talon, Final	Block, soft, pellet
Bromadiolone	Resolv, Maki, Nectus, Contrac	Block, soft, pellet, grain
Difethialone	Generation, FirstStrike	Block, soft
Bromethalin	TakeDown, TopGun, Cykill	Block, soft, gummy worms*
Cholecalciferol	Selontra, Terad	Soft block, block
Strychnine	Omega, Avalon	Grain
Zinc Phosphide	ZP Rodent Bait, Wilco Zinc, ZP Tracking Powder	Pellets, grain, powder

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## Formulations

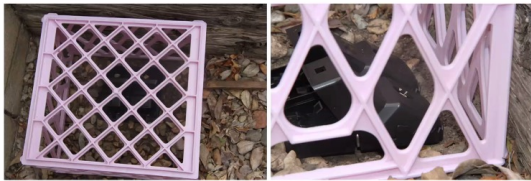
- Fumigants
  - CO and CO<sub>2</sub>

Active ingredients	Product examples	Formulation
Aluminum phosphide	Phostoxin, Fumitoxin	Pellets, tablets
Carbon dioxide	Eliminator, rat ice	Gas, dry ice
Carbon monoxide*	BurrowRx, Cheetah, CO-Jack, PERC	Device generated gas
Carbon, potassium nitrate, sulphur, carbon, sodium nitrate, charcoal	Gopher Gasser, USDA Gas Cartridge	Gas cartridge
4-Vinylcyclohexene diepoxide, Triptolide	Contrapest	Liquid
Methylmercaptan	Protec-T	Irrigation

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### Be mindful of non-target wildlife



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### Read the label carefully

- Some pesticides are not permitted for use against certain rodent species in different states.



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### Cockroaches



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### Cockroaches Facts

- Order **Blattodea**, which also includes termites
- Winged or wingless
- Closest relative: termites
- ~ 30 species may be found associated with human habitats



Roaches outdoors are actually beneficial to the environment: as important recyclers of decaying organic material

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### Cockroaches can be cute



<https://grist.org/article/glow-in-the-dark-cockroaches-look-like-jawas/>

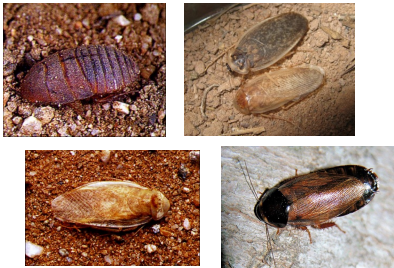
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### Cockroaches can be beautiful



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### Cockroaches are beneficial



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### Some are known as PESTS

- Invade human residences and other structures
- Can be carriers of various disease causing microbes
- Leading cause of childhood asthma

#### Common PEST species include (but not limited to)

- German cockroach (*Blattella germanica*)
- American cockroach (*Periplaneta americana*)
- Oriental cockroach (*Blatta orientalis*)
- Brown-banded cockroach (*Supella longipalpa*)

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### German cockroach (*Blattella germanica*)

- Most commonly found
- Flat and oval in shape
- 1/2 inch to 5/8 inch long
- Light brown to tan
- Two dark stripes down the back
- Have wings, rarely fly
- Run fast!



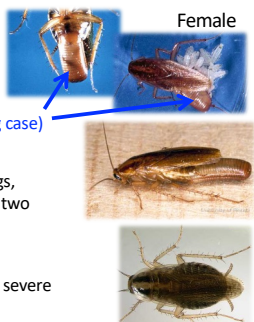
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- Like warm, humid places
- Proliferate in human homes
- Hide out in cracks and crevices close to food and water sources
- Omnivorous: eats table scraps, pet food, book bindings, dead cockroaches



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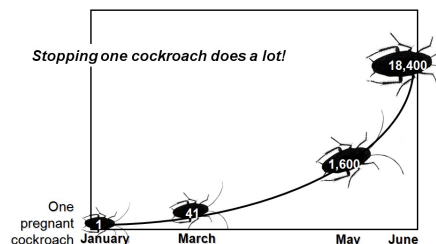
- Actively growing populations are 80% nymphs & 20 % adults
- Female carries ootheca (egg case) until 1-2 d before hatching
- Egg case contains 30~40 eggs, which may mature in about two months
- They reproduce rapidly, so infestations quickly become severe



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### German cockroach (*Blattella germanica*)

Stopping one cockroach does a lot!



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### German cockroach (*Blattella germanica*)

- Serious threats to human health
- Can contaminate food and other surfaces
- Carry and spread a variety of pathogens
  - *Proteus mirabilis*, *Pseudomonas aeruginosa*, *Salmonella* spp., *Serratia marcescens*, *Shigella*, *Enterobius vermicularis* (pinworm), *Trichuris trichiura* (threadworm), *Entamoeba histolytica* (amoebic dysentery), *Giardia* sp., *Poliovirus* (paralytic polio)
- Cause allergies and asthma
- More than a nuisance and not welcome!



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### American cockroach *Periplaneta americana*

- Largest of the common cockroaches
- Outdoor cockroach
- Likes warm, wet places
- During the day they respond negatively to light, resting in harborages close to water pipes, sinks, baths, and toilets, etc.



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### American cockroach *Periplaneta americana*

- Reddish brown with a yellowish figure 8 pattern on the back of the head
- Adults range 1.4" to 2.1" inch in length
- Oval in shape
- Both males and females have wings
- Fly short distances



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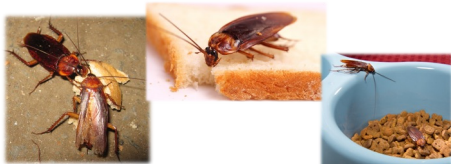
- The immatures emerge from the egg in six to eight weeks and mature in about six to twelve months
- Adults can live up to one year and a female will produce an average of 150 young



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### Omnivorous and opportunistic feeder

Consumes decaying organic matter, prefers sweets, but will eat paper, boots, hair, bread, fruit, book bindings, fish, peanuts, old rice, the soft part on the inside of animal hides, cloth and dead insects



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- Serious threats to human health
- Carry >33 species of pathogenic human bacteria, virus, fungi, protozoans, as well as six parasitic worms
- Can contaminate food and other surfaces
- Cause allergies and asthma



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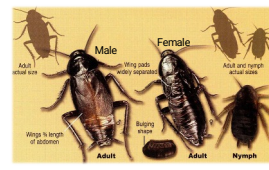
### Oriental cockroach *Blatta orientalis*

- Like **cool and damp environments**
  - basements, between the soil and foundation, underneath sidewalks, under garbage cans, water fountains
- Not common in the Valley, but in higher elevations
- Mostly feed on decaying organic matter



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- Adults are about 1" in length. Dark brown, nearly black
- Females have small wing pads that shelter the first few abdominal segments. Males have wings that cover three-quarters of their abdomen
- Neither males nor females can fly
- Nymphs and adults are usually found at or below ground



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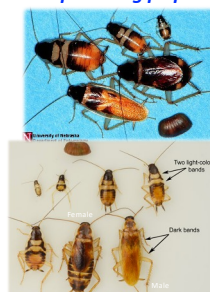
- Eggs are laid in capsules, near a food supply
- Females produce an average of eight capsules, each containing 16 eggs that hatch in about 60 days at room temperature
- The peak number of adults appears in late spring or early summer
- The life span of an adult female is 5 to 26 weeks with approximately 200 offspring



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### Brown-banded cockroach *Supella longipalpa*

- Like **dry, warm places**. Prefer higher locations
- Two light-colored bands** across wings and abdomen
- Adults are about 1/2" long. In males, wings cover abdomen. In females, not completely
- Need less moisture, more** broadly distributed in a home



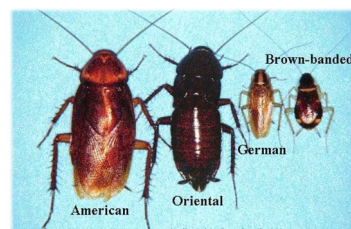
76

- Brown-banded cockroaches have been reported to spread at least 33 bacteria, 6 parasitic worms and 7 other human pathogens.
- Can cause allergies and exacerbate asthma attacks, especially in children.



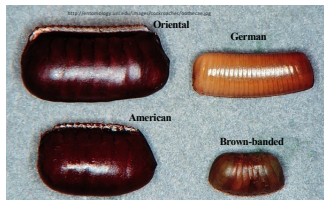
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### Roach Gallery: adult females



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## Roach Gallery: egg cases



79

## Other species

Turkestan cockroach *Blatta lateralis*

Male

Female

80



81



Adult male Turkistan, American and Oriental

82

## Other species

## Madagascar hissing cockroach

*Gromphadorhina portentosa*

Male

83

## Problems due to cockroaches

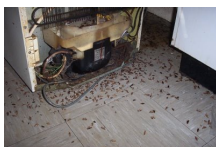
- Pose serious threats to human health
- Carry and spread a variety of pathogens
- Contaminate food, dishes and cooking surfaces
- Cause allergies and asthma
  - Make asthma worse in sensitive people
  - Cause asthma in preschool-aged children
  - Cause or aggravate allergies
- Are unwelcome in places where we live, work and play



84

### German cockroach & asthma

Cockroaches are a leading cause of childhood asthma



An inner-city study found that 36.8% of children are sensitive to cockroach allergens

85

### Cockroach allergens

- Substances produced in cockroach bodies
- Spread into the environment through their feces, shed skins and other body parts, and dead bodies
- The longer these materials persist in the environment, the higher the chances of them getting spread through the air and reaching sensitive people

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- For sensitive people, **eight** units of cockroach allergen per gram of dust can trigger a reaction. ONE female cockroach will produce **1500** units per day!
- Even one cockroach and its feces can be an asthma trigger
- Getting rid of cockroaches helps, but does not remove the remains. Clean using simple soap to remove allergens
- Helps to see when new evidence shows up

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### Cockroach IPM

An integrated pest management approach is critical. Combining chemical treatments with traps, improved sanitation and vacuums that can remove cockroaches.



Think like a cockroach

89

### Why monitor?

- **Monitor** – early intervention = minimal chemical exposure, especially important in sensitive environments
- Using ongoing monitoring tools allows for constant assessment of pest activity when you can not be around
- Monitoring helps determine pest population levels and how the pests are accessing or being introduced into buildings



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### Inspection and Monitoring

The best way to know if or when pests are present is by regular **inspection and monitoring**

What to look for:

1. Pests
2. Signs of pests
3. Pest conducive conditions - pest opportunities inviting pests for food, water, and harborage



Cockroaches feeding on crumbs



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### German cockroaches – recognize signs



93



Signs

94

### Sticky trap

Traps catch 24-7 and help to identify the pest, determine how many there are, assess the direction of travel and determine harborage locations



95



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### Good Sanitation

- Clean up after group activities, especially those involving food and drinks.
- Anything with food remains should be placed in trash cans, bagged, and taken to outside dumpsters before the day ends.
- Common room furniture should be checked and cleaned periodically



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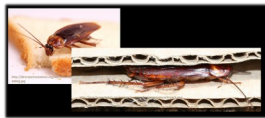


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### Eliminate harborage

Food Storage using cardboard  
= cockroach condos

Preventing hitchhiking pests



99

### De-clutter!



100

### Baits



Will be effective if there  
is **no** other food source  
around



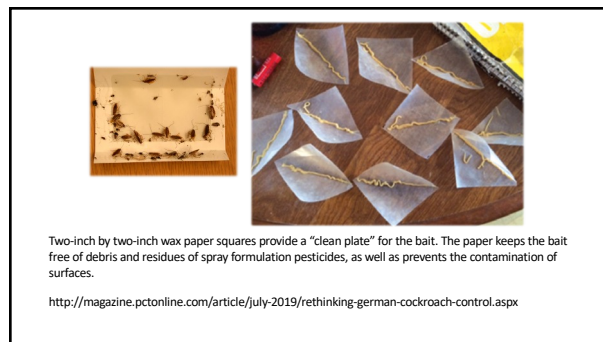
101



### Kitchen bait placement

- \* Drawers: Alongside the interior of the door frame
- \* Cupboards: Underneath cupboards where frame meets wall
- \* Sink: Under counter
- \* Fume Hood: Along the inside rear corner of hood

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**Exclusion**

- Remove cockroaches, frass, dead bodies, allergens
- Especially help in preventing outdoor species from entering
- **Pest-proofing** includes preventing pests from the outside getting in, and preventing hitchhiking pests from spreading
- Seal cracks, crevices and holes around exterior wall penetrations

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**In summary, for a roach-free environment**

- Know the cockroach species
- Ensure cleanliness, good sanitation
- Don't provide food, water and shelter
- Monitor regularly, act promptly
- Use least toxic materials

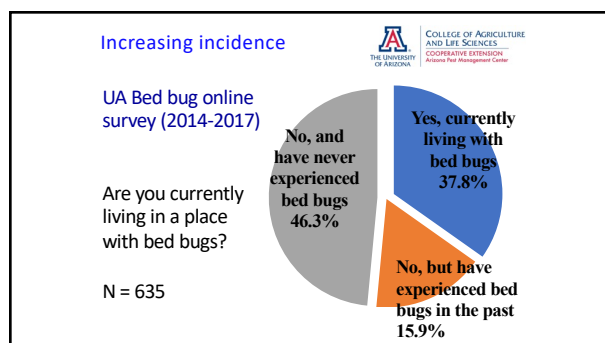
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**Bed Bugs**

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**Anyone**  
can accidentally  
acquire bed bugs

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**Bed bugs arrive**

**Passive**

Bed bug is introduced hitchhiking on something:

- Furniture
- Mattress
- Things we carry or wear (purse, coat, shoes, backpacks)

**Active**

Bed bug moves by walking from an infested area:

- From one room to another
- From one apartment to another via pipes, telephone or cable wires
- Down a hallway after dropping of an item being discarded

**100-500% increase in bed bug jobs in US, Europe, and Singapore**

111

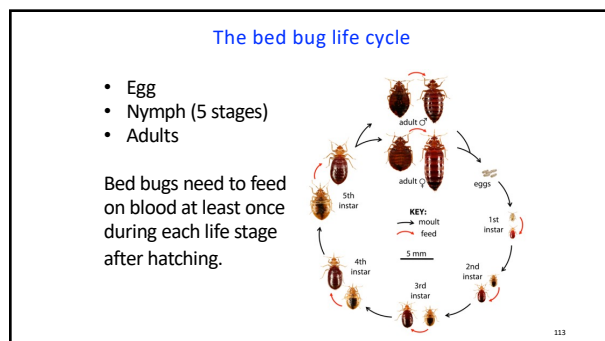
**Bed bug facts**

Blood feeding true bugs, *Cimex lectularius*

- Order Hemiptera
- Family Cimicidae

- Small
- Flattened
- Wingless
- Piercing-sucking mouthparts
- Undergoes incomplete metamorphosis

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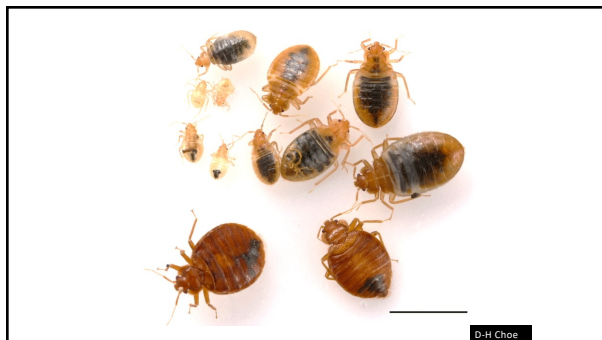
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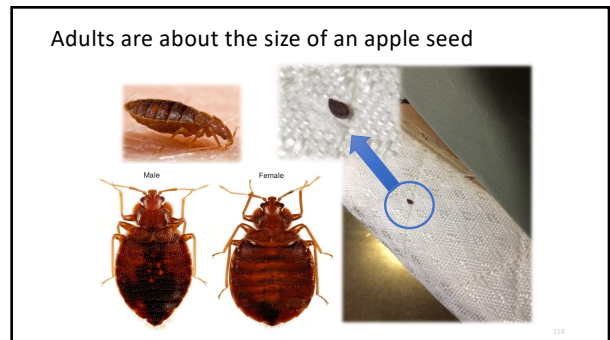
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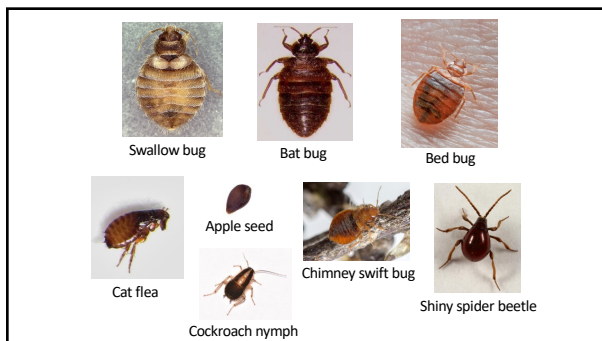
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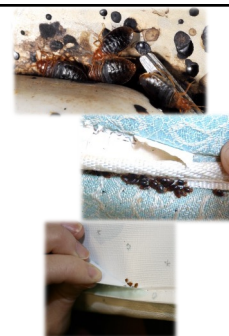


- Bed bugs feed exclusively on blood.
- Usually feed every 3-7 days.
- Can survive several months without feeding at 70°F (21°C), and can live longer at lower temperatures.
- After feeding, they go back into hiding and move to aggregations in cracks and crevices.



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- Digested blood is excreted as black or brown fecal spots.
- Bed bugs detect temperature, CO<sub>2</sub> and other chemicals.
- Stimulated by the increase of CO<sub>2</sub> in the room.
- Bed bug development rates are temperature dependent.



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- They engage in traumatic insemination.
- A single mated female can cause an infestation.
- After taking a blood meal females produce 5-20 eggs over ~12 days.
- Females produce ~143 eggs in a lifetime.



<https://www.youtube.com/watch?v=2IAOTjxYoh8>



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### Bed Bugs and Health Risks

- Itching
- Secondary infection
- Sleeplessness
- Anxiety
- Desperation
- Depression
- Blood loss, anemia
- Disease?



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### Emotional impact (top 5)

- Loss of sleep
- Cannot relax
- Depression/desperation
- Concerns that they transferred bed bugs other locations
- Loss of self esteem
- Loss of friends & family connections
- Etc.



United States  
Department of  
Agriculture

National Institute  
of Food and  
Agriculture

<http://cals.arizona.edu/apmc/public-health-IPM>



COLLEGE OF AGRICULTURE  
AND LIFE SCIENCES  
COOPERATIVE EXTENSION  
Arizona Pest Management Center

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### Reactions to bites

- Bites may occur in lines - usually on exposed skin.
- Saliva can cause a person to itch and cause swelling.
- Scratching can lead to secondary infections.






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- Reactions vary depending on your immune system and number of bites.
- Bites do not confirm bed bug infestations.

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Bed bugs are not known as competent vectors but are capable of transferring some

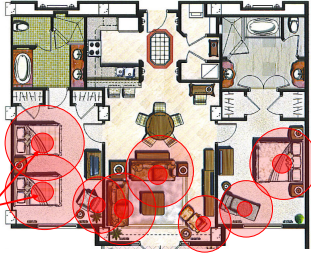




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### How to Detect an Infestation?

Beds, sofas, bedside tables, recliners, picture frames...

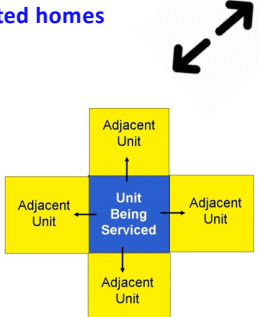
● Hot Spot



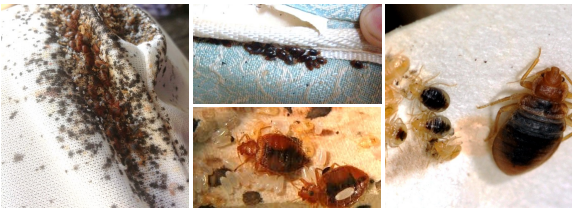
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### Inspect connected homes

- In multi-unit buildings
- Reported infestations may be from neighboring unit



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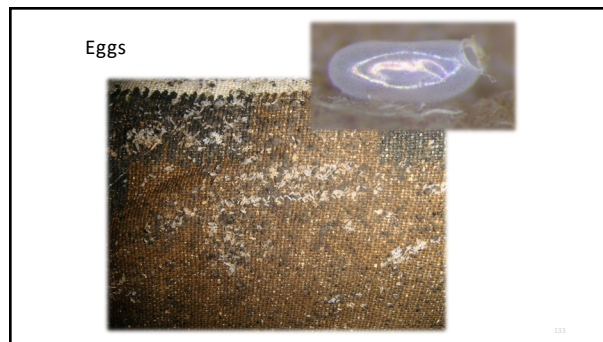
Visual inspection (signs)

Bed bugs

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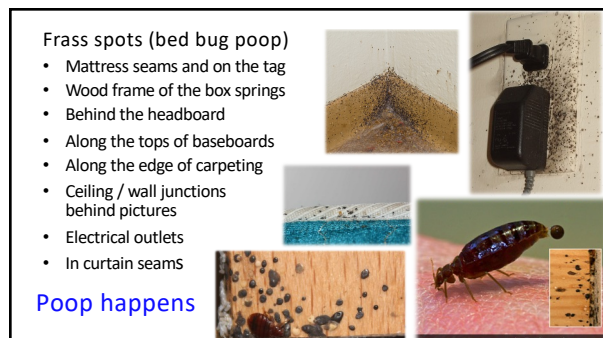

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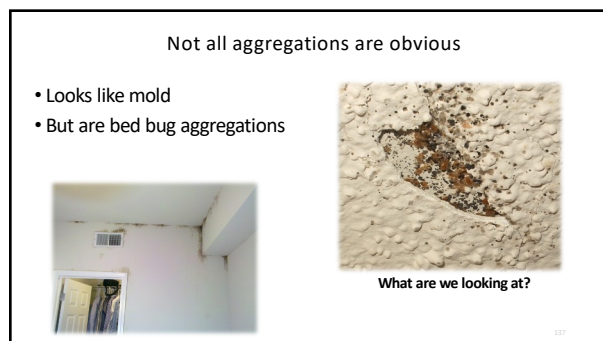
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### Canine detection

- Excellent detectors
- Can distinguish between live and dead bugs
- Expensive and require constant training
- Are only as good as their handler
- Dog handlers need to keep up with training



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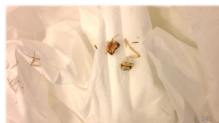
- Training differs
- Verification differs
- Few third party certifications



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### Bed bug discovery

- Do not panic or cause panic!
- Carefully collect specimens for identification
- Do not evacuate
- Do not allow people to start spraying or fogging shared space



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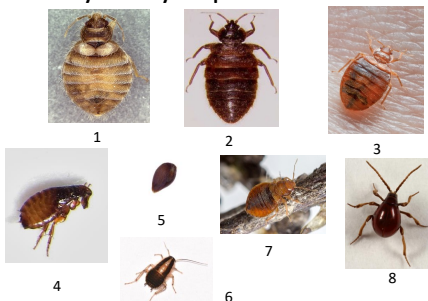
### How to Manage Bed Bugs?

- Integrated Pest Management (IPM) approach is the most likely strategy to successfully eliminate pests.
- Integrated approaches for management of potentially resistant pests.
- Choose most appropriate treatment options based on:
  - Level of infestation
  - Level of clutter
  - Square footage
  - Customer needs
  - Structure types



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### Accurately identify all specimens



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Swallow bug



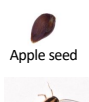
Bat bug



Bed bug



Cat flea



Apple seed



Chimney swift bug



Shiny spider beetle

Cockroach nymph

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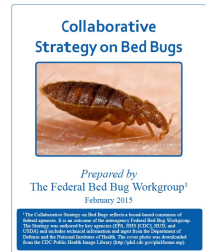




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### Prevention

Prevention is a very cost-effective tool for managing bed bugs.



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### Prevention of Picking Up Bed Bugs

- Don't place any items on beds or upholstered furniture.
- Conduct a visual of your clothing and belongings before leaving the work area.
- Launder and dry your work clothes.
- Place items that cannot be placed in the dryer in a household freezer for 4 days or a portable heat chamber for a few hours.



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Showering removes bugs from your person.



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### Non-chemical methods

Becoming the primary methods used in combination with chemical methods.

- Heat (>122°F)  
e.g. Dryer, steam, heat container
- Cold  
e.g. Freezer, liquid CO<sub>2</sub>
- Vacuuming
- Isolation  
e.g. Encasement, bag infested items



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### Correct Disposal



Don't pick up mattresses from curbside or near dumpster.

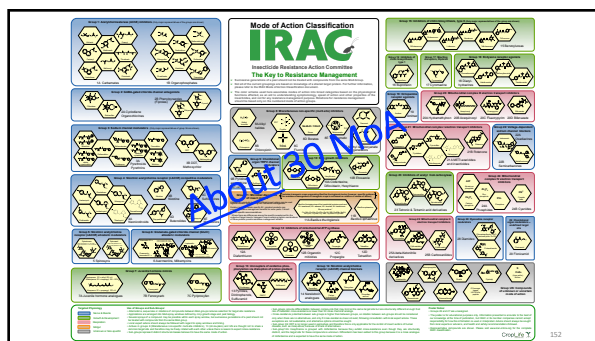


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### Chemical Methods

- EPA registered products <https://www.epa.gov/bedbugs>
- Seven chemical classes of pesticides:
  - Pyrethrins
  - Pyrethroids
  - Desiccants (DE, Boric acid)
  - Biochemicals
  - Pyrroles (chlorfenapyr, a pro-insecticide)
  - Neonicotinoids
  - Insect growth regulators
- Additional class registered for a very narrow use pattern

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- Resistance to pyrethroid products is very high.
- Rotate pesticides with different mode of action.
- Not all populations are resistant to the same products.
- Use dual-action insecticides combining pyrethroids with neonicotinoids. Resistance may occur.
- Both chlorfenapyr and a juvenile hormone analog formulation exhibited effectiveness on pyrethroid-resistant bed bugs (Goodman et al. 2013).



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	Active ingredient	Product name(s)
	Imidacloprid + 8-cyfluthrin (neonicotinoid + pyrethroid)	Tempri <sup>®</sup> SC Bayer
	Chlorfenapyr (halogenated pyrrole)	Phantom <sup>®</sup> PI BASF
	Acetamiprid + bifenthrin (neonicotinoid + pyrethroid)	Transport <sup>®</sup> Mikron
	Clothianidin + metofluthrin (PB) (neonicotinoid + pyrethroid)	Crossfire <sup>®</sup> MGK
	Thiamethoxam + λ-cyhalothrin (neonicotinoid + pyrethroid)	Tandem <sup>®</sup> Syngenta
	Dinotefuran + diatomaceous earth (neonicotinoid + silica dioxide)	Alpine <sup>®</sup> Dust BASF Alpine <sup>®</sup> PI BASF
	Imidacloprid + phenothrin (neonicotinoid + pyrethroid)	Bedlam Plus <sup>®</sup> MGK
	Amorphous silica gel	CimeXa <sup>™</sup> Rockwell Labs

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### Summary of treatment options

- Vacuuming
- Isolation
  - ✓ Mattresses encasements
  - ✓ Contain/bag infested items
  - ✓ Make the bed an island
- Freezing
  - ✓ Liquid CO<sub>2</sub>
  - ✓ Chest freezer
- Heat
  - ✓ Clothes dryer
  - ✓ Steam
  - ✓ Heat container
  - ✓ Whole unit
- Pesticides
  - ✓ Spray
  - ✓ Dust
  - Rotate pesticides with different mode of action
  - Use dual-action pesticides

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### Summary of treatment options

**Mattresses** – encasements, mattress liner, vacuuming, freezing, steam, approved chemical products

**Bedding** – launder and dry on high heat

**Non-washable clutter items** – heat/hotbox chamber, chest freezer, vacuuming, insecticidal strips, freezing at -20° C or below >48 hr, approved chemical products

**Upper seating surfaces** – vacuuming, freezing, steam, approved chemical products

**Furniture** – vacuuming, freezing, steam, approved chemical products

**Carpet** – dust products, vacuuming, freezing, steam


**Wall voids** – dust products, approved chemical products

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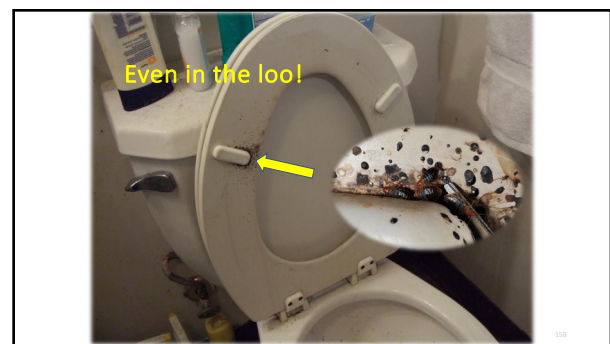
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**In a home,  
where do bed bugs hide?**  
(Choose the top 3)

- a.) box springs
- b.) couches / chairs
- c.) mattresses
- d.) night stand / dresser
- e.) baseboards and moldings
- f.) head boards and bed frames
- g.) walls / ceilings
- h.) TV remotes
- i.) curtains / drapes
- j.) toilets



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**Acknowledgements**

Claudia Riegel, New Orleans Mosquito & Termite Control Board  
 Dawn H. Gouge, Department of Entomology, University of Arizona  
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 Matt Frye, Cornell University



Wear appropriate PPE when  
working with rodents.



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