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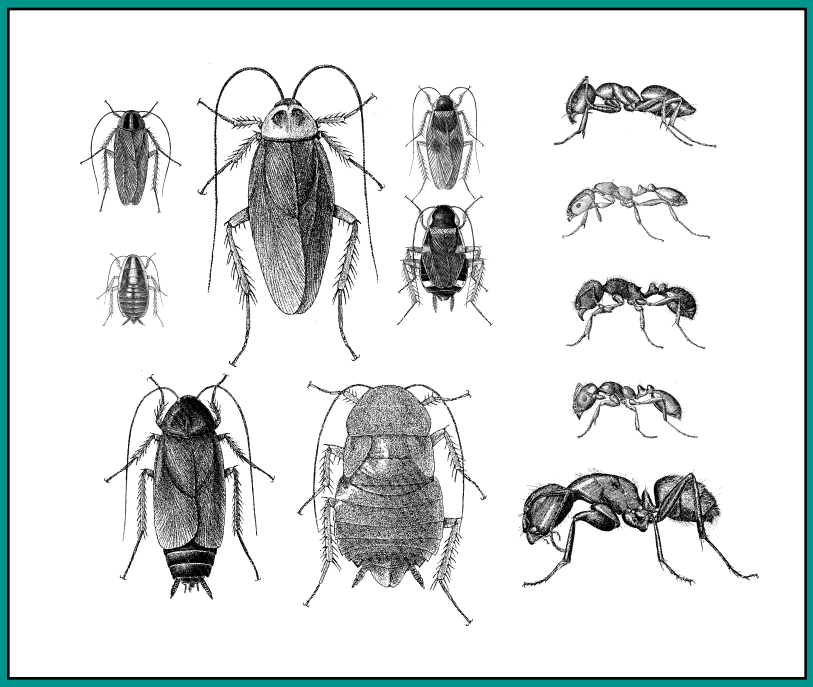
Integrated Pest Management for Northeast Schools



Natural Resource, Agriculture, and Engineering Service
Cooperative Extension

Acknowledgments

The editors thank the members of the Northeast School IPM Project for their contributions:

Richard Ashley, Ph.D.
University of Connecticut

Lee Bentz
Pennsylvania Department of Agriculture

Lynn Braband
Cornell University

Reg Coler, Ph.D.
University of Massachusetts

Ed Crow
Maryland Department of Agriculture

Gerard Ferrentino
Cornell University

Thomas Green, Ph.D.
IPM Institute of North America

George Hamilton, Ph.D.
Rutgers University

Diane Jorsey
Connecticut Department of Agriculture

Jim Van Kirk
Cornell University

Susan Whitney, Ph.D.
University of Delaware

Additional contributions were made by:

Joe McDowell
Questar III

Jennifer Grant, Ph.D.
Cornell University

Laura Sahr
NewYork Education Department

Michael Raupp, Ph.D.
University of Maryland

In addition to original material, many elements of this IPM guideline have been compiled from previously published writings in the public domain, including such sources as:

U.S. Environmental Protection Agency
Maryland Department of Agriculture
IPM Institute of North America
Cornell University
and the
Universities of
Florida, Illinois, Tennessee,
Texas, and Wisconsin.

This project was funded jointly by a grant from the
U.S. Environmental Protection Agency Pesticide Stewardship Program (X981122-010) and
by the University of Massachusetts Extension Integrated Pest Management Program.

COOPERATIVE EXTENSION NRAES–152

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EDITED BY

C. S. HOLLINGSWORTH, Ph.D.
University of Massachusetts Extension IPM Program

W. M. COLI, M.S.
University of Massachusetts Extension IPM Program

K. D. MURRAY, Ph.D.
Maine Department of Agriculture, Food, and Rural Resources

D. N. FERRO, Ph.D.
Department of Entomology, University of Massachusetts

NATURAL RESOURCE, AGRICULTURE, AND ENGINEERING SERVICE (NRAES)
Cooperative Extension • 152 Riley-Robb Hall
Ithaca, New York 14853-5701

NRAES–152
April 2002

ISBN 0-935817-81-6

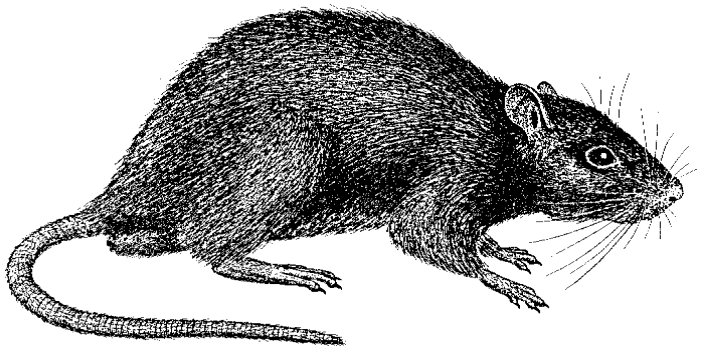
Library of Congress Cataloging-in-Publication Data

Integrated pest management for Northeast schools / edited by C.S. Hollingsworth … [et al.].
p. cm. -- (NRAES ; 152)
Includes bibliographical references (p.).
ISBN 0-935817-81-6 (pbk.)
1. Pests--Integrated control--Northeastern States. I. Hollingsworth, C. S. (Craig S.), 1951- II. Natural Resource, Agriculture, and Engineering Service. Cooperative Extension. III. NRAES (Series) ; 152.

SB950.2.N96 I58 2002
632'.9'0974--dc21

2002016533

Natural Resource, Agriculture, and Engineering Service (NRAES)
Cooperative Extension • 152 Riley-Robb Hall
Ithaca, New York 14853-5701
Phone: (607) 255-7654 • Fax: (607) 254-8770
E-mail: NRAES@CORNELL.EDU • Web site: WWW.NRAES.ORG



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INTRODUCTION

This guideline was developed to help school personnel in the Northeast USA establish a comprehensive Integrated pest management (IPM) program, including developing an IPM policy statement, identifying roles and responsibilities of various members of the school community, and providing an IPM bid specification to use in contracting with outside pest management contractors. It is a general resource for school administrators, parents, maintenance staff, and others interested in establishing an IPM program in schools. Those who need information beyond what is provided in this guideline should consult the listing of additional resources that begins on page 57.

Surveys have shown that routine pesticide use is common in Northeast schools.

State	*Year of survey*	*Schools reporting routine pesticide use (%)*
CT[1]	1999	32
MA[2]	2000	36
MD[3]	1997	46
ME[4]	2000	42
NY[5]	1993	88

[1]Addiss et al. 1999 [2]Hollingsworth and Coli 2000
[3]Maryland Department of Agriculture 1997
[4]Anonymous 2000 [5]Vacco 1996

WHAT IS IPM?

Integrated pest management (IPM) is an ecology-based, holistic approach to solving pest problems. IPM programs rely on effective, economic, environmentally sensitive, and scientifically proven techniques to minimize and eliminate pest problems. In a typical program, management decisions are based on pertinent information about pests and their interactions with the natural or man-made environment. This information, along with careful selection of suitable management techniques, is used to eliminate the causes of pest outbreaks or to otherwise manage pests in cost-effective ways that represent the lowest possible hazard to people, property, and the environment.

IPM begins with learning how to prevent pests from becoming established. With an understanding of how pests live, problems can often be prevented simply by denying them food, shelter, or water — the resources they need to survive and reproduce. Good facilities management is essential to IPM. Sometimes, prevention is as simple as blocking a pest's access into buildings or paying extra attention to sanitation and maintenance. Buildings must be kept clean, uncluttered, and in good repair to ensure healthy indoor air, maintain structural integrity, and conserve costs and energy. This will also help keep pests below harmful levels. The systematic IPM approach is a cost-effective way to provide a safe and healthy environment in which students and staff can learn and work.

WHY PRACTICE IPM IN SCHOOLS?

IPM programs can provide health and economic benefits to schools. The impacts of pests and pesticides on human health are well documented. IPM programs can protect human health by:

- suppressing pests that may carry allergens or disease pathogens
- reducing human exposure to pesticides
- reducing environmental pollution

Costs associated with pest control can be reduced using an IPM approach. Implementing IPM provides economic benefits by:

- reducing pest damage
- reducing unnecessary pesticide applications
- minimizing emergency repairs
- improving maintenance and sanitation
- reducing waste caused by infested food products

Other reasons to implement IPM include:

- An IPM program that is planned, implemented, and documented well offers some protection from liability concerning exposure to pests and pesticides.
- The implementation of IPM programs is required by certain cities, counties, and states (for example, Massachusetts' Children and Families Protection Act).
- A documented IPM program enhances public confidence and trust.

COMPONENTS OF AN IPM PROGRAM

An IPM program consists of a cycle of inspecting the site, identifying potential pest problems, monitoring pest numbers, evaluating their potential damage against an action threshold, implementing appropriate control methods, keeping careful records, and evaluating the outcomes of all actions.

Components of an IPM Program

- Site inspection
- Pest monitoring and identification
- Habitat modification, including sanitation
- Physical and mechanical controls
- Biological control
- Chemical control
- Record keeping

Inspection/Identification/Monitoring

Routine inspection and accurate identification of pests are vital to ensuring that control methods will be effective. Inspection includes determining potential locations of pest entry; determining sources of food, water, and harborage; and looking for pest signs (for example, rodent droppings, feeding damage, and cast skins of insects). Identification involves confirming the type or species of a pest (for example, a mouse versus a rat or a German cockroach versus a brown-banded cockroach). Once the pest is identified and the source of its activity pinpointed, habitat modifications — primarily repair, exclusion, and sanitation efforts — may greatly reduce the prevalence of the pest. Monitoring is the periodic estimation of relative pest population levels. Information gained through monitoring is evaluated to determine whether control measures are required.

Action Thresholds

An action threshold defines the point above which specific pests cannot be tolerated, thus initiating a pest-specific treatment action. Action thresholds may be based on different criteria, including health problems associated with pests, pest damage resulting in monetary loss, or aesthetic damage to plants or buildings. Public health threats should take precedence over other factors.

Action thresholds should reflect the pest management objectives for the site. *The presence of some pests does not necessarily require application of pesticides or other pest control actions.* However, when pest populations exceed action thresholds, action should be taken. Examples of action thresholds can be found in appendix 2 on page 47. The tolerable number of any one pest is likely to be adjusted for different sites with different histories, conditions, and pest management objectives.

Treatment Options

Many methods are available to treat pest problems, including habitat modification, physical and mechanical controls, biological control, and chemical control. Selection of an appropriate treatment involves choosing from available options using appropriate criteria. The control methods selected should complement one another. Careful record keeping is crucial to the evaluation of individual treatment options and the IPM program as a whole.

Ideally, pest control treatment options should be:

- Least toxic to human health and nontarget organisms
- Appropriate to the site and maintenance system
- Most likely to prevent recurrence of the problem
- Most cost-effective in the short- and long-term
- Easiest to carry out safely and effectively
- Least disruptive to natural enemies (in landscape situations)

Habitat Modification

Pests need food, water, and shelter to survive. Eliminating or reducing these resources provides an environment that supports fewer pests. Examples include practicing good sanitation to reduce food available for rodents, flies, yellowjackets, ants, and cockroaches; repairing leaks and keeping surfaces dry overnight to reduce water available to pests; removing clutter and caulking cracks and crevices to eliminate cockroach and flea harborage; and sealing food tightly in pest-proof containers to prevent access to food by flour moths and beetles. Because cardboard boxes provide shelter for rodents and cockroaches, when shipments are received in cardboard boxes, the boxes should be inspected upon arrival for pests, unpacked, and promptly discarded. Cracks and crevices in buildings should be blocked and/or sealed to prevent pests from finding shelter in places such as behind walls and under shelving.

Good sanitation is a critical part of a school pest management program; without good sanitation, all other practices are bound to fail.

Physical and Mechanical Controls

Traps are common mechanical control methods, and they are available for a variety of pests — especially rodents, wasps, and cockroaches. A heavy-duty vacuum can be used to remove cockroaches, spiders, and many temporary invading insects. Barriers such as window screens are simple but effective controls. Removing pests with a vacuum cleaner, a fly swatter, or even a jar may be the simplest and most effective control for occasional pests.

Biological Controls

Introducing and conserving natural enemies to control pest species is often appropriate for around interior ornamental plants and on school grounds. Avoiding the use of broad-spectrum insecticides (which kill a wide range of pests) helps conserve beneficial insects such as ladybugs and lacewings. Some natural enemies can be purchased for controlling pest insects on indoor or outdoor ornamental plants or in greenhouses.

Chemical Controls

Many different kinds of pesticides are currently available for use against urban and structural pests. Pesticides include insecticides, rat and mouse poisons (rodenticides), weedkillers (herbicides, including "weed and feed" lawncare products), disinfectants, mold and mildew products, products that control plant disease (fungicides), and other chemicals designed to kill pests.

The health of school residents and the long-term suppression of pests are the primary objectives of a school IPM program. To accomplish these objectives, the program should first look for nonchemical alternatives. When nonchemical methods are unavailable or ineffective, pesticide use — often in combination with the other nonchemical methods — is justified. This approach will reduce the need for pesticides and will maximize their effectiveness when they are used.

Read and follow the pesticide label directions. The fact that a particular product is registered does not mean that it is "safe" under all conditions of use. Know how to apply and handle these chemicals, and try to minimize the exposure of children, adults, and other nontarget species to the chemicals. General recommendations for pesticide applications are provided in appendix 3 on page 48.

IMPORTANT
In most states, pesticides may be applied in schools only by licensed applicators. Consult your state pesticide-regulating agency (see appendix 4, page 50).

Education

Education is a cost-effective pest management strategy essential to a successful school IPM program. Changing people's behaviors, particularly how they dispose of wastes and store food, plays an important part in the management of pest problems in schools. For an IPM program to be successful, all people — including administrators, teachers, support and maintenance staff, and students — must be made aware of the school's policies on pest control and their respective roles in the overall pest management plan.

Educational materials for IPM in schools in the form of brochures, posters, books, and videos are available through state departments of agriculture, university extension IPM programs, and the U.S. Environmental Protection Agency (see appendix 4, page 50). For web sites containing educational material, consult "IPM for Schools" in the resources section of this publication (page 57).

Record Keeping

Careful record keeping leads to a better educated school IPM team and informed decision making in managing school pest problems. Knowing where, when, and what pests have been seen on school grounds can help focus pest control efforts and can be helpful to professional pest control operators. Such documentation is critical in an IPM program, as treatment is based on monitoring and other information.

Records can be maintained in a logbook in the main office of the school. Maps of the school building and grounds will aid in describing where pests are sighted or pesticides are used. Records should be kept of maintenance and structural deficiencies as well as all corrective actions. Maintenance staff, teachers, and students should all contribute to pest sighting logs. Records of follow-up actions should also be maintained. Sample log forms for recording pest sightings and pesticide uses are provided in appendix 5 on page 52.

Personnel applying any pesticides should record the details — including the location, date, time, target pest, pesticide name, EPA number, and amount of pesticide applied — in a pesticide use record. Each state requires specific information to be included in applicator pesticide records; consult your state pesticide-regulating agency. Copies of pesticide labels and material safety data sheets (MSDSs) should be kept accessible. Finally, the name of the pesticide applicator and a photocopy of his or her pesticide certification should be on file. All IPM records should be available for inspection by anyone.

ESTABLISHING AN IPM PROGRAM FOR YOUR SCHOOL

The following six steps outline a general procedure for implementing an IPM program for a school or school district:

Step 1: Develop an official school IPM policy statement.

Step 2: Designate pest management roles for school personnel, pest management personnel, and key decision makers. An advisory committee may be useful in implementing an IPM program.

Step 3: Develop an IPM plan.

Step 4: Develop contractor bid specifications if using outside contractors.

Step 5: Apply the strategies proposed in the IPM plan.

Step 6: Evaluate results to determine if management objectives are met or if modifications to the plans are required.

IPM Policy Statement

The school IPM policy statement describes the reasons for implementing an IPM program, states the objectives of the program, and emphasizes the importance of IPM to the school. Establishing an IPM policy can provide an incentive to school staff to actively implement appropriate IPM procedures. An example of a school IPM policy statement is found on page 10.

Roles of the School Community in a School IPM Program

Implementing a schoolwide IPM program involves the cooperation of the entire school community. For members of the community to accept their roles in the program, they must understand how IPM benefits the members individually and the community as a whole.

IPM Advisory Committee

An IPM Advisory Committee can help develop and implement the school IPM program. In some situations, this could be a districtwide committee; in others, IPM decisions will be made at each school. The principal or superintendent may appoint members to serve on the school committee. In addition to an IPM Coordinator (see next section), the IPM Advisory Committee should consist of individuals with concerns related to pest management, as well as individuals with appropriate technical expertise. Members might include the school principal, teaching staff, facilities director, maintenance and/or custodial director or staff, athletic program director or staff, food service director or staff, school nurse, office staff, or parents.

Possible roles of the IPM Advisory Committee include:

- Developing the school IPM policy
- Developing the IPM plan
- Evaluating the progress of the IPM program
- Facilitating communication within the school about IPM practices
- Assisting in the development of contract specifications
- Providing notification to parents about pesticide use

The IPM Advisory Committee can help implement the school IPM plan by addressing specific issues set forth in the plan, which might include:

- Do individuals who apply pesticides at the school have appropriate certification?
- What forms should be used for reporting pests, documenting repairs, and recording pesticide applications?
- Where should reporting documents be kept?
- How can communication of IPM issues and practices be improved? How can notification of parents regarding IPM practices be improved?
- What specific pest action thresholds are appropriate?

School IPM Coordinator

The School IPM Coordinator decides what IPM practices are needed at the school site. The IPM Coordinator is designated by the school administration or by the IPM Advisory Committee and could be the school principal, the facilities manager, the custodian, a teacher, or someone under contract to the school. The School IPM Coordinator plays a major role in a school IPM program and is responsible for the day-to-day requirements of the program. The IPM Coordinator has an important responsibility and must be given the authority to make requests for facility repairs, renovations, or other improvements to manage and prevent pest problems. The administration must also recognize the time required to take on the many added responsibilities involved with this position.

The duties of the IPM Coordinator may include:

- Maintaining a prioritized list of needed structural and landscape requirements
- Working with administrators when contracting for pest control services
- Helping members of the school community understand their roles in the IPM program
- Overseeing training and certification of in-house IPM personnel
- Approving specific pesticide applications
- Ensuring appropriate notification prior to pesticide applications
- Maintaining records of pest problems, IPM activities, and related complaints
- Maintaining files of pesticide application records, pesticide labels, and material safety data sheets (MSDSs)
- Maintaining a copy of the school's IPM policy

Maintenance/Custodial Staff

Maintenance, custodial, and grounds superintendents and their staffs play key roles in an IPM program. They are responsible for recognizing and correcting conditions that may lead to pest problems, such as water leaks, potential pest entryways, and poor sanitation practices. It is essential that all facilities and grounds maintenance and custodial staff be adequately trained to recognize and prevent pest problems.

Kitchen Staff

Food handling and preparation areas are among the most critical areas for pest management. Kitchen staff should understand the importance of good sanitation and proper food storage and play an active role in implementing the IPM program.

Administrators

Administrators and school boards set the tone for the IPM program. Administrators should have a general understanding of any state laws pertaining to IPM in schools and regarding application of pesticides in schools. The most important responsibilities of administrative staff are forming an IPM Advisory Committee, designating an IPM Coordinator, and developing a pest management policy. Another important role of administrators is to assign priorities for building maintenance requests submitted by the IPM Coordinator. Without administrative support for such requests, IPM programs will have limited effectiveness.

School Nurse

The school nurse should maintain copies of material safety data sheets (MSDSs) for any chemicals used on school property and be aware of any children or staff with asthma or chemical sensitivities. The nurse may help coordinate notification about the use of pesticides at the school. Because head lice are a common problem for children between 3 and 10 years old, the school nurse should educate parents and staff about preventing the spread of lice.

Students and Staff

The most important pest management responsibility of students and staff is sanitation. Often, success in preventing and reducing pest infestations depends on whether or not food is left in classrooms, common areas, and lockers. Staff and students can also provide important information by reporting the presence of pests.

Parents

Parents want their children to experience a safe and pleasant learning environment in school. For this reason, parents are usually among the first to speak up about perceived unsafe conditions in a school. Unsafe conditions can occur when pest problems are improperly managed or when pesticides are overused or used improperly. Parents should never hesitate to bring their concerns about safety issues to the attention of school personnel. Parents should be aware of pest management practices in their children's schools. Schools should welcome questions and encourage parents to seek information. Visible interest and concern by parents serves as a stimulus to the school to do the best job it can to provide effective, safe pest control. Parents should express their views to the IPM Coordinator, the school district superintendent, the school principal, school-based improvement committees, the PTO, or the PTA.

Vendors and Contractors

While it is in the interest of vendors and contractors to foster good customer relations, the only way to enforce good sanitation practices by vendors is by putting specific language in their bid specifications and contracts. Contracts should specify regular maintenance service, cleaning under and behind machines during service visits, and immediate correction of problems that may foster pests (such as breakage, leaks, or excessive condensation from machinery).

Pest Control Contractors

As with other contractors, a professional pest manager is responsible for adhering to a contract. This contract should include such elements as maintaining and using pest sighting and pesticide use records at the school site, conducting inspections, consulting with the IPM Coordinator, providing specific recommendations to correct pest-promoting conditions, using proper posting and notification, and implementing appropriate least-hazardous procedures to correct pest problems. Any desired restrictions concerning the use of sprays and aerosol formulations, known carcinogens, and baseboard applications should be clearly noted in the contract. Refer to the sample pest management plan and contract in this publication for more information (see pages 10 and 15).

Pest Management Plan

A written pest management plan specifically establishes pest thresholds and pest control methods that will be used to maintain pests below threshold levels. It is a reference for pest control contractors, school staff, and others to ensure implementation and compliance with the school's IPM policy. The plan also includes procedures for record keeping, notification, and communication. There are many ways to write a pest management plan; however, every plan should include at least the following components:

- A copy of the school pest management policy
- Designation of the IPM Coordinator and IPM Advisory Committee
- A description of how the IPM philosophy will be applied at the school (for example, *All activities designed to reduce pest populations will be based on an accurate determination of the pest's identity and on knowledge of its biology and life cycle.)*
- A description of the pest monitoring plan (for example, *Significant, recurring pest problems will be observed and recorded by school staff so that pest populations can be detected and remedial measures applied.)*
- Predetermined action thresholds for important pest problems and a statement emphasizing the adoption of these thresholds for making treatment decisions (see appendix 2, page 47)
- A description of the treatment options — including physical controls, mechanical controls, biological controls, and chemical controls (including the option of "no action") — that will be considered when deciding on a pest management action
- A description of educational activities to be conducted to gain cooperation among school staff, students, and the community

Sample Pest Management Plan

The example of a pest management plan on the following pages was adapted from the University of Wisconsin (see <http://ipcm.wisc.edu/programs/school/default.htm> for more information).

Sample School Pest Management Plan

School Pest Management Policy Statement

Structural and landscape pests can pose significant problems for people and property. Pesticides can pose risks to people, property, and the environment. It is therefore the policy of *(school or district name)* to incorporate Integrated Pest Management (IPM) procedures for control of structural and landscape pests. The objective of this program is to provide necessary pest control while minimizing pesticide risk.

This school will manage pests to address the following goals:

- Reduce any potential human health hazard or threat to public safety
- Prevent loss or damage to school structures or property
- Prevent pests from spreading into the community or to plant and animal populations beyond the site
- Enhance the quality of life for students, staff, and others

IPM Coordinator

The school principal will appoint an IPM Coordinator. The Coordinator will be responsible for implementing the IPM policy and plan, including:

- Recording all pest sightings by school staff and students
- Recording all pesticide use
- Meeting with the pest control contractor to share information on what pest problems are present in the school
- Approving appropriate pesticide applications
- Ensuring that all of the pest control contractor's recommendations on maintenance and sanitation are carried out where feasible
- Ensuring that any pesticides are applied only when school is not in session or when the area can be completely secured against access by school staff and students
- Providing notification of pesticide application to staff, students, and parents as provided in the IPM plan
- Evaluating the school's progress in the IPM plan

Pesticide Applicators

Any person applying pesticides on school grounds must be trained in and knowledgeable of the principles and practices of IPM and must be appropriately licensed and certified. Applicators must follow state regulations and label precautions and must comply with the school IPM policy and pest management plan.

Selection of Pesticides

Preferred pesticides are baits and other formulations with the signal word of "caution." (Note: Some states have lists of preferred pesticides.)

Notification/Posting

A notice will be provided to school staff, students, and parents at the beginning of each school year briefly explaining the school's pesticide-use policy. The notice will indicate that pesticides may be used both indoors and outdoors, as needed. The school will provide notification of pesticide applications at least 48 hours before pesticides are applied, with the exception of instances that require immediate action. (Note: Some states have specific laws regulating posting and/or notification.)

Record Keeping

A pest sighting log will be kept in the main office, and all observations of pest incidence will be

recorded in this log. Records of pesticide use will be completed on the day of application and will be maintained on-site for two years. Copies of current pesticide labels and consumer information sheets will be maintained in the main office. Material Safety Data Sheets (MSDSs) of all pesticide products will be maintained by the school nurse.

Education

Staff, students, pest managers, parents, and the public will be informed about potential school pest problems, the IPM policies and procedures, and their respective roles in achieving the desired pest management objectives.

IPM Thresholds

It is the policy of this school that direct action will be taken against pests only when specific pest thresholds have been reached. Nonchemical control options will be considered first.

Pest Management Procedures for Specific Areas

INDOOR SITES

Typical pests of indoor sites include mice, rats, cockroaches, ants, flies, wasps, hornets, yellowjackets, spiders, microorganisms, termites, carpenter ants, and other wood-destroying insects.

ENTRYWAYS (such as doorways; overhead doors; windows; holes in exterior walls; and openings around pipes, electrical fixtures, and ducts) allow pests access to the school interior. To restrict entry:

- Keep doors shut when not in use.
- Place weatherstripping on doors.
- Caulk and seal openings in walls.
- Install and repair screens.
- Install air curtains.
- Keep vegetation, shrubs, and wood mulch at least 1 foot away from structures.
- Replace wood mulch with stone mulch where practical.

CLASSROOMS and OFFICES (classrooms, laboratories, administrative offices, auditoriums, gymnasiums, and hallways) are areas where pests are frequently encountered. To reduce pests' access to food, water, and shelter:

- Allow food and beverages only in designated areas.
- Keep indoor plants healthy and, when small insect infestations appear, remove pests manually.
- Keep areas as dry as possible by removing standing water and water-damaged or wet materials.
- In the science lab, store animal foods in tightly sealed containers and regularly clean cages. In all areas, remove dust and debris.
- Regularly clean lockers and desks.
- Frequently vacuum carpeted areas.

FOOD PREPARATION, STORAGE, and SERVING AREAS (dining room, main kitchen, teachers' lounge, home economics kitchen, snack area, vending machines, and food storage rooms) are critical areas of pest management. To reduce pest incidence:

- Store food and waste in containers that are inaccessible to pests. Containers must have tight lids and be made of plastic, glass, or metal. Waste should be removed at the end of each day.
- Inspect cardboard packaging for pests upon delivery. Promptly unpack and then discard packaging.
- Regularly inspect food storage areas for evidence of pests (such as mouse droppings or other signs).
- Store food so it is not in direct contact with floor and walls.
- Store food on wire shelving units or other storage that minimizes harborage available to pests.

- Rinse disposable food containers before discarding them.
- Place screens on vents, windows, and floor drains to prevent cockroaches and other pests from using unscreened ducts or vents as pathways.
- Create inhospitable living conditions for pests by reducing availability of food and water by removing food debris, sweeping up all crumbs, fixing dripping faucets and leaks, and drying out wet areas.
- Empty mop buckets and hang mops to dry after each use.
- Improve cleaning practices, including promptly cleaning food preparation equipment after use and removing grease accumulation from vents, ovens, and stoves.
- Use caulk or paint to seal cracks and crevices.
- Capture rodents by using mechanical or glue traps. Traps should be placed in areas inaccessible to children.
- Check mechanical rodent traps, including glue boards, daily. Trapped rodents should be disposed of as quickly as possible – no later than 24 hours after capture.

ROOMS and AREAS WITH EXTENSIVE PLUMBING (bathrooms, rooms with sinks, locker rooms, dishwasher rooms, home economics classrooms, science laboratories, swimming pools, and greenhouses) provide sources of water for pests. To reduce potential pest habitat:

- Promptly repair leaks and correct other plumbing problems to deny pests access to water.
- Routinely clean floor drains, strainers, and grates.
- Seal pipe chases with steel wool, copper mesh, or metal plates.
- Keep areas dry and avoid conditions that promote condensation. Areas that never dry out are conducive to molds and fungi. Increasing ventilation may be necessary.
- Store paper products or cardboard boxes in dry areas and out of direct contact with the floor or the walls. This practice also allows for ease of inspection. Wire shelving is preferable. Avoid using hollow-based shelving or inverted wood boxes for storage pallets, since these can harbor pests.

MAINTENANCE AREAS (boiler rooms, mechanical rooms, janitorial/housekeeping areas, and pipe chases) may harbor pests if not properly maintained. IPM practices include:

- After use, promptly clean mops and mop buckets, dry buckets, and hang mops vertically on a rack above the floor drain.
- Allow eating only in designated areas.
- Keep areas as clean and dry as possible; remove debris.

TRASH DISPOSAL and RECYCLING PROCEDURES SHOULD INCLUDE:

- Collect and dispose of waste materials in all rooms within the school building daily.
- Inspect trash/recycling rooms, compactors, and dumpsters regularly. Clean up spills and repair leaks promptly.
- Keep indoor garbage in lined, covered containers, and empty them daily.
- Clean all garbage cans and dumpsters regularly.
- Place outdoor garbage containers away from building entrances.
- Place outdoor garbage containers, dumpsters, and compactors on hard, cleanable surfaces.
- Remove stored waste and recyclables off site at least once weekly.
- Collect recyclables and move off site at least once weekly.

HEAD LICE POLICY

Head lice are unique pests and present a special problem in schools. They are human parasites that can only survive by staying in direct contact with people. They do not survive for long off a person's

head. They are spread among people primarily by person-to-person contact or by direct exchange of hats, combs, and jackets. Surfaces, such as carpets, closets, lockers, or floors, should NOT be treated with pesticides for head lice control. To reduce the spread of head lice:

- Discourage children from exchanging combs, brushes, hats, and scarves.
- Provide coat racks or cubbies with sufficient space between pegs or hangers to prevent each person's hat and jacket from touching those of another person. When this is not possible, provide clean plastic bags to each student for storage of hats and jackets, and instruct students not to exchange bags.
- Send an information sheet on prevention of head lice home with children, and perform a head check of all children in the first month of school. Children found with head lice should not be permitted to attend school until their hair is free of nits (lice eggs).
- Provide information on how to control lice, if head lice are found in school. Information should be sent home with all children, along with a note describing the "no nit" policy. Additional head checks may be conducted.

OUTDOOR SITES

Outdoor sites that require pest management include athletic fields, lawns and gardens, bushes and shrubs, playgrounds, parking areas, walkways, and swimming pools. Typical pests in these areas are vertebrates (such as mice, rats, moles, or birds), weeds (such as dandelions and poison ivy), insects (such as Japanese beetles, wasps, and ants), and plant or turf diseases (such as brown patch or anthracnose). Contact the local Cooperative Extension office or other sources for more information about management of school grounds. The following is a brief guide for management and prevention of outdoor pests.

LOADING DOCKS and REFUSE DUMPSTERS provide an attractive area for many pests that may later find access to building interiors. Appropriate IPM practices include:

- Locate dumpsters and trash cans away from building entrances.
- Regularly clean trash containers and gutters, and remove all waste, especially food and paper debris.
- Secure lids on trash containers.
- Repair cracks in pavement and sidewalks.
- Provide adequate drainage away from the structure and on the grounds.

PESTS on TURF (lawns, athletic fields, and playgrounds) may be significantly affected by the use of cultural practices:

- Aerate, preferably with a hollow-tine aerator, one to three times per year, preferably in spring and fall, to reduce soil compaction, prevent thatch buildup, and maintain healthy turf.
- Provide good drainage.
- Maintain healthy turf by selecting a mixture of turf types (certified seed, sod, or plugs) best adapted for the area.
- Keep mower blades sharp.
- Avoid mowing grass shorter than 2½ to 3½ inches in most athletic fields to enhance its competition with weeds. Adjust cutting height of the mower, depending on the grass type; remove no more than one-third of the grass height at each mowing.
- Vary mowing patterns to help reduce soil compaction.
- Supplement rainfall, if necessary, by watering turf infrequently but sufficiently during morning hours (to let turf dry out before nightfall). Let soil dry slightly between watering periods. A good rule of thumb is to apply 1 inch total water (from irrigation plus rainfall) per week.
- Regularly inspect turf for evidence of disease and other pests.
- Allow grass clippings to remain in the turf, and topdress with other organic material.
- Test soil to determine pH and fertilizer requirements, and adjust as recommended.

- Use a dethatcher, when necessary, to remove excessive thatch buildup. Do this in early fall or early spring when turf can recover and when overseeding is likely to be more successful.
- Fertilize each field at the recommended rate and frequency with a fertilizer containing a minimum of slow-release (water-insoluble) nitrogen to maximize effectiveness while minimizing the potential for pest outbreaks and water pollution.
- Avoid the use of "weed and feed" products. These contain pesticides, which may not be needed or effective in your situation. Some states require a pesticide applicator's license to apply these products on school grounds.
- Topdress with 1/16 to 1/2 inch topsoil or compost in early summer or fall.
- Overseed thin areas of athletic fields in fall or early spring with appropriate seed mixture.
- Use pesticides only if pests (weeds, insects, diseases) exceed a tolerance threshold.

ORNAMENTAL SHRUBS and TREES are affected by many pests. To reduce the impact of these pests:

- Design appropriate landscapes, such as selecting plants with few pests and placing plants in areas where they do not create problems (for example, fruiting trees near doorways attract bees and wasps).
- Apply fertilizer and nutrients to annuals and perennials during active growth and to shrubs and trees during the dormant season or early in the growing season.
- If using fertilizer, use the correct one at the suitable time, water properly, and reduce soil compaction.
- Prune branches to improve plants and to prevent access by pests to structures.
- Correctly identify pests in question. When in doubt, send several specimens to the local Cooperative Extension office or a professional pest control specialist. Once the pest is identified, treatments can be recommended.
- Pheromones are chemicals released by various organisms as means of communication with others of the same species, usually as an aid to mating. Using traps baited with pheromone is a time-saving technique for determining the presence and activity periods of certain pest species.
- Select winter-hardy and insect- and disease-resistant plant species and varieties. For example, avoid roses, raspberries, and other plants that are particularly favored by Japanese beetles.
- Remove disease-susceptible plants if they become diseased. Some ornamental plants, trees, and turf are so susceptible to plant diseases that efforts to keep them healthy may be futile. Check with the local Cooperative Extension office or university for information on plant types appropriate for your site.

Developing Bid Specifications and Contracts

Depending on the administrative system, bid specifications and pest control contracts may be developed by the school or district IPM Coordinator or by an administrator working with the IPM Advisory Committee. The bid specifications and contract determine exactly how the professional pest manager or pest control operator is to monitor and treat pests in a school. Developing appropriate bid specifications is critical.

The following document was provided by the Safer Pest Control Project (http://www.spcpweb.org/). *It provides general guidance in developing bid specifications and contracts for interior pest management for schools. Certain elements may be missing or inappropriate for some schools. It is recommended that a contract officer or legal counsel review any contract to ensure compliance with local and state regulations.*

Sample Contract Guide Specification for Integrated Pest Management in Schools

1. GENERAL

A. DESCRIPTION OF PROGRAM: This specification is part of a comprehensive Integrated Pest Management (IPM) program for the premises listed herein. IPM is a process for achieving long-term, environmentally sound pest suppression through the use of a variety of technological and management practices. Strategies in an IPM program include monitoring and physical, cultural, biological, and procedural modifications that reduce the food, water, harborage, and access used by pests. Chemical controls are used only as a last resort after considering nontoxic options.

B. IPM COORDINATOR: The school district will appoint a school employee as the IPM Coordinator. The IPM Coordinator will act as the manager of the IPM program, including overseeing and monitoring contract performance.

C. CONTRACTOR SERVICE REQUIREMENTS:

i. The Contractor shall furnish all supervision, labor, materials, and equipment necessary to accomplish the surveillance, trapping, pesticide application (when deemed necessary), and pest removal components of the IPM program.

ii. The Contractor shall provide detailed, site-specific recommendations for any structural and procedural modifications needed to aid in pest prevention.

iii. The Contractor shall provide evidence of sufficient expertise in pest control and IPM training and/or IPM experience to carry out these responsibilities. No contractor without IPM training or experience need apply. All contractors must be a licensed commercial structural pest control business certified by the appropriate state agency.

iv. All services provided by the Contractor will be in compliance will all relevant federal, state, and local laws, including the state laws requiring IPM and notification in schools.

2. PESTS INCLUDED AND EXCLUDED

The IPM program specified in this contract is intended to suppress the populations of rodents and insects found indoors and all excluded pest populations that are incidental invaders inside buildings.

3. ACTION THRESHOLDS

Levels of pest populations or site environmental conditions that require remedial action by the Contractor shall be established. Action shall be taken only when a pest population is present and posing a problem and/or risk to school property and/or building inhabitants.

4. INITIAL BUILDING INSPECTIONS

The Contractor and the IPM Coordinator shall conduct a thorough, initial inspection during the first month of this contract. The purpose of the initial inspection is for the Contractor to evaluate the pest management needs of the property and discuss these with the IPM Coordinator. Access to building space shall be coordinated with the IPM Coordinator. The inspection shall address:

- Identification of problem areas in and around buildings
- Identification of structural features or sanitation problems contributing to pest infestations
- Discussion of the effectiveness of previous control efforts
- Facilitation of Contractor access to all necessary areas
- Information about restrictions, special safety precautions, or other constraints of which the Contractor should be aware

5. PEST MANAGEMENT PLAN

Following the initial inspection, the Contractor shall develop a detailed Pest Management Plan and Service Schedule for each property. This written plan and schedule must be submitted to the IPM Coordinator for approval prior to initiation. The Pest Management Plan shall consist of the following:

A. SERVICE SCHEDULE FOR EACH BUILDING or SITE: Frequency of inspections, monitoring, and treatment by the Contractor shall depend on the specific pest management needs of the premises. At a minimum, the Contractor shall perform regularly scheduled inspections and monitoring to determine if remedial action is necessary.

B. MONITORING and INSPECTION PROGRAM: The Contractor shall outline a monitoring and inspection program that includes proposed methods of surveillance and that will identify infested areas and allow an objective assessment of site environmental conditions and pest population levels. Monitoring and inspection shall be continued throughout the duration of this contract. Between visits from the Contractor, the IPM Coordinator shall ensure that regular monitoring of pest-prone areas takes place.

C. DESCRIPTION OF SITE-SPECIFIC PEST CONTROL METHODS: The Contractor shall describe physical, structural, operational, biological, and least-hazardous chemical responses to pest populations that exceed the established thresholds or other measures aimed at preventing pest infestations. The Contractor shall use nonchemical methods wherever possible.

D. DESCRIPTION OF ANY STRUCTURAL or OPERATIONAL CHANGES THAT WOULD FACILITATE THE PEST MANAGEMENT EFFORT: The Contractor shall provide the IPM Coordinator with written recommendations for site-specific solutions for preventing future pest infestations or eliminating observed sources of pest food, water, harborage, and access.

E. STATEMENTS OF THE CONDITIONS CONSIDERED NECESSARY TO ALLOW PESTICIDE APPLICATION: Pesticide applications shall be by need and not by schedule. The Contractor must obtain written permission from the IPM Coordinator to use pesticides that require notification of parents, guardians, and staff under state law. (Note: Some schools might opt to list which pesticides require permission and which do not.)

F. PROPOSED MATERIALS and EQUIPMENT for SERVICE: The Contractor shall provide current labels and Material Safety Data Sheets (MSDSs) for all pesticides to be used as well as brand names of pesticide application equipment, rodent bait boxes, pest monitoring devices, pest surveillance and detection equipment, and any other pest control devices or equipment that may be used to provide service.

G. COMMERCIAL PESTICIDE APPLICATOR CERTIFICATES or LICENSES: The Contractor shall provide photocopies of the business' Pest Control License and Pesticide Applicator Certificates and/or Identification Cards for every Contractor employee who will be performing on-site service under this contract.

H. NOTIFICATION and POSTING: The Contractor shall work with the IPM Coordinator to ensure full compliance with state notification and posting requirements, where applicable.

6. RECORD KEEPING

The IPM Coordinator shall be responsible for maintaining a pest control logbook or file for each building or site specified in this contract. These records shall be kept on site. The Contractor shall be responsible for documenting each visit to the site and all services provided. This file shall include:

A. PEST CONTROL PLAN: A copy of the Contractor's approved Pest Control Plan, including labels and MSDSs for all pesticides used in the buildings, brand names of all pest control devices and equipment used in the buildings, and the Contractor's service schedule for the buildings.

B. PEST SIGHTING REPORTS: Pest monitoring data sheets, which record the number and location of pests as revealed by the Contractor's monitoring program or sightings by building occupants.

C. WORK REQUEST and INSPECTION FORMS: Work Request and Inspection Forms will be used to advise the Contractor of routine service requests and to document the performance of all work, including emergency work. Upon completion of a service visit to the building or site, the Contractor's employee performing the service shall complete, sign, and date the form, and return it to the logbook.

D. CONTRACTOR'S SERVICE REPORT FORMS: Customer copies of a Contractor's Service Report Form documenting all information on pesticide applications, including the location of all traps, trapping devices, and bait stations in or around the property.

7. MANNER AND TIME TO CONDUCT SERVICE

A. TIME FRAME of SERVICE VISITS: The Contractor shall perform routine pest control services that do not adversely affect building occupant health or productivity during the regular hours of operation in buildings. When it is necessary to perform work outside of the regularly scheduled hours set forth in the Pest Control Plan, the Contractor shall notify the IPM Coordinator at least one day in advance.

B. SAFETY and HEALTH:

i. The Contractor shall observe all safety precautions throughout the performance of this contract. All work shall comply with applicable state and municipal safety and health requirements. Where there is a conflict between applicable regulations, the most stringent will apply.

ii. The Contractor shall assume full responsibility and liability for compliance with all applicable regulations pertaining to the health and safety of personnel during the execution of work.

C. SPECIAL ENTRANCE: The Contractor must coordinate access to restricted areas with the IPM Coordinator.

D. UNIFORMS AND PROTECTIVE CLOTHING: All Contractor personnel working in or around buildings designated under this contract shall wear distinctive uniform clothing. The Contractor shall determine the need for and provide any personal protective items required for the safe performance of work. Protective clothing, equipment, and devices shall comply with FIFRA (Federal Insecticide, Fungicide, and Rodenticide Act) and the specific pesticide labels.

E. VEHICLES: Vehicles used by the Contractor shall be identified in accordance with state and local regulations.

8. SPECIAL REQUESTS AND EMERGENCY SERVICE

On occasion, the IPM Coordinator may request that the Contractor perform corrective, special, or emergency service(s) that are beyond the routine service requests. The Contractor shall respond to these exceptional circumstances and complete the necessary work within one working day after receipt of the request. In the event that such services cannot be completed within one working day, the Contractor shall immediately notify the IPM Coordinator and indicate an anticipated completion date. (Note: Some states require special procedures for emergency pesticide application.)

9. USE OF PESTICIDES

The Contractor shall minimize the use of pesticides whenever possible. The Contractor shall not apply any pesticide that has not been included in the Pest Management Plan or approved in writing by the IPM Coordinator. These applications shall be restricted to unique situations where no alternative measures are available or practical and nonchemical options have been exhausted. The pesticides used by the Contractor must be registered with the U.S. Environmental Protection Agency (EPA) and used in strict accordance with the manufacturer's label instructions and all applicable federal, state, and local laws and regulations.

The Contractor shall adhere to the following rules for pesticide use:

A. WRITTEN PERMISSION TO USE PESTICIDES: The Contractor shall not use any pesticide without first obtaining written permission from the IPM Coordinator after inspections or monitoring indicate the presence of pests that

exceed action thresholds and nonchemical control methods or actions have not reduced the pest population to below the action threshold. The Contractor shall provide a written request explaining the need to use a pesticide. The request shall identify the target pest, the need for such treatment, the time and specific place of treatment, the pesticide to be used, the method of application, what precautions should be taken to ensure tenant and employee safety, and the steps taken to ensure the containment of the spray to the site of application. If pesticide use is approved, the Contractor shall employ the least-hazardous material, most precise application technique, and minimum quantity of pesticide necessary to achieve control.

B. TIMING OF APPLICATION: The Contractor must time applications of pesticides requiring notification to occur when buildings are unoccupied and will remain unoccupied until the reentry period specified by the label.

C. NOTIFICATION PROCEDURES: The IPM Coordinator shall provide the Contractor with information about the district's procedures for notifying parents, guardians, and staff about applicable pesticide applications. The Contractor shall provide the IPM Coordinator with sufficient advance notice of pesticide applications for the district to comply with the notification requirement. (Note: Some states have specific posting and notification requirements.)

D. PESTICIDE STORAGE: The Contractor shall not store any pesticide product on the premises listed herein.

10. STRUCTURAL MODIFICATIONS AND RECOMMENDATIONS

Structural modifications for pest suppression shall not be the responsibility of the Contractor. The Contractor shall be responsible for advising the IPM Coordinator about any structural, sanitary, or procedural modifications that would reduce pest food, water, harborage, or access.

11. INSECT CONTROL

A. MONITORING: Sticky traps shall be used to guide and evaluate indoor insect populations and control efforts as appropriate.

B. EMPHASIS ON NONCHEMICAL METHODS: The Contractor shall use nonchemical methods of control whenever possible. For example:

i. Portable vacuums rather than pesticide sprays shall be used for initial cleanouts of cockroach infestations, for swarming (winged) ants and termites, and for control of spiders in webs wherever appropriate.

ii. Exclusion and trapping devices rather than pesticide sprays shall be used for control of flying insects indoors wherever appropriate.

C. INSECTICIDE BAIT FORMULATIONS: Bait formulations shall be used for cockroach and ant control wherever appropriate. Bait shall be placed in areas inaccessible to children and other building occupants.

D. RECORDS: The locations of all monitoring devices, bait stations, and other control devices shall be recorded in the pest control logbook.

12. RODENT CONTROL

A. INDOOR TRAPPING: As a general rule, rodent control inside occupied buildings shall be accomplished with trapping devices only. All such devices shall be concealed out of the general view and in areas inaccessible to children and in protected areas not affected by routine cleaning and other operations. The Contractor or school

employee authorized by the IPM Coordinator must check trapping devices regularly. The Contractor or school personnel shall dispose of rodents killed or trapped within 24 hours. (Note: Specific responsibility for trap-checking and pest removal should be defined in the actual contract.)

B. RODENTICIDES: Rodenticides shall not be placed inside buildings unless in EPA-registered tamper-resistant bait boxes. Frequency of bait box service shall depend upon the level of rodent infestation. All bait boxes shall be labeled and dated at the time of installation and each service. All bait boxes shall be maintained in accordance with EPA regulations, with an emphasis on the safety of nontarget organisms.

C. RECORDS: The locations of all traps, trapping devices, and bait boxes shall be recorded in the pest control logbook.

13. QUALITY CONTROL PROGRAMS

The Contractor shall establish a complete quality control program to ensure that the requirements of the contract are provided as specified. The program shall include at least the following items:

A. INSPECTION SYSTEM: The Contractor's quality control inspection system shall cover all the services stated in this contract to detect and correct deficiencies in the quality of services before the level of performance becomes unacceptable and/or the IPM Coordinator identifies the deficiencies.

B. CHECKLIST: A quality control checklist shall be used in evaluating contract performance during regularly scheduled and unscheduled inspections.

C. FILE: A quality control file shall contain a record of all inspections conducted by the Contractor and any corrective actions taken. The file shall be made available to the IPM Coordinator upon request.

D. INSPECTOR(S): The Contractor shall state the name(s) of the individual(s) responsible for performing the quality control inspections.

MANAGING PESTS FOUND IN NORTHEAST SCHOOLS

Surveys of school personnel have indicated that a small number of key pests are common in Northeast schools. These pests include ants, various stinging insects (bees, wasps, and hornets), cockroaches, flies, head lice, and rats and mice. Occasionally, pantry pests (such as meal moths) may become a problem.

Surveys have shown that the most common indoor pests in northeastern schools are ants, mice, head lice, bees and wasps, flies.

The following general information concerns the identification, biology, and treatment of these pests that schools can incorporate into their IPM programs. For more detailed information on each pest, please refer to "Additional Resources" beginning on page 57.

Ants

Most ants commonly found in the Northeast do not pose a serious threat to human health or property. Figures 1, 2, 3, and 4 show some of the many types of ants that might occur as pests in schools. Although ants are often considered pests in schools when they are found inside buildings, it is usually not advisable or effective to apply pesticides to floors or baseboards indoors or as a perimeter treatment outdoors against ants. A commonsense approach that emphasizes good sanitation and building maintenance should be taken in managing indoor infestations. Such an approach should keep ants from establishing foraging trails indoors for food and water. Eliminating entryways by caulking and sealing holes prevents ants from wandering indoors in search of food and water. Use nonchemical measures (see sidebar on page 22) to prevent ant problems. Place sticky cardboard traps or glue boards in areas where ants have been found in the past to provide early warning of new ant infestations.

Ants enter buildings in search of food to take back to their nests. Any wandering ants found indoors should be killed to prevent them from establishing a trail into the building. If a trail of ants is found, watch them to determine where they are going and how they are getting into the building. Then seal the entryway, remove the food they are attracted to, and vacuum the ants to remove them.

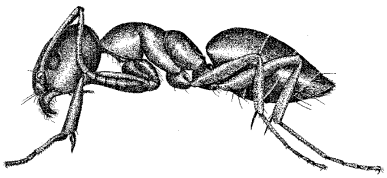

Figure 1. Odorous house ant, *Tapinoma sessile* (actual size ⅛ inch)
Source: Gorham 1991

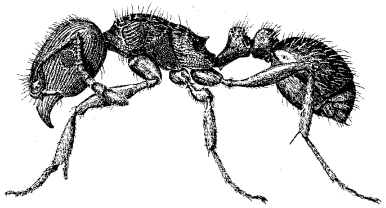

Figure 2. Pavement ant, *Tetramorium caespitum* (actual size ⅛ inch)
Source: Gorham 1991

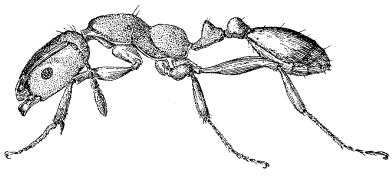

Figure 3. Pharaoh ant, *Monomorium pharaonis* (actual size 1/10 inch)
Source: Gorham 1991

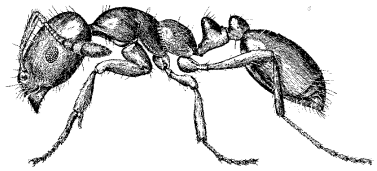

Figure 4. Little black ant, *Monomorium minimum* (actual size 1/12 inch)
Source: Gorham 1991

Vacuuming a small amount of cornstarch along with the ants will help kill them inside the vacuum bag. Wash the "trail" with soapy water to remove the scent that ants use to lead their nestmates to the food.

When ant problems persist despite preventative and nonchemical control methods, a pest control professional can help identify the ant species and use strategically placed pesticide stations containing baits that the ants take back to the nest. Food preferences of ants vary by species and can change daily depending on the nutritional requirements of the ant colony. Therefore, a good pest control professional will monitor the bait stations regularly to verify that the bait is effective. Many states require that all pesticides, even those contained in ant cups or bait stations, be used in schools only by properly licensed professionals. Even if your state does not require a license, a professional can help identify the ant species, locate pest entryways, and advise on the proper bait type and bait station placement.

Nonchemical Measures to Prevent Ant Invasions

- Keeping food preparation and serving areas (including classrooms) clean, dry, and free of grease buildup
- Cleaning up food and drink spills promptly
- Keeping pet and human food in pest-proof containers
- Emptying wastebaskets and other trash containers frequently
- Rinsing recyclable cans and bottles and storing them in pest-proof containers
- Trimming shrubs, trees, and grass that touch the building
- Cleaning gutters
- Repairing leaks and condensation problems promptly
- Caulking cracks and keeping screens, weatherstripping, and door sweeps in good repair

Remember that ant baits contain toxic pesticides. Make sure they are inaccessible to children and cannot contaminate food preparation surfaces. Remove bait stations after the ant infestation is controlled to avoid providing harborage for other pests.

Carpenter Ants

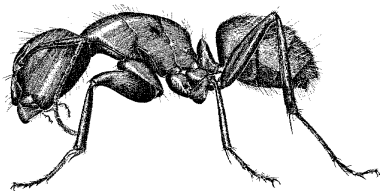

Figure 5. Black carpenter ant, *Camponotus pennsylvanicus* (actual size ⅓ inch)
Source: Gorham 1991

Large ants commonly referred to as carpenter ants (figure 5) can cause considerable damage to buildings and should be eliminated when found indoors. They are usually black and tend to be somewhat large (up to ½ inch long). The key to eliminating carpenter ants is to locate and remove the nest. Carpenter ants are often encountered in trees, stumps, and rotting logs outdoors but will enter school buildings in search of food, water, and nesting sites. Inspect trees and stumps near buildings at night for signs of carpenter ant activity. Any infested stumps or trees located near buildings should be completely removed. When nests occur in buildings, they are usually in association with moisture problems such as roof or plumbing leaks. Inspect building sills, attics, windowsills and frames, porches, and the areas around sinks, dishwashers, and coolers. Detecting and repairing leaks or condensation problems will help prevent ant infestation. Small piles of wood particles

and/or dead ants found near any of these areas are an indication of carpenter ant nesting activity. In some instances, carpentry repairs to buildings can both remove the nest and restore the building to an undamaged condition at reasonable cost. Using a pesticide to treat the nest is a job best left to a professional exterminator.

Bees, Wasps, and Hornets

In general, bees, wasps, and hornets are more beneficial to humans than they are detrimental. The most valuable product of bees is not honey, but the pollination of flowering plants they perform while collecting the nectar to make honey. Without the pollinating effects of bees, our agricultural system would literally collapse.

Wasps and hornets are also beneficial but in a less conspicuous manner. They are aggressive generalist predators that play an important role in suppressing various plant pests. Without the predatory effects of wasps and hornets, many currently minor insects would certainly reach outbreak proportions. In addition, venom from bees and wasps is used in research and treatment — particularly for some forms of arthritis — and for desensitizing people with severe sting allergies.

However, given their ability to sting, when these insects invade our personal space, their beneficial aspects are not foremost on our minds. While stings are sometimes only a painful annoyance, for a small percentage of individuals, the sting may be debilitating or even deadly. Allergic reactions in these individuals may be expressed as a swelling of the affected area, hives, difficulty breathing, or even death. In and around schools, stinging insects present a special hazard due to the danger of allergic reactions in some people. For more information, see the sidebar on page 27.

Distinctions Among Bees, Wasps, and Hornets

Despite distinct differences in the appearance and behavior of bees, wasps, and hornets, many people commonly refer to wasps and hornets as bees. Though they are related, it is useful to know the difference. First, bees have hairy bodies (see figure 6), while the bodies of wasps and hornets are smooth. For this and other reasons, wasps and hornets are more closely related to each other than they are to bees. Honeybees construct a hive that is often used for years, collect nectar and pollen to feed their larvae, and produce and store honey in wax honeycombs. Wasps and hornets construct a nest that is used for a single year and feed their larvae insects or scavenged meat. While bees obtain all their dietary needs from flowers, wasps and hornets do not, foraging instead on soft-bodied insects such as caterpillars. Bees are generally considered pests only when a hive is built in a building or individual foragers find their way inside. Because of their scavenging behavior and carnivorous food preferences, wasps (particularly the social species) tend to be most annoying during picnic outings.

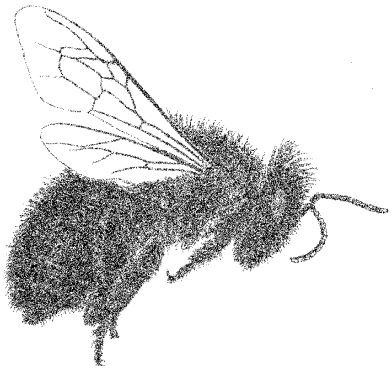

Figure 6. Honeybee, *Apis mellifera* (actual size ½ inch)
Source: Gorham 1991

Life History

Honeybees

The honeybee is perhaps our most beneficial insect. Honeybees are social insects, living in large colonies ranging from 20,000 to 80,000 individuals. Of the five species of honeybees known to exist, *Apis mellifera* is the most common (see figure 7). Bee colonies comprise three distinct castes: the queen (the sole fertile female), workers (infertile females), and males. Males develop from unfertilized eggs. Male bees lack a stinger and are entirely harmless. They do not collect nectar or pollen and cannot even feed themselves. Their sole function is to mate with virgin queens, after which they die. The weather is known to affect the "temper" of bees on windy, cloudy days, when workers are unable to forage for nectar or pollen. Under these conditions, they are more irritable and will often attempt to drive off people approaching too close to the hive. Generally, if left alone, honeybees will not sting.

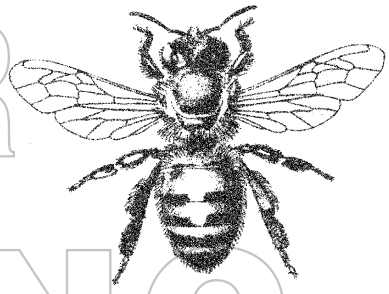

Figure 7. Honeybee, *Apis mellifera* (actual size ½ inch)
Source: Gillott 1980

Wasps and Hornets

Four species of social wasps or hornets are commonly encountered in the Northeast United States, all with similar life histories. Mated queens overwinter as individuals in tree hollows, attics, walls, and crawl spaces. In early spring, they emerge from hiding and seek nectar and water. After a short time, they begin searching for a nest site, which might be in the ground, inside a cavity of a hollow tree or a wall, or attached to branches or other outdoor structures at varying heights above ground. The nest is constructed from a papery material (called carton), which is made from chewed plant fibers mixed with salivary juices. Wasps collect the fibers by scrapping bare wood from dead trees or unfinished/weathered lumber, by stripping bark from shrubs, or even by chewing paper or cardboard left outdoors. Once nest cells are completed, eggs are laid. Eggs hatch into maggotlike larvae, and adults begin hunting for protein (meat) to feed them. Some prey on live insects, caterpillars, flies, and so forth, while others scavenge for dead animals, garbage, or picnic meats such as tuna and ham. Adults need carbohydrate sources for energy and are strongly attracted to sugary liquids, such as sodas and fruit juices, as well as ripe or damaged fruit.

As each brood becomes adults (all female workers), the nest size and the number of foragers increase. At this point, the colony consists of the queen and workers (who are all unmated females). As fall approaches, the nest reaches its peak, and a last brood, containing both males and females, is raised. The males have no sting and die shortly after mating. The young queens mate, then scatter and hide for the winter. The old queen and workers begin to die about the time of the first frost, and the nest is usually abandoned by mid-November. As they are dying, these wasps wander away from the nest and may appear indoors if the nest was in a wall. Though the nest is not used again, the same nest site may be reused.

A Wasp Fact:
The idea of making paper from plant pulp is thought to have originated from observations that wasp nests are made from a papery material consisting of chewed plant fibers mixed with wasp saliva.

The social, nest-building wasps and hornets are very aggressive stingers and should be treated with caution. In any encounter with wasps, the most essential thing is to remain calm, as any excited movement may be misinterpreted as aggression.

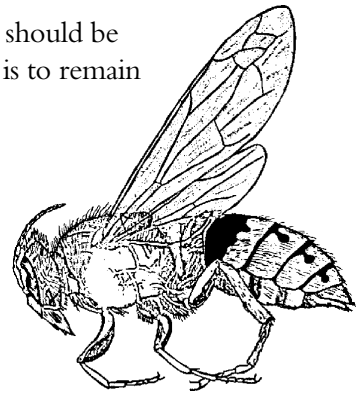

Figure 8. European hornet, *Vespa crabro germanica* (actual size 1¼ inches)
Source: Ohio State University 2000

Identification of Wasps and Hornets

European Hornet, *Vespa crabro germanica*

The European hornet (figure 8) entered the United States in the mid-1800s. It is very large and reddish brown with yellow markings. Mainly a cavity nester, it prefers hollows in trees and building walls, though it occasionally nests underground. More prevalent in heavily wooded areas, it is unusual in that it flies at dusk and is attracted to light. It can be found flying around porch lights and banging against window screens. It has been known to kill plants such as lilac, birch, and even dahlias by girdling their stems. The papery nest is brownish, unlike the gray of other wasps, and usually contains less than one thousand wasps at its peak. They seek live prey such as grasshoppers and even attack yellowjacket wasps.

Paper Wasps, *Polistes* spp.

These wasps build the small, umbrella-shaped nests with visible cells (honeycomb-shaped) commonly seen attached under eaves and other protected overhangs (figure 9). They are mostly black with indistinct yellow and red markings and (unlike the other social wasps) a noticeable wasp-waist. The colony is few in number and not very aggressive, so they can usually be ignored if the nest is built far from human traffic. Caterpillars are the main larval food.

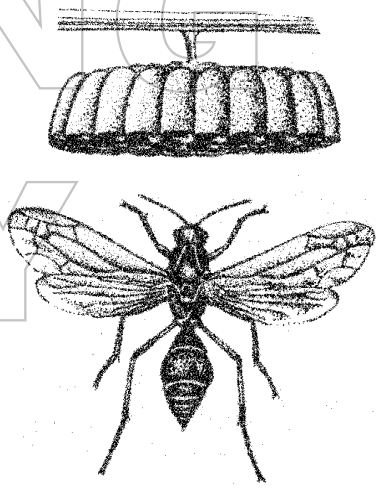

Figure 9. Paper wasp, *Polistes* spp. (actual size 1 inch), and nest
Source: Palmer and Fowler 1975

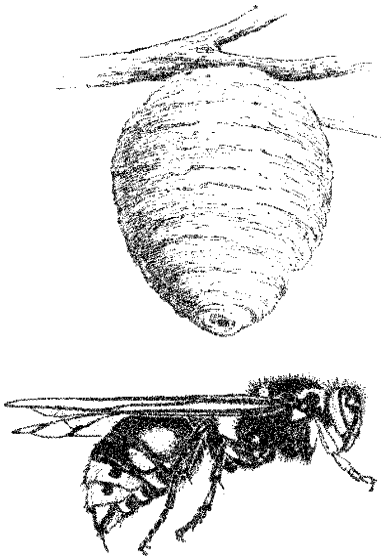

Figure 10. White-faced hornet, *Vespula maculata* (actual size 1 inch), and nest
Source: Palmer and Fowler 1975

White-Faced Hornets, *Vespula maculata*

This is not a true hornet but actually a type of yellowjacket wasp. Black with white markings, it is sometimes called the white- or bald-faced hornet. The nest is typically attached to branches or other outdoor structures (figure 10 at left). Golf ball-size at first, the nest can become larger than a basketball by season's end. Though very aggressive nest defenders, these "hornets" often go unnoticed until encountered during late-summer pruning of hedges and shrubs. The nest may contain around five hundred workers at their peak, and flies are the principal larval food.

Yellowjackets, *Vespula* spp.

Several species of yellowjackets (figure 11) occur in New England, and they are the most troublesome of wasps. Nests may be formed in walls, under mulch, underground, or occasionally in trees and shrubs. Black with yellow markings, they are often mistakenly called bees. Some attack live prey (earwigs, caterpillars, and so forth), some scavenge, and some do both. These persistent scavengers raid cookouts for meats and sweets, patrol dumpsters and garbage cans for scraps, and will steal pet food from a dish. Nest size can vary from several hundred to a few thousand.

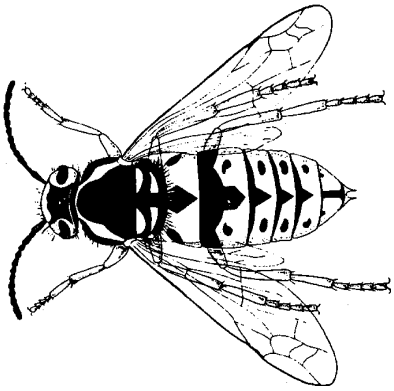

Figure 11. Yellowjacket, *Vespula* spp. (actual size 1 inch)
Source: Sweetman 1965

Mud Daubers, *Trypoxylon* spp.

Mud daubers may become a nuisance when they construct nests of mud on structures where people live, work, and play. In spite of their formidable appearance, they do not defend their nests and sting only when touched or caught up in clothing. These solitary wasps are not aggressive, and controls are rarely needed.

Managing Bees, Wasps, and Hornets on School Grounds

Bees

Bees are generally mild-mannered and usually pose a threat only if handled. They are often found on flowering plants, such as clover, wildflowers, and ornamental plants. Because of their importance as pollinators, it is not advisable to apply pesticides to lawns, athletic fields, or ornamental plantings where bees are active, and many pesticide labels make doing so illegal. To avoid stings, do not allow children to walk barefooted in these areas. Occasionally, honeybees will "swarm" to seek a new site for the growing colony. Swarms found on school grounds should be removed by a professional beekeeper who can install the bees into a nest box.

Yellowjackets and Hornets

Yellowjackets and other hornets are attracted to food and food odors, so make sure all trash containers have tight-fitting lids or spring-loaded doors. Empty trash containers frequently, especially during warm months. Washing dumpsters on a regular basis will eliminate spilled food and liquids that are attractive to yellowjackets and hornets. Limit food consumption outdoors. Clean up and dispose of trash promptly after outdoor events where food was served.

Several types of yellowjacket traps are commercially available. Use and maintain traps when yellowjackets are active. Place traps near nests or where yellowjackets are troublesome, but not where children can tamper with them. Instruct children not to disturb traps. Empty traps when full by 1) placing them in a freezer or a black plastic bag in the sun for a day to kill trapped yellowjackets, 2) washing the traps in soapy water, and 3) refreshing the bait and repositioning the trap.

Seal off openings in outside walls, playground structures, fences, pipes, and so forth to prevent wasps from

building nests inside cavities such as hollow fence posts, PVC pipes, meter boxes, and wall voids. Do not seal the entrance to an active nest until the colony is destroyed.

Keep people away from known nest locations. If possible, rope off areas where nests are located, and instruct children not to disturb nests. Nests can be found in the ground (often under shrubs, logs, or rock piles); in hollow trees; among branches of trees or shrubs; under eaves; in hollow fencing, playground structures, and meter boxes; and in wall voids of buildings. Look for wasps entering and exiting from one of these locations. Ground nests often have bare earth around the entrance. If nests are in a location where they can be avoided, they do not need to be treated. Yellowjackets and hornet colonies are killed by freezing temperatures in fall and winter, and their nests are not reused the following season.

Remove or treat nests if they are located in areas where disturbance is inevitable or where there is a persistent problem, such as on athletic fields or around outdoor food-service areas. Hire a professional to remove or treat nests to avoid the risk of stings to students and school staff. Experienced professionals can vacuum nests located indoors or in sensitive areas where pesticides should not be used.

Most state laws require that anyone applying any pesticide on school property be licensed as a commercial applicator. Before applying a pesticide, check with your local state regulatory agency.

Control of Bees, Wasps, and Hornets

Control individual wasps found indoors with a fly swatter. Do not handle stunned or dead wasps with bare hands, as the stinger may be exposed. If preventative methods fail to reduce hornet and yellowjacket problems, nests may be treated with a registered insecticide, by a certified applicator. It is safest to treat nests during cool, wet weather, such as after a rainstorm, when insect activity is lower. **NEVER use gasoline or fuel oil for treating nests,** as it pollutes the soil and groundwater.

Stings

While honeybees have stingers, they are used only as a last resort, as honeybees can sting only once. The stinger and the poison sac are left behind, and the bee dies. Wasps, however, can sting as often as they have the opportunity. Nationally, about forty people a year are fatally stung, and many more require emergency medical treatment. People with known sensitivity, a history of asthma or allergies, or heart conditions should be especially cautious and should check with their physicians before dealing with a wasp problem or immediately after being stung.

For most people, stings result only in temporary pain, and a cold compress helps reduce the swelling and spread of the venom. Over-the-counter sting-relief products are readily available. In the event of a bee sting, remove the stinger before doing anything else. Scrape it off from the side rather than pull it out to prevent injecting more venom. Emergency kits containing epinephrine and antihistamines should be used only under the direction of a physician.

To help avoid being stung, do not use perfumes, hairspray, suntan lotions, or other scented cosmetics; wear light-colored clothing (whites, tans); avoid walking barefoot outdoors; and cautiously scout the area before mowing the lawn, trimming shrubs, painting the house, cleaning the gutters, or any other activity that might bring you near a nest.

Cockroaches

Cockroaches are the most important public health pest of schools, homes, restaurants, and other indoor spaces. They consume human foods and contaminate them with saliva and excrement. Infested buildings are easily detected by a characteristic fetid odor that is produced by the cockroach bodies and fecal material. Additionally, cockroach feces and cast skins contain allergens that can become airborne and cause allergic reactions, asthma, and other bronchial problems in persons inhabiting infested buildings.

Except for size and markings, all cockroaches are similar in overall appearance: a flattened, oval-shaped insect with long legs and antennae. The most common pest cockroaches in the northeastern United States are the German cockroach *(Blatella germanica,* figures 12 and 13), the American cockroach *(Periplaneta americana,* figure 14), and the brown-banded cockroach *(Supella longipalpa,* figures 15 and 16). The German cockroach prefers moist kitchen and bathroom areas, while brown-banded cockroaches are most often found in drier areas. American cockroaches are generally found in very high-moisture habitats (like in sewers, basements, and mulch). Another type of cockroach, the Oriental cockroach *(Blatta orientalis),* is illustrated in figures 17 and 18.

Inspection

Efforts to control cockroaches should begin with a thorough visual site inspection and a continuous monitoring program. Cockroaches are rarely distributed everywhere throughout the building. Once they have located a suitable harborage, they tend to concentrate there, leaving periodically to forage for food and water. Thus, the first step in the visual inspection is to locate potential cockroach harborage sites.

Draw a map of the premises. Mark all the locations where cockroaches are sighted or where signs of their presence, such as fecal matter, shed skins, and egg cases, are seen. Mark any places that are likely to provide harborage or food. Note any sanitation problems, such as food or grease spills; food or grease buildup in, behind, or under kitchen equipment; or improper garbage disposal procedures. Note any leaks or condensation. Look for cockroach entry points, such as holes in walls or floors, spaces around pipes where they enter a wall, spaces around electrical conduits, or in vents.

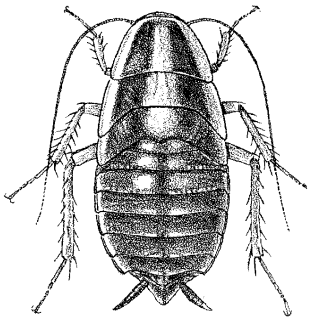

Figure 12. German cockroach, *Blatella germanica* — nymph
Source: Gorham 1991

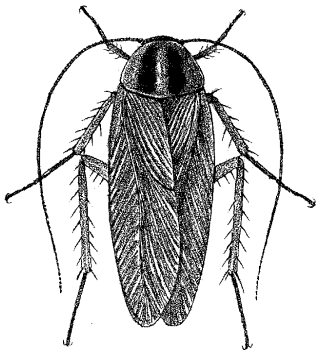

Figure 13. German cockroach, *Blatella germanica* — adult (actual size ½ inch)
Source: Gorham 1991

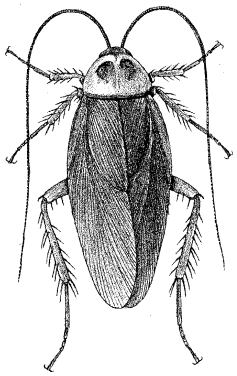

Figure 14. American cockroach, *Periplaneta americana* (actual size 1½ inches)
Source: Gorham 1991

When inspecting for cockroaches, define the specific area that is to be inspected on a map. Inspect the entire area in a systematic and logical fashion from floor to ceiling to make sure no potential harborage areas are overlooked. Most inspections are conducted during daylight hours for the convenience of the inspector. However, since cockroaches tend to remain hidden during the day, it is difficult to assess the size and location of the population until after dark. Therefore, be sure to schedule at least one inspection after dark when the majority of the population is active. This will give more information about where the cockroaches are and the level of sanitation at a time when the building is supposed to be clean. Begin the inspection with the lights off, if possible. Use a flashlight covered with a yellow filter to prevent cockroaches from being disturbed while looking for harborages and sources of food and water. Then turn on the lights and examine areas where cockroaches were observed. Note this information on your map.

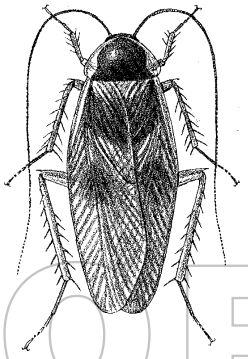

Figure 15. Brown-banded cockroach, *Supella longipalpa* — male (actual size ½ inch)
Source: Gorham 1991

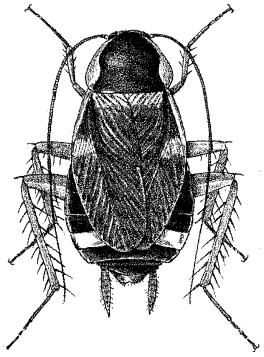

Figure 16. Brown-banded cockroach, *Supella longipalpa* — female (actual size ½ inch)
Source: Gorham 1991

Monitoring with Sticky Traps

To determine the extent of the roach problem and assess the results of any treatments, monitor building areas identified through inspection as harboring cockroaches. It is especially important to continue monitoring infestation sites after treatments to determine whether or not control efforts have satisfactorily reduced the cockroach population or if roaches are again on the increase.

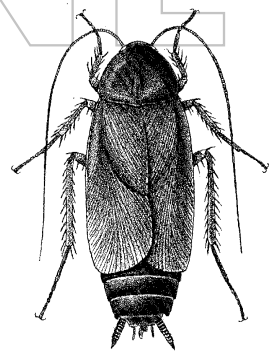

Figure 17. Oriental cockroach, *Blatta orientalis* — male (actual size 1 inch)
Source: Gorham 1991

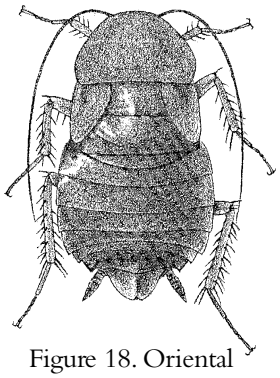

Figure 18. Oriental cockroach, *Blatta orientalis* — female (actual size 1 inch)
Source: Gorham 1991

A visual inspection alone may not provide all the information needed, so commercially available sticky traps are often used for monitoring. Many brands of sticky traps are available, but most are of a similar design — a rectangular or triangular cardboard box with bands of sticky glue inside. Some models contain a dark strip of cockroach attractant as well.

The best sites for placing traps are near harborages and along cockroach travel routes. Initially, it is best to put out traps at all suspected harborages, water resources, and travel routes. However, avoid placing traps in extremely dusty or moist areas, because they will quickly lose their stickiness.

Keeping in mind the habitats preferred by cockroaches, place the traps in the following types of locations: near and under sinks and stoves; near motors of refrigerators and other appliances; near electric clocks, switch plates, and conduits; next to computer equipment; near leaky plumbing fixtures; near steam pipes or hot water pipes with insulating jackets; near drains; in drawers and cupboards; and in areas where packaged goods and equipment are delivered and stored.

Cockroaches like to travel along edges where vertical and horizontal surfaces intersect (that is, where the floor and wall come together). Hence, it is important that traps be placed flush against the vertical surface, or the cockroaches may continue to travel behind the trap without ever entering it. Number and date each trap before deployment and mark trap locations on the map. After 24–48 hours, pick up the traps, then count and record the number of cockroaches in each trap. Record the date and the number of cockroaches on the monitoring form.

Use trap counts recorded on the map to pinpoint sites of infestation. Traps with high numbers of cockroaches indicate nearby harborages, and this is where management efforts should be concentrated. Large numbers of adult cockroaches in the traps can indicate a potential population explosion.

A week or two after treatment, place monitoring traps again at the infestation sites to see how well treatments are working. To avoid future infestations, continue monitoring on a monthly or quarterly basis. Good record keeping will save time and energy.

Management Options

An IPM approach to cockroach management is not a matter of using any single tactic. Rather, it involves a number of elements which, when used together, will reduce the initial infestation and eliminate the conditions that allowed cockroach populations to become established and increase.

Habitat Modification

Cockroaches need food, water, and harborage to survive. By modifying the environment of an infested building, cockroach access to these resources can be reduced. A few well-chosen alterations will often produce a long-term reduction in the capacity of the structure to support cockroaches, sometimes without the use of pesticides.

It is important to note that simply limiting food, water, and harborage will dramatically reduce the number of cockroaches an environment can support. Designate appropriate areas for eating, and enforce these rules. The fewer designated areas, the easier it will be to limit the pests. Food not kept in the refrigerator should be kept in sealed containers. Cardboard boxes and paper are not cockroach-proof.

Screw-top jars are cockroach-proof only if the lid has a rubber seal. Advise students and teachers not to leave unsealed food items in their desks or lockers. Any food kept in offices or classrooms should be stored in ant- and cockroach-proof containers. Inspect food products upon delivery, and remove products from cardboard shipping containers (which can harbor cockroaches inside the corrugations) before moving them into kitchens or storage areas.

Commonsense Cockroach Management

- Practice a high level of sanitation
- Limit areas where food is eaten
- Store food properly
- Keep shipping boxes out of the food preparation area
- Eliminate water sources
- Eliminate cracks and crevices
- Eliminate points of entry

German cockroaches can survive for up to two weeks without food, but they must have regular access to moisture or they will die within a few days. Cockroaches find drinking water in sink traps, appliance drip pans, drainpipes, and toilet bowls and from spills and condensation on cold-water pipes and windows. Keep aquariums and terrariums sealed with tight-fitting screened covers. Repair leaks and dripping faucets, then drain or ventilate moist areas. Keep kitchen surfaces dry when not in use, especially overnight.

Eliminate cracks and crevices where cockroaches hide, starting by caulking areas where populations are highest. Before beginning the sealing process, vacuum and wash the area to eliminate egg cases, fecal material, and other debris. Use silicon caulk or mildew-resistant caulk around sinks, toilets, and drains. Caulk or paint over cracks around baseboards, wall shelves, cupboards, pipes, sinks, toilets, and similar furnishings. Repair holes in window screens. Weatherstrip around doors and windows where cockroaches may enter.

Sanitation

Practicing good sanitation is essential to preventing and controlling cockroach infestations. Sanitation creates an additional advantage by making the cockroach environment so barren that they have a much greater chance of contacting toxic baits. Thorough daily cleaning of food preparation and dining areas is essential. Sweep, wet mop, and dry floors. Clean up spills and dispose of drink containers immediately after use. Drain all sinks and remove any food debris. Empty mop buckets and hang mops and washing cloths to dry after use. At least once a month, thoroughly clean behind and around large kitchen equipment. Clean vents and hoods to eliminate grease buildup, and clean floor drains with an enzyme-based drain cleaner.

If children eat snacks in classrooms, HEPA vacuum and/or wet mop these floors daily. Periodically, give food preparation areas an all-inclusive cleaning, focusing on areas where grease accumulates: drains, vents, deep fryers, ovens, and stoves. Steam clean drains and infested appliances. Thoroughly vacuum the area with a powerful HEPA vacuum cleaner. Eliminate clutter. Remove from the building all food waste to prevent cockroaches from feeding at night.

Use soapy water to wash any bottles, cans, wrappings, and other items that have food residues clinging to them before storing them for recycling. If dishes cannot be washed right away, it is very important that they at least be rinsed to remove all food debris.

Place garbage in sealed plastic bags before it is placed into a rodent-proof dumpster or other storage receptacle. Keep garbage cans and dumpsters as clean as possible to deny food to cockroaches as well as ants, flies, mice, and rats.

Physical Controls

Cockroaches can travel within and between buildings on runways formed by electrical conduits, heating ducts, and plumbing pipes. Seal openings around these runways with caulk, steel wool, or screening material or other mechanical barriers.

A strong vacuum can be used to pick up live cockroaches as well as their egg cases and droppings. Use a vacuum capable of filtering out very small (0.3 micron) particles (such as a vacuum equipped with a HEPA filter) to greatly reduce the amount of cockroach allergen that can become airborne during cleaning.

If the cockroach population is large, vacuuming is a quick way to reduce the population immediately. Once a large portion of the population has been eliminated, it is much easier to eliminate the remaining cockroaches with other treatment measures.

Education

Food service and custodial staff are an essential part of any successful cockroach management program. They should be provided with information on how to maintain cockroach-free kitchens, dining rooms, and waste disposal areas by applying the methods described above. Teachers, students, and other staff also play a significant role in maintaining a high level of sanitation in other areas of the school, so they must be informed of their responsibilities in that regard as well.

Chemical Controls

If nonchemical methods alone prove insufficient to solve the problem, integrating a least-hazardous pesticide into the management program may be warranted. The most recent advances in chemical control for cockroaches have been in bait formulations and insect growth regulators. Another currently used product is desiccating dusts.

Pesticides must always be used in accordance with their EPA-approved label directions. Applicators must be certified to apply pesticides and should always wear protective gear during applications. All labels and material safety data sheets (MSDSs) for the pesticide products authorized for use in the IPM program should be maintained on file. Do not apply these materials when buildings are occupied, and never apply

them where they might wash into the sewer, storm drains, or any body of water. When insecticides are used, they should be applied preferably as crack-and-crevice treatments or in a bait formulation in order to reduce potential human exposure.

Cockroach baits consist of a food source mixed with a toxicant. Some baits also contain attractants or feeding stimulants that are supposed to make the bait more attractive to cockroaches than other available food sources. Indoor bait formulations are applied as bait stations, gels, dusts, or pastes. The bait station is one of the more popular application methods for educational facilities, because the stations are easy to put out, are safe around children and animals, and have residual activity. Gel and dust bait formulations are also very safe and are packaged for injection into cracks and crevices that are not easily accessible.

Small amounts of bait placed in numerous locations work far better than large amounts placed in central areas. Put bait near harborages and between harborages and water sources, using maps and information collected from monitoring traps. Once harborage areas are pinpointed, place the baits along edges or in places where cockroaches are most likely to travel or congregate. Sometimes an inch one way or the other can make all the difference in bait placement. If air currents are moving the bait odors away from the cockroach harborage, they may never find the bait.

Do not place gel or paste baits in areas where they may get covered over with grease, flour, or dust. In areas where this might be a problem, use bait stations. Avoid harsh environmental conditions when baiting. In excessively warm areas, baits can melt and run. In cold locations, the cockroaches do not move far and may miss the bait. In very wet locations, the baits may grow mold and become unattractive to cockroaches. Check baits frequently to make sure they have not been completely consumed or inadvertently removed by cleaning.

Insect growth regulators (IGRs) are compounds that disrupt the normal growth and development of insects. They generally have very little toxicity to mammals, because they act by disrupting hormonal processes that are specific to insects. Treated cockroaches are unable to reproduce, and over time, the cockroach populations begin to decline. Control may take four to nine months, so IGRs are often combined with a residual insecticide.

Inorganic dusts, such as silica gel and boric acid, have been used successfully for indoor cockroach control. These dusts can be applied with a squeeze-bulb duster into cracks and crevices under sinks and stoves, behind refrigerators, along baseboards, and in electrical outlets, cabinets, and wall voids. Silica gel is simply finely ground sand or glass that adheres to and absorbs the protective waxes on the cockroach cuticle, resulting in death from dehydration. Boric acid is a stomach poison that is picked up by cockroaches walking across dusted areas. The boric acid adheres to the cockroach cuticle and is ingested when the cockroach grooms itself.

Flies

Many species of flies can cause problems in buildings. Controlling fly problems is often as simple as eliminating their breeding sites. Since different species have different breeding sites, proper identification of pest flies is essential to an effective integrated pest management program. Consult the table on the next page.

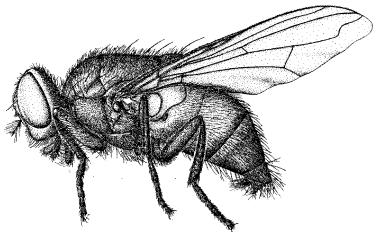

Figure 19. House fly, *Musca domestica* (actual size ⅓ inch)
Source: Gorham 1991

Fly Management

Sanitation

The most effective management practice is to identify the fly species present and eliminate its breeding site(s). Without controlling organic wastes and odors, it is impossible to control filth flies. Depending on the fly species, breeding sites might include fermenting or moist organic material, trash cans and recycling bins, compost, sour mops, floor drains and sink overflows, unused urinals, sump pumps and sewers, animal and plant waste, earthworms, or potting soil or potted plants. Once the site has been identified, it should be cleaned thoroughly and maintained to prevent subsequent infestations. This may be as simple as emptying trash containers more often or rinsing recyclables. Keep trash containers downwind of school buildings, dump them once or twice a week, and clean them regularly. Floor drains should be cleaned with enzyme-based cleaners.

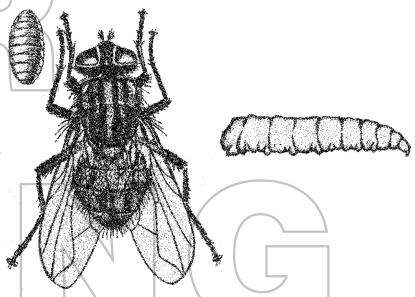

Figure 20. House fly, *Musca domestica* — adult (actual size ⅓ inch), egg, and larva
Source: Palmer and Fowler 1975

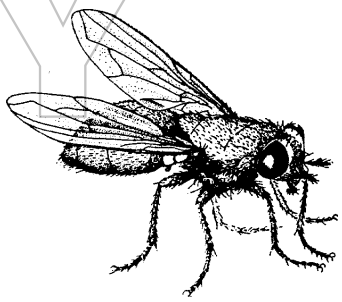

Figure 21. Green bottle fly, *Phaenicia sericata* (actual size ½ inch)
Source: Sweetman 1965

Exclusion

Prevent flies from entering buildings by maintaining screens on windows and keeping doors closed when not in use. Screen doors should be installed or doors should be fitted with automatic closing devices or vertical strips of overlapping plastic that allow human access but prevent fly entry. "Air walls" that force air across openings are another alternative to screen doors, although they are more costly.

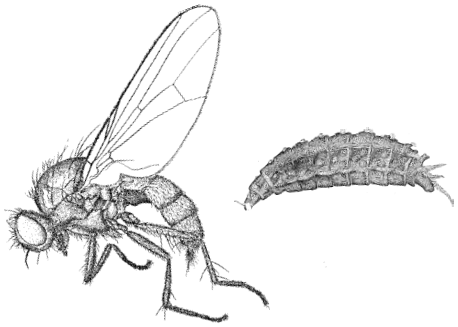

Figure 22. Little house fly, *Fannia canicularis* — adult (actual size ⅛ inch) and larva
Source: Gorham 1991

Traps

Traps for different fly species use different attractants. Indoors, electric flytraps can be used in food or storage areas. Traps work better in dark corners, false ceilings, and

Common Indoor Pest Flies in the Northeast

Common name	*Scientific name*	*Description*	*Sources of infestation*
HOUSE FLY (see figures 19 and 20, page 34)	*Musca domestica*	Medium-sized, gray, four stripes on thorax	Garbage, human and animal manure
BLACK BLOW FLY	*Phormia regina*	Large, dark blue	Garbage, animal carcasses; most abundant in early spring
GREEN BOTTLE FLY (see figure 21, page 34)	*Phaenicia sericata*	Medium-sized, shiny green to bronze	Garbage containing mixtures of animal and vegetable matter, dead animals, fresh meat
BLUE BOTTLE FLY	*Cynomyopsis cadaverina, Calliphora* spp.	Medium-sized, thorax dull, abdomen metallic blue	Exposed meat, feces, overripe fruit and other decaying vegetable matter; enters buildings in cool seasons
LITTLE HOUSE FLY (see figure 22, page 34)	*Fannia canicularis*	Small, dull gray, yellow on upper abdomen; males circle in the air	Decaying vegetable and animal matter, especially manure and piled, moist grass clippings
CLUSTER FLY (see figure 23, page 36)	*Pollenia rudis*	Larger than house fly, dark gray with distinctive yellow hairs; adults sluggish	Larvae parasitic on earthworms; adults enter houses in fall
FRUIT FLY (see figure 24, page 36)	*Drosophila* spp.	Very small, yellow-brown	Fermenting fruit and vegetables, other moist organic matter
FUNGUS GNAT (see figure 25, page 36)	*Sciara* spp. and others	0.1 inch, many segmented antennae, white or clear maggots	Damp, decaying organic matter; common in overwatered potted plants
PHORID FLY (DRAIN FLY) (see figure 26, page 36)	*Megaselia scalaris*	Similar to fruit fly but more humpbacked in appearance	Decomposing organic matter, including vegetables, fruit, flesh, feces

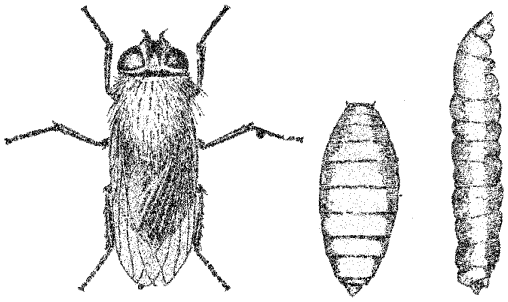

Figure 23. Cluster fly, *Pollenia rudis* — adult (actual size ½ inch), egg, and larva
Source: Palmer and Fowler 1975

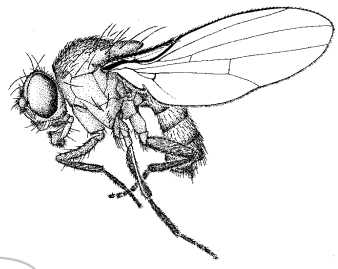

Figure 24. Fruit fly, *Drosophila* spp. (actual size ⅛ inch)
Source: Gorham 1991

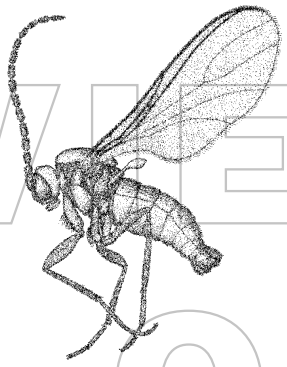

Figure 25. Fungus gnat, *Sciara* spp. and others (actual size 1/10 inch)
Source: Gorham 1991

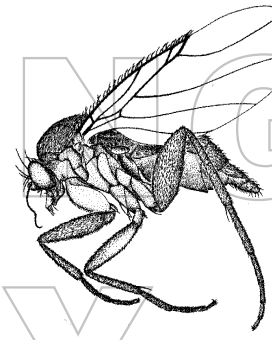

Figure 26. Phorid fly, *Megaselia scalaris* (actual size ¼ inch)
Source: Gorham 1991

other sites away from windows and light. Do not place traps where flies that are outside can see the light bulb, or this may attract more flies. Flypaper may be effective for individual flies. Keep all flytraps and flypaper away from food preparation areas. Traps that kill insects and disperse their parts into the air should never be used near food preparation areas. Ultraviolet light/electrocutor traps are not recommended for outdoor fly control.

Chemical Control

Except for odor-eliminating chemicals (such as borax) and baits, pesticides are not recommended for fly control. Low concentrations of borax in water can be used to eliminate fly odors. This solution is particularly effective for removing flyspecks from walls and eaves and for rinsing out garbage cans and dumpsters. Borax solutions should not be used near bodies of water and should not be poured onto plants.

Aerosol sprays will knock down adults but will not solve the problem. Flies will likely reappear within a few days if the breeding sites are not cleaned. In most states, any pesticide, even "fly sprays," can be applied in schools only by legally certified applicators.

Information summarized from T. McCoy; S. Darr, T. Drlik, H. Olkowski, and W. Olkowski; and University of Wisconsin.

Head Lice

The head louse *(Pediculus humanus capitis,* figure 27) may cause irritation, scratching, and subsequent secondary infection. Pediculosis or "lousiness" is one of the most prevalent communicable conditions in the United States, affecting 10 to 12 million people each year. Head louse infestations are normally found on children but can also spread to adults.

Lice can neither jump nor fly. Because they cling to hairs with clawlike legs, they can be spread only by person-to-person direct contact, including sharing of combs, brushes, hats, or bedding. Head lice do not normally live within rugs, carpet, or school buses. Head lice are not found on animals or household pets and are not transmitted from pets to humans.

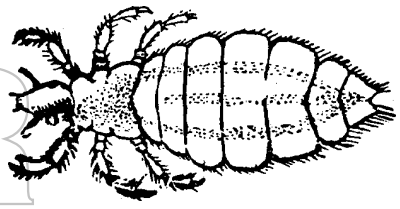

Figure 27. Head louse, *Pediculus humanus capitis* (actual size ⅛ inch)
Source: Sweetman 1965

The eggs of lice, called nits, are oval white cylinders (1/16 inch long). Eggs are usually glued by female head lice to hairs on the head near the scalp, particularly around the ears and back of the head. Head lice prefer to live on the hair of the head, although they have been known to wander to other parts of the body. Under normal conditions, the eggs will hatch in seven to ten days. The nymphs (immatures) and adults all have piercing-sucking mouthparts that they use to feed on blood. Lice must feed within 48 hours, or they die.

Individual reactions to louse bites vary considerably. Persons previously unexposed to lice experience little irritation from their first bite. After a short time, individuals may become sensitized to bites and may react with a general allergic reaction involving reddening of the skin, itching, and overall inflammation.

Prevention of Head Lice

Children should be discouraged from sharing combs, hats, scarves, and other personal belongings. Daily washing and changing of clothes and keeping hair short will also help discourage lice. Periodic inspections will aid in early detection of any individuals with adult lice or nits. Schoolwide inspections when students return from summer vacation are promoted by the National Pediculosis Association.

Head Lice Management in Schools

An information packet on how to control lice should be sent home with students if head lice are found in the school. This may include a note describing the "no nit" policy, if applicable.

Management of Head Lice in Schools

- Discourage children from exchanging hats and scarves
- Perform an annual head check of all children in the first month of school
- Send home with students an information sheet on prevention of head lice
- Do not permit children with head lice to attend school until they are free of nits
- Do not use pesticides to treat desks, chairs, or other surfaces for head lice control

Nonchemical control is most often the sole course of action needed to control a head lice infestation. Once an infestation is detected, all clothes should be washed in hot, soapy water. Pillow cases, sheets, blankets, and other bedding material should also be washed and placed in the clothes dryer on the "high heat" cycle to kill the lice and their eggs. Dry clean clothing that is not washable (coats, hats, scarves, and so forth), and store all clothing, stuffed animals, comforters, and the like that cannot be washed or dry cleaned in a sealed plastic bag for two weeks. In general, lice remain on the head, so aggressive cleaning is not recommended.

Surfaces should NOT be treated with pesticides for head lice control.

Lice infestations may be effectively controlled by careful combing with a specialized fine-toothed comb. This procedure is only effective if it is performed with sufficient care. Combs and other tools used to remove lice should be soaked in rubbing alcohol after use to kill any lice or nits trapped on the comb.

Chemical Controls

Various chemicals are available in either prescription or nonprescription formulations to control head lice, but their use is controversial because of potential side effects and control failures due to development of pest resistance to the chemicals. Head lice shampoos and creams are considered to be a medical treatment; therefore, parents should seek medical advice before using these products for control of head lice. Use of lice sprays to treat objects such as toys, furniture, and carpets is neither recommended nor effective, since lice cannot live off the host longer than a couple of days. Vacuuming will provide some protection from reinfestation.

Pantry or Stored-Product Pests

A wide variety of beetles and moths feed on foods commonly found in the kitchen pantry. The majority of pest problems occur when contaminated products are brought into the school from a store, warehouse, or delivery truck. Both the immature larvae and adults can infest stored products. Once these pests reach the adult stage, they develop the ability to fly. If left unchecked, the adult pests can easily and rapidly spread into other vulnerable products.

Moths

The Indian meal moth *(Plodia interpunctella,* figures 28 and 29) is the most common pantry pest. The first sign of infestation is usually the presence of silk webbing in food packages where caterpillars are feeding. Full-grown "worms" crawl off to spin cocoons and are often found on the ceiling. When you see moths flying, egg laying has begun, and all dry food products should be treated as suspect. The moth is attracted to lights and may turn up anywhere in the school.

Beetles

More than a dozen types of beetles attack dry products. The saw-toothed grain beetle *(Oxyzaephilus surinamensis,* figure 30) and the drugstore beetle *(Stegobium paniceum,* figure 31) are the most common.

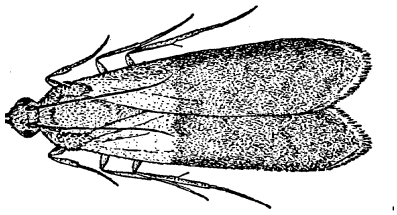

Figure 28. Indian meal moth, *Plodia interpunctella* (actual size ½ inch)
Source: Sweetman 1965

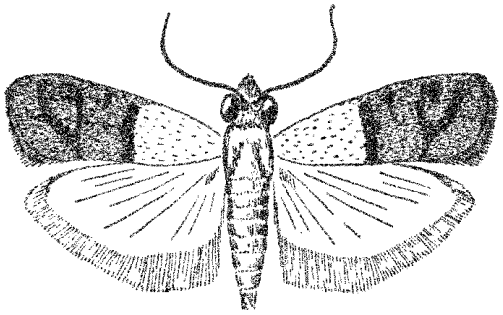

Figure 29. Indian meal moth, *Plodia interpunctella*
Source: Palmer and Fowler 1975

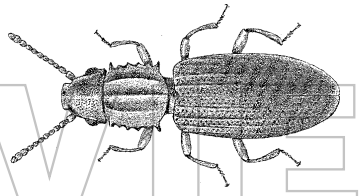

Figure 30. Saw-toothed grain beetle, *Oxyzaephilus surinamenisis* (actual size 1/10 inch)
Source: Gorham 1991

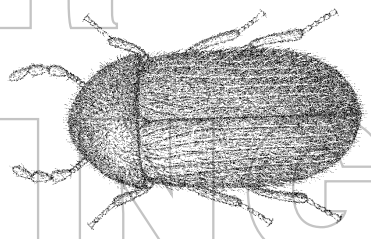

Figure 31. Drugstore beetle, *Stegobium paniceum* (actual size ½ inch)
Source: Gorham 1991

Both beetles are very small, reddish brown adults (with legs). The adults and wormlike larvae consume food, and the adults can live for a long time with little food. Two other types of beetles, the confused flour beetle and the yellow mealworm, are shown in figures 32 and 33 on page 40.

Products most likely to be affected by pantry pests include dry pet foods and birdseed, flour and baking mixes, cereals, grains, dry beans, dried fruits, nuts, spices, cookies, crackers, and bread crumbs. Products that are occasionally infested include candies and chocolates, dried flowers and potpourri, tobacco, animal skins, and medicines.

Management of Pantry Pests

Sanitation and exclusion are the cornerstones of control and, if the infestation is caught early, may be all that is needed. This is particularly true for meal moths. It is important to regularly and carefully inspect stored dry food products. Pay particular attention to flour, dry mixes, and cereals. Check along seams of unopened packages or the contents of opened packages for insect debris or webbing. Destroy all infested packages and materials. There is no satisfactory method to separate the insects from flour or meal. In addition to the kitchen and pantry, it is important to check classrooms and closets for dry pet food, birdseed, ornamental corn, nuts, and even stored grain and/or pasta used in crafts or math exercises in grade schools. Another source that may be overlooked is wallpaper paste, which is often cereal-based and may contain pests.

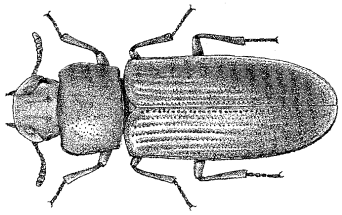

Figure 32. Confused flour beetle, *Tribolium confusum* (actual size ⅛ inch)
Source: Gorham 1991

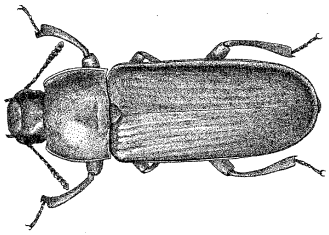

Figure 33. Yellow mealworm, *Tenebrio molitor* (actual size ½ inch)
Source: Gorham 1991

Remove all food containers and utensils from the infested area and clean all shelf and counter surfaces thoroughly, first with a vacuum cleaner and then with water and soap. Pay particular attention to cracks and corners where bits of food (flour, dust, spices) may have accumulated.

Clean old containers thoroughly before filling them with fresh products. Do not mix old and new food, as insects infesting old materials may spread to the new. Transfer the contents of uninfested packages to glass, metal, or plastic containers with tight-fitting tops. This will help isolate possible subsequent infestations or reinfestations, since it is possible that eggs were laid in some apparently uninfested packages. These eggs can later hatch and start a new infestation if not contained.

Avoid leaving exposed food on shelves or counters. Buy mixes and similar food in quantities suitable for rapid use, unless they can be stored in tightly closed containers. Do not purchase broken or damaged packages of dried foods, as they are more likely to be or become infested. Whenever possible, construct storage units so they are tight and can be cleaned easily. Keep storage units dry, because dryness discourages the development of pantry pests.

When confronted with a persistent pest problem, pheromone (insect sex odor) traps can be used to monitor and/or locate the contaminated food source. Removing the source of contamination is the easiest and most efficient way to control stored-product pests. The chemical attractants used to lure the male pests into the trap are safe for use in pantries and kitchens. Since pheromone traps are usually attractive to only one species, it is essential that the insect pest be correctly identified before purchasing traps. Another strategy is to purchase a variety of traps designed for the most common pest species. Remember, however, that traps are not available for all pest species.

Preemptive inspections of delivery trucks and vendor storage may prevent infestations throughout a school district. Schools should request federal inspection records from their food service distributors.

Rats and Mice

Rodents damage buildings, food, clothing, and documents through gnawing, urination, defecation, and nesting activities. They have been implicated in the spread of numerous diseases and can cause fires by damaging electrical equipment.

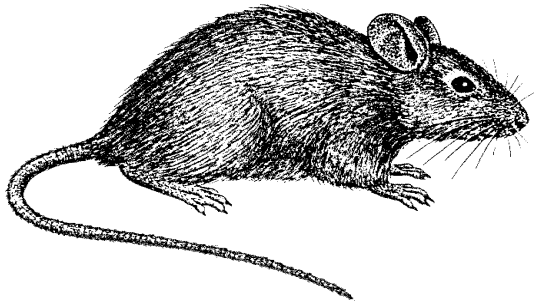

Figure 34. House mouse, *Mus musculus* (actual size 3 inches)
Source: Purdue University

The most serious rodent pests are mice and rats. The most common mouse species to invade buildings is the house mouse (figure 34), *Mus musculus,* which has a pointed nose, large ears, brown to gray fur, and a weight of about ½ ounce. Meadow voles, *Microtus pennsylvanicus,* have furry ears and a short tail and weigh about 1 ounce (figure 35). Deer mice, *Peromyscus maniculatus,* have white fur on the belly and may move into buildings as the temperature drops. White-footed mice, *Peromyscus leucopus,* can be found year-round in human-occupied buildings (figure 36). All of these mice species are easily trapped.

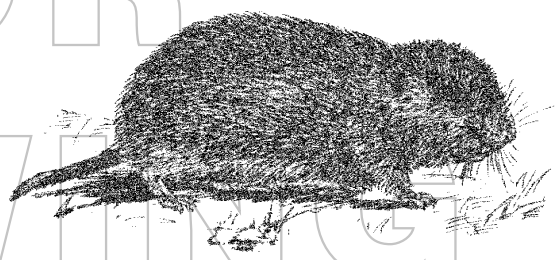

Figure 35. Meadow vole, *Microtus pennsylvanicus* (actual size 4 inches)
Source: Palmer and Fowler 1975

The most important rat species in the Northeast is the Norway rat (figure 37). It has a blunt nose, small ears, and shaggy black/brown fur and is 3–21 ounces in weight.

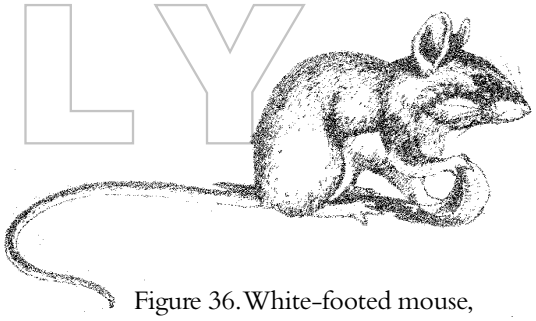

Figure 36. White-footed mouse, *Peromyscus leucopus* (actual size 4 inches)
Source: Palmer and Fowler 1975

Inspection/Monitoring

A thorough inspection is critical for management of rodent pests. An inspection should locate active infestations and signs of rodent activity, identify harborage sites and sources of food and water, and identify openings in the exterior of the building that provide access. Inspections should include basements, attics, roofs, outbuildings, garbage storage, electrical boxes, waste piles, doors and windows, vegetation, and all water sources.

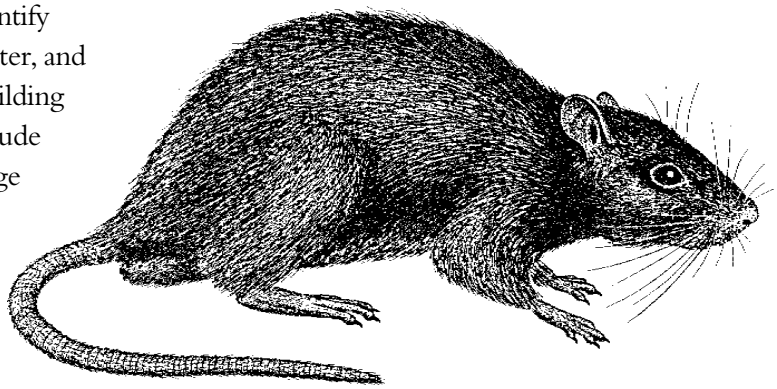

Figure 37. Norway rat, *Rattus norvegicus* (actual size 9 inches)
Source: Purdue University

Signs of an active rodent population include droppings, marks from gnawing or rubbing, and burrows. A dusting of

talcum powder can be used to track rodent activity, and an ultraviolet light will cause rodent urine to fluoresce. Rodent activity can also be monitored using nontoxic food blocks, which should be placed in areas of suspect rodent activity and checked periodically.

Commonsense Rodent Management

- Deny rodents access to buildings
- Deny rodents access to water
- Reduce food availability
- Eliminate harborage sites
- Use trapping
- If warranted, use chemical control

Rodent Management Options

As in the case of other pests, many commonsense methods exist to prevent rat and mouse problems. The simplest approach is to deny rodents access to buildings. This can be accomplished by sealing small holes with steel or copper wool or caulk, sealing gaps around exterior doors with weatherstripping, screening openings in all vents and louvers, capping drain pipes, and repairing broken sewer pipes.

Rodents can be denied access to water by fixing leaking pipes, faucets, and irrigation systems and eliminating freestanding water, especially during rodent episodes. Eliminate condensation where possible as well.

Potential sources of food for rodents can be eliminated by enforcing a restriction on eating only in designated areas, storing food in rodent-proof containers, cleaning up all food spills promptly, rinsing recycled cans and bottles, keeping garbage containers tightly sealed, and cleaning waste containers frequently to prevent the buildup of food waste.

Harborage sites can be reduced by trimming back all vegetation to at least 12 inches from buildings; breaking up dense plantings with pathways, lawns, or groundcover; and thinning out dense shrubbery.

Trapping rodents using snap traps, glue boards, and live traps is another nonchemical option. Always use traps that will not cause a hazard to staff or students by placing them in a commercial rodent bait station or PVC (polyvinyl chloride) plastic pipe. Secure the traps so that they will not be dragged away. It is best to check traps daily until captures stop and immediately dispose of any captured rodents. Mice captured by glue boards must be killed humanely; discretion is advised when using such traps in public areas. Map locations of traps and use catch information to determine the source of the rodent problem.

Rodenticides may be warranted when nonchemical measures prove ineffective. Applicators must be specifically certified to apply rodenticides by the state pesticide-regulating agency. Rodenticides should always be placed in tamper-resistant bait stations and should only be applied in areas to which children do not have access.

Microbial Pests

Microbes, including molds, mildews, bacteria, and viruses, can present health risks in schools. Unsanitary conditions favoring microbes are also conducive to infestations of insect and vertebrate pests. Consequently, cleaning and sanitizing school facilities is an important component of a school IPM program. However, misuse or overuse of antimicrobial chemicals can also pose risks to school occupants. Therefore, it is important that any compounds used for cleaning and disinfecting be selected, used, stored, and disposed of properly to ensure human health and safety and minimize negative environmental impacts.

The first step in implementing an IPM program for microbes is to distinguish between materials used for cleaning and those used for disinfecting. Cleaning, such as scrubbing with soap and water, can be used to remove or kill many microbes and is sufficient in many cases. Disinfectant products, on the other hand, are specifically designed to kill microbes and often rely on the use of antimicrobial chemicals such as chlorine bleach. The best approach in schools is to use disinfectants only where and when needed (primarily in bathrooms, locker rooms, and on food preparation surfaces in kitchens) and to clean with low-risk products, such as soaps, detergents, or enzyme-based compounds, for most routine sanitation needs (for example, in hallways, offices, and classrooms).

According to federal regulations, any product labeled as having antimicrobial properties is considered to be a "disinfectant." Many of these products contain active ingredients, such as chlorine bleach, that can be hazardous to human health if used inappropriately. In fact, disinfectants are regulated by the U.S. Environmental Protection Agency (EPA) as pesticides and must be used in accordance with state and federal pesticide laws. Check with your state officials to find out the state laws regulating the use of disinfectants in schools in your state. Products registered as disinfectants have an EPA registration number on the label.

Cleaning products for which the manufacturer makes no antimicrobial claim are not registered with the EPA as pesticides. However, many cleaning agents contain ingredients such as chlorine bleach, ammonia, acids, or other chemicals that can be hazardous to humans or the environment with improper use, storage, or disposal. Therefore, it is important to check each product label and material safety data sheet (MSDS) to determine what precautions should be used to ensure that products are used safely and effectively.

Read the label and follow directions when using disinfectants.

Below are some basic tips for selecting and using cleaners and disinfectants:

- Distinguish between tasks that require a **disinfectant** and those that require a **cleaner,** and select products that do not contain disinfectants for routine cleaning. Use disinfectant-containing products only when necessary. Use all products according to all label regulations and instructions. Follow label directions exactly. Staff should be adequately trained in appropriate use of all cleaning and disinfectant products.

- Avoid air "freshener" products. Instead, find and eliminate odor sources and ensure adequate ventilation. Routinely inspect all facilities and repair water leaks and other moisture problems to prevent microbial growth. Mold and mildew growth in heating, ventilation, or air conditioning (HVAC) systems or those resulting from moisture control problems such as roof or pipe leaks, blocked drainage systems, or poor ventilation should be addressed by persons with professional expertise. Some states have laws regulating such uses of antimicrobial products.
- When **diluting and using cleaners and disinfectants,** always use proper ventilation. Prepare only the amount of solution needed for immediate use. Never combine products containing chlorine bleach with products containing ammonia or acids. Avoid the use of spray formulations, especially when buildings are occupied. Clean all equipment, including mops, pails, and measuring containers, immediately after use.
- When **selecting and purchasing cleaners and disinfectants,** always consider risks as well as effectiveness and cost. Establish environmental and human health risk criteria for purchasing custodial supplies, such as those used by the State of Massachusetts (see www.state.ma.us/osd/enviro/products/cleaning.htm). Review MSDSs and product labels and then select products that meet those criteria. Select products that do not contain known carcinogens or ozone-depleting substances and that have low concentrations of volatile organic compounds (VOCs) and phosphates. Avoid purchase and use of products in aerosol cans.
- **Storage of antimicrobial products** should be in secure areas inaccessible to children. Keep MSDSs for every stored product on file in a location where they can easily be located. Store all products in original containers. Ensure that storage areas for corrosive, volatile, flammable, or explosive products meet standards for safe storage of hazardous chemicals. Routinely inspect all containers, and properly dispose of damaged, leaking, or outdated products. Follow product label instructions for spill clean up and proper disposal of unused products.

Appendix 1. School IPM Checklist

Modified from IPM Standards for Schools, The IPM Institute of North America, <http://www.ipminstitute.org>.

Schools can reduce the likelihood and extent of pest problems through simple procedures and preventative maintenance. The following practices will help exclude pests from school buildings and hinder their establishment, thus reducing the need for chemical solutions to pest problems.

Building Exteriors

__ Trees and shrubbery are trimmed away from exterior walls and rooflines.
__ Sources of light are positioned away from doors and windows.
__ Windows and air vents are screened.
__ Exterior doors are kept shut when not in use.
__ Weatherstripping and door sweeps are used to prevent pest entry.
__ Cracks in walls and pavement are sealed.
__ Openings around electrical conduit, plumbing, and other potential entrances to the building are sealed.
__ Building eaves, walls, and rain gutters are in good repair; water drains away from the building.

Plumbing

__ Drains are cleaned and inspected regularly.
__ Plumbing is kept in good repair; there are no dripping pipes, faucets, or other uncontrolled sources of water.
__ Floor and sink traps are kept full of water.
__ Sewer lines are in good repair.

Waste Management

__ Indoor garbage is kept in lined, covered containers and emptied daily.
__ Outdoor garbage containers are placed away from school entrances.
__ Dumpsters have close-fitting lids that are kept closed.
__ Stored waste is collected and moved off site at least weekly.
__ Recyclables are collected and moved off site at least weekly.
__ All garbage cans and dumpsters are cleaned regularly.
__ Trash/recycling rooms are inspected and cleaned regularly.
__ Packing and shipping trash is disposed of promptly.

Classrooms, Hallways, and Office Areas

__ Floors are cleaned regularly.
__ Furniture that is rarely moved is cleaned annually.
__ Food is consumed only in designated areas, and these areas are kept clean.
__ Lockers and desks are emptied and cleaned twice per year.
__ Cracks and crevices in walls and floors are sealed or caulked.
__ Materials are stored in a manner to assist pest inspections.
__ Areas near doors and windows are kept clear.
__ Food products are stored in refrigerators or in pest-proof containers.
__ Sink areas are kept clean and dry.

Kitchen and Cafeteria

__ Cracks and crevices in walls and floors are sealed or caulked.
__ Drain covers are removed, and drains are cleaned weekly.
__ Incoming shipments of food and supplies are inspected for pests and rejected if infested.
__ Stored products are rotated on a "first-in-first-out" basis.
__ Stored products are stored off the floor and away from walls.
__ Food products are stored in refrigerators or in pest-proof containers.
__ All used dishes and utensils are cleaned by the end of the day.
__ All surfaces are cleaned and dry by the end of the day.
__ Surfaces in food preparation and serving areas are regularly cleaned of any grease deposits.
__ Areas around all appliances are cleaned to remove dust and grease at least monthly.
__ Vending machines are maintained in clean condition inside and out.
__ Food waste is stored in sealed plastic bags before removal from school grounds.
__ Wiping cloths are disposable or laundered daily.
__ Mops and mop buckets are properly dried and stored.

Bathrooms

__ Cracks and crevices in walls and floors are sealed or caulked.
__ Drain covers are removed, and drains are cleaned regularly.
__ Rooms are cleaned daily, and trash is removed.

Appendix 2. Examples of Action Thresholds

These pest action thresholds were developed by the Maryland Department of Agriculture. They are for example only. Schools are urged to develop their own action thresholds.

Pest	*Classroom / Public Areas*	*Maintenance Areas*	*Infirmary*	*Kitchen*	*Grounds*
Common ants	5/room	5/100 square feet	1/room	3/room	2 mounds/yard
Carpenter ants	3/room	3/room	1/room	2/room	1 nest within 25 feet
Bees **Honey** **Bumble** **Carpenter**	1/room	3/room	1/room	1/room	If children are threatened; 1 carpenter bee/ 5 linear feet
Cockroaches	2/room	5/room	1/room	1/room	If noticeable or invading
Crickets	3/room	10/room	1/room	2/room	If nuisance
House flies	3/room	5/room	1/room	1/room	5/trash can; 10/dumpster
Lice (head or body)	*Take no action — refer to nurse*				
Mice	1/room	1/room	1/room	1/room	Activity in student area
Rats	1/room	1/room	1/room	1/room	Any activity
Silverfish	1/room	3/room	1/room	2/room	N/A
Spiders, poisonous	1/room	1/room	1/room	1/room	1/activity area
Spiders, other	1/room	1/room	1/room	1/room	Only if nuisance
Wasps, hornets	1/room	1/room	1/room	1/room	If threatening children; 10/10 minutes at trash

Appendix 3. General Recommendations for Pesticide Applications

The following recommendations should be followed by all pesticide applicators. They are designed to minimize pesticide exposure to people and other nontarget species. Even if your school hires professional contractors to apply pesticides, the school is ultimately responsible for ensuring that risk to all building occupants is minimized. Take all appropriate steps to ensure that pesticides are used safely. Ask your contractor to adhere to the following guidelines to minimize risk.

IMPORTANT: It is unlawful in most states for unlicensed persons to apply any pesticides (any chemical sold for control of a living organism, including insects, rodents, weeds, molds, plant diseases, and others) in schools. Check with your state pesticide regulatory agency (see appendix 4) for your state laws.

- Read and follow all label instructions.
- Choose a pesticide that specifically mentions **on its label** the pest you are trying to control and the site where you intend to apply it. Choose materials that are as pest-specific as possible, rather than those that kill many types of insects, including the beneficial ones.
- Notify students, staff, and interested parents of upcoming pesticide applications. Pay particular attention to those individuals who may be more sensitive to pesticide exposure. Laws in some states require such notification.
- When pesticide treatments are required, whenever possible use a spot-treatment method of application (that is, limit treatment to affected areas).
- Limit the use of sprays, foggers, or volatile formations. Where possible, use baits and/or applications to cracks and crevices instead. These treatments maximize the exposure of the pest to the pesticide while minimizing pesticide exposure for the occupants.
- Limit the exposure of children to pesticides. Apply pesticides in areas inaccessible to children. Keep nonvolatile insecticidal baits in tamper-resistant bait stations.
- Use rodenticides (mouse and rat poisons) only when mechanical trapping is not possible or to reduce a very large rodent population to manageable levels. When rodenticides are necessary, place them in locations inaccessible to children and nontarget species and/or in tamper-resistant bait boxes. Securely lock or fasten shut the lids of all bait boxes. Place bait in the baffle-protected feeding chamber of the box. Never place the bait in the runway of the box, where it may be accessible to children or spill out.
- Apply pesticides only when occupants are gone or in areas where they will not be exposed to the material applied. Note any reentry time limits listed on the label, and be aware that some residues can remain long after application.
- Use proper protective clothing or equipment when applying pesticides.
- Properly ventilate areas after pesticide application.

- Keep copies of current pesticide labels, consumer information sheets, and material safety data sheets (MSDSs) easily accessible. These should be kept at a central location, managed by a designated person, and organized so the right one can be found quickly in an emergency. Key people should be aware of them and know where they are kept.
- Keep records of all pesticide applications in an accessible location on school property. The date, time, and exact location of treatment; name and formulation of the pesticide; amount that was applied; and type of equipment used should be recorded.

Pesticide Selection

Pesticides used in the United States must be registered by the U.S. Environmental Protection Agency (EPA), and the pesticide's EPA registration number must be listed on the label. (Note: Some pesticides containing active ingredients with minimum risk potential—such as white pepper or mint oil—are exempt from federal registration, but registration is required by some states.)

In a school setting, only pesticides that pose the least hazard should be considered. These can be identified by the signal word "CAUTION" on the label. The label also contains information concerning potential risks to wildlife and groundwater and surface waters. Select a pesticides with the following characteristics:

- is effective against the target pest
- has low acute and chronic toxicity to mammals
- degrades rapidly
- kills a narrow range of target pests
- has little or no effect on nontarget organisms

Products that often possess many of these characteristics include pheromones (insect odor attractants), insect growth regulators, repellents, nonvolatile insecticidal baits, desiccating dusts, pesticidal soaps and oils, and some botanical pesticides.

Appendix 4. Contacts for IPM in the Northeast

State governments and university extension systems recommend and promote the use of IPM for any urban or rural situation in which pests may be encountered. For more information about IPM programs in your state, contact the following individuals. Updated listings of these contacts may be obtained from the U.S. Environmental Protection Agency's Nationwide Directory of IPM in Schools at <http://www.epa.gov/r5ptb/pest/ipm/index.html>.

Connecticut

Diane Jorsey
Connecticut Department of Environmental Protection
Pesticides Division
79 Elm Street
Hartford, CT 06106
Phone: (860) 424-3369

Lorraine Los
University of Connecticut Cooperative Ext. Service
College of Agriculture and Natural Resources
1376 Storrs Road
Storrs, CT 06269-4036
Phone: (860) 486-3435
E-mail: ilos@canrone.cag.uconn.edu

Delaware

Larry Towle
Delaware Department of Agriculture
2320 South Dupont Highway
Dover, DE 19901
Phone: (302) 674-5504
E-mail: larry@smpt.dda.state.de.us

Susan Whitney
University of Delaware
Cooperative Extension Service — Pesticides
Department of Entomology and Applied Ecology
Newark, DE 19717
Phone: (302) 831-8886
E-mail: susanwhitney@mvs.udel.edu

Maine

James F. Dill
University of Maine Cooperative Extension
491 College Avenue
Orono, ME 04473-1295
Phone: (207) 581-3879
E-mail: jdill@umce.umext.maine.edu

Gary Fish
Maine Department of Agriculture
Board of Pesticides Control
28 State House Station
Augusta, ME 04333
Phone: (207) 287-2731
E-mail: gary.fish@state.me.us

Kathy Murray
Maine Department of Agriculture, Food, and Rural Resources
28 State House Station
Augusta, ME 04333-0028
Phone: (207) 287-7616
E-mail: kathy.murray@state.me.us

Maryland

Edward A. Crow
Maryland Department of Agriculture
Pesticide Regulation Section
50 Harry S. Truman Parkway
Annapolis, MD 21401
Phone: (410) 841-5710
E-mail: crowea@mda.state.md.us

Michael Raupp
Department of Entomology
University of Maryland
4112A Plant Sciences Building
College Park, MD 20742-4454
Phone: (301) 405-8478
E-mail: mr7@umail.umd.edu

Massachusetts

Brad Mitchell
Massachusetts Department of Food and Agriculture
251 Causeway Street, Suite 500
Boston, MA 02114
Phone: (617) 626-1700
E-mail: brad.mitchell@state.ma.us

William M. Coli
Department of Entomology
University of Massachusetts
Agricultural Engineering Building
Amherst, MA 01003
Phone: (413) 545-1051
E-mail: wcoli@umext.umass.edu

New Hampshire

Alan T. Eaton
Spaulding Hall
University of New Hampshire
Durham, NH 03824
Phone: (603) 862-1734
E-mail: alan.eaton@unh.edu

New Jersey

Ann R. Waters
Pesticide Control Program
New Jersey Department of Environmental Protection
P.O. Box 411
Trenton, NJ 08625-0411
Phone: (609) 984-5014
E-mail: awaters@dep.state.newjersey.us

George Hamilton
Office of Pest Management
Rutgers University
New Brunswick, NJ 08901-8524
Phone: (732) 932-9802
E-mail: hamilton@aesop.rutgers.edu

New York

Michael Hoffmann
New York State IPM Program
New York State Agricultural Experiment Station
Geneva, NY 14456-0462
Phone: (315) 787-2353
E-mail: mph3@cornell.edu

Mary Roy
New York State Department of Environmental Conservation
Bureau of Pesticides Management
625 Broadway
Albany, NY 12233-7254
Phone: (518) 402-8781
E-mail: maroy@gw.dec.state.ny.us

Pennsylvania

Lee Bentz
Pennsylvania Department of Agriculture
Bureau of Plant Industry, Room G11
2301 North Cameron Street
Harrisburg, PA 17110-9408
Phone: (717) 772-5204
E-mail: lbentz@agric.state.pa.us

Ed Rajotte
The Pennsylvania State University
Cooperative Extension Service
501 ASI Building
University Park, PA 16802
Phone: (814) 863-4641
E-mail: edrajotte@psu.edu

Rhode Island

Richard A. Casagrande
Department of Plant Sciences
210-A Woodward Hall
University of Rhode Island
Kingston, RI 02881
Phone: (401) 874-2924
E-mail: casa@uriacc.uri.edu

Vermont

Lorraine P. Berkett
University of Vermont
Plant and Soil Science Department
6 Hills Building
Burlington, VT 05405-0082
Phone: (802) 656-0972
E-mail: lberkett@zoo.uvm.edu

Phil Benedict
Vermont Department of Agriculture
Plant Industry Division
116 State Street, Drawer 20
Montpelier, VT 05620-2901
Phone: (802) 838-2431
E-mail: phil@agr.state.vt.us

Appendix 5. IPM Record Forms

PEST SIGHTING LOG

Date	*Time*	*Location*	*Pest*	*Number of Pests*	*Person Reporting Sighting*	*Recommended Action*	*Date Action Completed*

PESTICIDE USE LOG

Date	*Time*	*Location*	*Targeted Pest*	*Pesticide Name*	*EPA Registration Number*	*Active Ingredients*	*Application Method*	*Concentration and Amount*

Glossary of Pest Management Terms *(Modified from Hollingsworth 2000)*

Action threshold — The point at which pest control measures are applied to avoid economic, medical, and/or aesthetic damage.

Arthropod — Any invertebrate of the phylum Arthropoda, having a segmented body, joined appendages, and a hard shell composed of chitin, including insects and other organisms such as spiders, mites, and ticks.

Bait — A formulation of a pesticide that contains a poison and a food attractant. These formulations are often considered less hazardous than sprays, as human exposure to the toxicant can be minimized.

Biological controls — Pest control measures that rely on natural controls such as pathogens, parasites, predators, and natural enemies. This type of control is largely limited to agricultural and ornamental pests, rather than structural pests.

Biopesticide — (also known as biological pesticides) Certain types of pesticides derived from such natural materials as animals, plants, bacteria, and certain minerals. Biopesticides are usually inherently less harmful than conventional pesticides.

Bioremediation — In fly management, the use of microbes and enzymes to break down organic substances in drains and plumbing lines, thus reducing fly habitat.

Certification (IPM certification) — Designation that an individual or organization has met specific standards of IPM competency and professionalism.

Crack-and-crevice treatment — Application of small amounts of chemical directly into cracks and crevices where insects, especially German cockroaches, hide and enter.

Cultural practices — Established activities used in IPM whereby one manipulates conditions within an environment to reduce or avoid pest presence and damage.

Dusts — A pesticide formulation consisting of a pesticide active ingredient and a carrier such as talcum powder or corn cobs.

Education — The process by which someone acquires knowledge and develops skills, such as in the use of IPM techniques for pest control.

Exclusion — A physical control method that prevents pests from entering a structure—for example, sealing cracks and openings (also referred to as pest-proofing).

Fungicide — A pesticide used to control fungi.

Good practice — Using the preferred and/or proper way to control a pest in various situations.

Harborage — An area or site that pests find suitable for living, such as a cluttered and unclean place.

HEPA (high-efficiency particulate-arresting) air filter — A filter that removes very small particles (larger than 0.3 micron), including dust, dust mites, pollen, tobacco smoke, animal dander, mold spores, and bacteria.

High-risk pesticides — Refers to those legally registered materials and products that will control pests effectively but are used only when nonchemical and low-risk pesticides have proven to be inadequate in the management of a pest problem.

Insecticide — A pesticide used to manage or prevent damage caused by insects.

Insecticide baits — Insecticides formulated with an attractant, either enclosed inside a bait station or applied directly to cracks and crevices. These formulations generally reduce potential chemical exposure.

Inspection — Systematically investigating or otherwise looking for signs of pest presence, damage, and conditions that favor their survival.

Integrated pest management (IPM) — A systematic strategy of managing pests that considers prevention, avoidance, monitoring, and suppression. Where chemical pesticides are necessary, a preference is given to materials and methods that promote public safety and reduce environmental risk.

IPM practitioner — A person who specializes in the practice of IPM.

Low-risk pesticides — Those legally registered materials and products that control a pest effectively and pose low risk to people, children, pets, and the environment. NOTE: Some pesticides may have relatively high toxicity but are formulated to minimize human exposure, such as some insecticidal bait formulations.

Material safety data sheet (MSDS) — A written document that provides product users and emergency personnel with information and procedures needed for handling and working with chemicals.

Mechanical control — Physical and/or nonchemical controls such as traps, barriers, caulks, sealants, and vacuuming.

Monitoring — Closely tracking or recording pest activity, density, and location.

Multiple catch traps — Mechanical devices that are attractive to certain kinds of pests, such as mice, and that automatically reset themselves and can catch many mice.

Pest-proofing — Using materials such as caulking and sealants, steel wool, weatherstripping, and screening to minimize and eliminate pest entry and harborage in structures.

Perimeter treatment — A chemical treatment involving the application of a pesticide to the exterior surface of the foundation of a structure in order to kill and/or repel pests.

Pheromones — Chemicals released by various organisms as a means of communication with others of the same species, usually as an aid to mating. Pheromones are often used as attractants in traps.

Reentry time — The time specified on a pesticide label between when a pesticide is applied and when it is considered safe to enter the treated area. Reentry times vary with individual pesticides.

Rodenticide — A pesticide used to control rodents, especially mice and rats.

Sanitation — Eliminating or cleaning up conditions such as food, water, and clutter that attract pests.

Sighting log — An ongoing record documenting specific information pertaining to pest sightings and problems, such as their date and location.

Spot treatment — Application of a chemical to limited areas—usually not more than 2 square feet.

Sticky trap — A nonchemical device that has a sticky surface that catches insects and/or related organisms. It is used as a monitoring tool to confirm the presence and identity of pests and as a direct control device for pests such as mice.

Tamper-resistant — Refers to the placement of pesticides inside a bait station designed to minimize exposure to children, pets, and nontarget animals.

Traps — Nonchemical devices that catch or kill pests. These devices can be used for both monitoring and mechanically controlling a pest problem.

Void treatment — An application of a pesticide, usually a dust, into spaces within a structure, such as within walls, where pests may be living.

Volatile organic compound (VOC) — An important source of indoor air pollution. VOCs include paints, paint strippers, and other solvents; aerosol sprays; cleansers and disinfectants; moth repellents and air fresheners; and hobby supplies.

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Hollingsworth, C. S. and W. M. Coli. 2000. *Integrated Pest Management in Massachusetts Schools.* University of Massachusetts Extension Publication AG-1403.

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Maryland Department of Agriculture. 1995. *Integrated Pest Management in Schools: IPM Training Manual.* 56 pages.

Maryland Department of Agriculture. 1997. *Summary of Structural Pest Control Programs and Implementation of Integrated Pest Management (IPM) in Maryland Public School Systems.* 37 pages.

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U.S. Environmental Protection Agency. 1993. *Pest Control in the School Environment: Adopting Integrated Pest Management.* 43 pages.

Vacco, D. C. 1996 (revised). *Pesticides in Schools: Reducing the Risks.* New York State Department of Law. 32 pages.

Vail, K. M. 1997. *Suggested Guidelines for Managing Pests in Tennessee's Schools: Adopting Integrated Pest Management.* University of Tennessee Agricultural Extension Service Document PB 1603. 44 pages.

General Pest Management Information

Bennet, G. W., J. M. Owens, and R. M. Corrigan. *Truman's Scientific Guide to Pest Control Operations.* 5th edition. Purdue University.

Gillott, Cedric. 1980. *Entomology.* 2nd edition. New York: Plenum Press.

Gorham, J. Richard, ed. 1991. *Insect and Mite Pests in Food: An Illustrated Key.* Volumes 1 and 2. Washington, DC: U.S. Department of Agriculture.

Mallis, A. 1997. *Handbook of Pest Control.* 8th edition. Mallis Handbook and Technical Training Company. 1,456 pages.

Mitchell, B. 1997. *Integrated Pest Management Kit for Building Managers.* Massachusetts Department of Food and Agriculture.

National Pest Control Association, Inc. (NPCA). 1998. *Urban IPM Handbook.* Dunn Loring, VA: NPCA. 149 pages.

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Smith, E. H. and R. C. Whitman. 1992. *Field Guide to Structural Pests.* Dunn Loring, VA: National Pest Control Association, Inc.

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Sweetman, Harvey L. 1965. *Recognition of Structure Pests and Their Damage.* Dubuque, Iowa: Wm. C. Brown Company Publishers.

Additional Resources

WEB SITES

Note: The Internet is a dynamic environment. Some of the links below may not be active when you use this resource.

Children's Health

U.S. Environmental Protection Agency Office of Children's Health Protection
<http://www.epa.gov/children/>

American Lung Association School Programs
<http://www.lungusa.org/school/>

Children's Environmental Health Network
<http://www.cehn.org/cehn/resourceguide/rghome.html>

IPM for Schools

These web sites provide information on the organization and implementation of IPM programs for schools as well as specific information on pest problems as they apply to schools.

State-Specific Sites

Connecticut — *Connecticut Integrated Pest Management (IPM) Program for Schools*
<http://www.hort.uconn.edu/ipm/ipmscool.htm>

Florida — *Integrated Pest Management in Schools: University of Florida*
<http://schoolipm.ifas.ufl.edu/>

Illinois — *Practical Guide to Common Pests in Schools*
<http://www.pestweb.com/ipca/contents.html>

Massachusetts — *Massachusetts School IPM*
<http://www.umass.edu/umext/schoolipm>

Maine — *Maine School IPM Program*
<www.state.me.us/agriculture/schoolipm>

New York — *IPM Workbook for New York State Schools*
<http://www.nysipm.cornell.edu/publications/schoolwkbk.pdf>

Pennsylvania — *The Pennsylvania IPM Program: School IPM*
<http://paipm.cas.psu.edu/schools/schoolIPM.html>

Tennessee — *Suggested Guidelines for Managing Pests in Tennessee's Schools: Adopting Integrated Pest Management*
<http://web.utk.edu/~extepp/ipm/pb1603.pdf>

Texas — *Adopting Integrated Pest Management In Texas Schools*
<http://www.spcb.state.tx.us/ipm/Adopting%20IPM%20In%20Schools.htm>

Vermont — *Vermont Public Interest Research Group: Healthy Schools Initiative*
<http://www.vpirg.org/campaigns/environmentalHealth/healthy_schools.html>

Wisconsin — *Wisconsin's School Integrated Pest Management Manual*
<http://ipcm.wisc.edu/programs/school/default.htm>

National Sites

The IPM Institute of North America
<http://www.ipminstitute.org/>

Safer Pest Control Project
<http://www.spcpweb.org/>

U.S. Environmental Protection Agency — *IPM in Schools*
<http://www.epa.gov/pesticides/ipm/>

IPM for Schools: A How-To Manual
<http://www.epa.gov/region09/toxic/pest/school/index.html>

Indoor Air Quality Tools for Schools Kit
<http://www.epa.gov/iaq/schools/tools4s2.html>

Pest Information

Specific pest information can also be found in a number of the school IPM web sites cited as well as the general pest information web sites.

General

IPM in the Northeast
<http://northeastipm.org>

Pest Control Technology Magazine Online
<http://www.pctonline.com/>

PestWeb <http://www.pestweb.com/>

University of Maryland Structural Urban Entomology Program
<http://pest.umd.edu/ipm/structural/urbanIPM.html>

University of Vermont Extension — Household and Structural Pest Management: General Management Recommendations
<http://ctr.uvm.edu/ctr/pubs/apc829a.htm>

Specific Pests

Ants

North Carolina Cooperative Extension Service — Biology and Control of Carpenter Ants
<http://www.ces.ncsu.edu/depts/ent/notes/Urban/carpant/carpant.htm>

Ohio State University Extension Service — Carpenter Ants
<http://www.ag.ohio-state.edu/~ohioline/hyg-fact/2000/2063.html>

Carpet Beetles

University of Vermont — Carpet Beetles
<http://ctr.uvm.edu/ctr/el/el27.htm>

Virginia Cooperative Extension — Carpet Beetle
<http://www.ext.vt.edu/departments/entomology/factsheets/carpbeet.html>

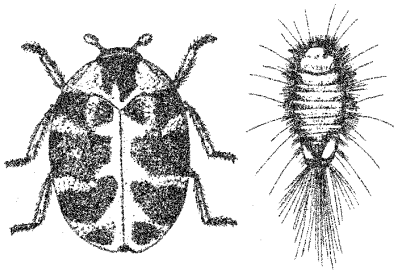

Figure 38. Carpet beetle, *Anthrenus scrophulariae* — adult (actual size ¼ inch) and larva
Source: Cornell Agricultural Experiment Station

Centipedes

Iowa State University — House Centipede
<http://www.ipm.iastate.edu/ipm/iiin/housece.html>

Ohio State University Extension Service — Centipedes
<http://www.ag.ohio-state.edu/~ohioline/hyg-fact/2000/2067.html>

Cockroaches

University of Illinois at Urbana-Champaign — Managing German Cockroaches
<http://www.ipm.uiuc.edu/publications/infosheets/104-gcockroach/mgc.html>

University of Massachusetts — The Cockroach Home Page
<http://www.bio.umass.edu/biology/kunkel/cockroach.html>

University of Nebraska Cooperative Extension — Least Toxic Cockroach Control
<http://www.ianr.unl.edu/ianr/lanco/enviro/pest/factsheets/120-94.htm>

Fleas

Colorado State University — Fleas
<http://www.colostate.edu/Depts/IPM/natparks/fleas.html>

University of Florida Cooperative Extension Service — Fleas <http://edis.ifas.ufl.edu/scripts/htmlgen.exe?DOCUMENT_IG087>

Flies

Integrated Fly Management by Actron, Inc.
<http://www.actroninc.com/flash/ifmflash.htm>

Ohio State University Extension Service — Drain Flies
<http://www.ag.ohio-state.edu/~ohioline/hyg-fact/2000/2071.html>

Figure 39. Cat flea (left), *Ctenocephalides felis,* and dog flea (right), *Ctenocephalides canis* (both actual size ⅛ inch)
Source: U.S. Department of Agriculture

Ohio State University Extension Service — Vinegar Flies (Drosophila *spp.)*
<http://www.ag.ohio-state.edu/~ohioline/hyg-fact/2000/2109.html>

Head Lice

Harvard School of Public Health — Head Lice Information and Frequently Asked Questions
<http://www.hsph.harvard.edu/headlice.html>

National Pediculosis Association
<http://www.headlice.org>

University of Nebraska Cooperative Extension (Lancaster County) — Head Lice Management
<http://www.ianr.unl.edu/ianr/lanco/enviro/pest/factsheets/018-99.htm#No-nit>

Microbial Pests and Disinfectants

Cleaning Products Pilot Project (CPPP)
<http://www.epa.gov/opptintr/epp/cleaners/select/index.htm>

The Commonwealth of Massachusetts Environmentally Preferable Products Procurement Program
<http://www.state.ma.us/osd/enviro/products/cleaning.htm>

Green Seal <http://www.greenseal.org/>

Janitorial Products Pollution Prevention Project
<http://www.westp2net.org/Janitorial/jp4.htm>

U.S. General Services Agency Federal Supply Service. Safer Paints, Cleaning and Other Chemical Products
<http://www.fss.gsa.gov/environ/safer-chemicals.cfm>

Millipedes

Ohio State University Extension Service — Millipedes
<http://www.ag.ohio-state.edu/~ohioline/hyg-fact/2000/2067A.html>

University of Maine Cooperative Extension — Millipedes
<http://pmo.umext.maine.edu/factsht/Mill95.htm>

Rats and Mice

Oregon State University — Database of IPM Resources: Rodent Pests
<http://www.ippc.orst.edu/cicp/pests/rodents.htm>

Silverfish

Washington State University — Quick Answers: Silverfish and Firebrats
<http://www.cahe.wsu.edu/~hp31/qa88r.htm>

Stinging Insects

North Carolina Cooperative Extension Service — Biting and Stinging Pests
<http://www.ces.ncsu.edu/depts/ent/notes/Urban/biting.htm>

Ohio State University Extension Service — Bee and Wasp Stings
<http://www.ag.ohio-state.edu/~ohioline/hyg-fact/2000/2076.html>

Stored-Product Pests

Nearctica — Stored-Product Pests
<http://www.nearctica.com/family/pests/home/stored.htm>

Termites

Iowa State University — Iowa Insect Information Notes: Termites in Iowa
<http://www.ipm.iastate.edu/ipm/iiin/termites/>

University of Maryland — Termite Links and Literature
<http://pest.umd.edu/ipm/structural/urbanIPM.html#termite_links>

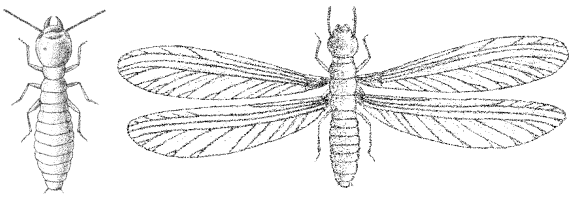

Figure 40. Termite worker (left) and winged termite (right)
Source: Gorham 1991

University of Nebraska Cooperative Extension — Termites
<http://www.ianr.unl.edu/pubs/Insects/g1062.htm>

Pesticides

EXTOXNET: Extension Toxicology Network
<http://ace.orst.edu/info/extoxnet/>

New York Coalition for Alternatives to Pesticides
<http://www.crisny.org/not-for-profit/nycap/nycap.htm>

University of Florida — Technical Information: Pesticides
<http://schoolipm.ifas.ufl.edu/techp.htm>

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Turfgrass Problems: Picture Clues and Management Options (NRAES-125)

This pocket guide helps in identifying turfgrass problems and implementing appropriate management strategies to maintain healthy plants. Over 130 color photos are included to help pinpoint problems that affect cool-season turfgrasses (such as creeping and colonial bentgrasses, Kentucky and annual bluegrasses, fine-leaf and tall fescues, and perennial ryegrasses). The abiotic section covers 18 chemical, physical, and mechanical types of damage that can lead to turfgrass injury or death. The biotic portion is divided into three sections: diseases, insects, and weeds. Each problem discussion includes photos, a detailed description, conditions under which the problem tends to occur, and nonchemical management strategies. Other features include a chapter on scouting and sampling procedures; symptom timelines that tell when a certain disease, insect, or weed is likely to emerge; growing degree days information; and a glossary. (2001, 214 pages)

*Home*A*Syst: An Environmental Risk-Assessment Guide for the Home* (NRAES-87)

Home*A*Syst helps people assess homes for pollution and health risks. Eleven chapters cover site assessment, stormwater management, drinking water well management, household wastewater, hazardous household products, lead in the home, yard and garden care, liquid fuels management, indoor air quality, heating and cooling systems, and household waste management. (1997, 122 pages)

Implementing Pheromone Technology in the Northeast (NRAES-83)

The importance of pheromones for pest surveying and management has grown stronger over the years. This publication includes nine papers that contain benchmark information about the use of pheromones. Current pheromone technology is discussed, including the types of pheromone traps and lures, pheromone-mediated mating disruption, and commercial applications. Also discussed is how pheromones are used in the many crops and commodities of the Northeast. (1996, 65 pages)

Pesticides and Groundwater: A Guide for the Pesticide User (NRAES-34)

This guide discusses groundwater movement and contamination, pesticides in the environment (including site factors and pesticide properties), applicator practices, and health effects of groundwater contamination. A drawing of a sample pesticide label is included as well. The guide will be of interest to pesticide users and rural residents concerned about protecting groundwater resources. (1995, 26 pages)

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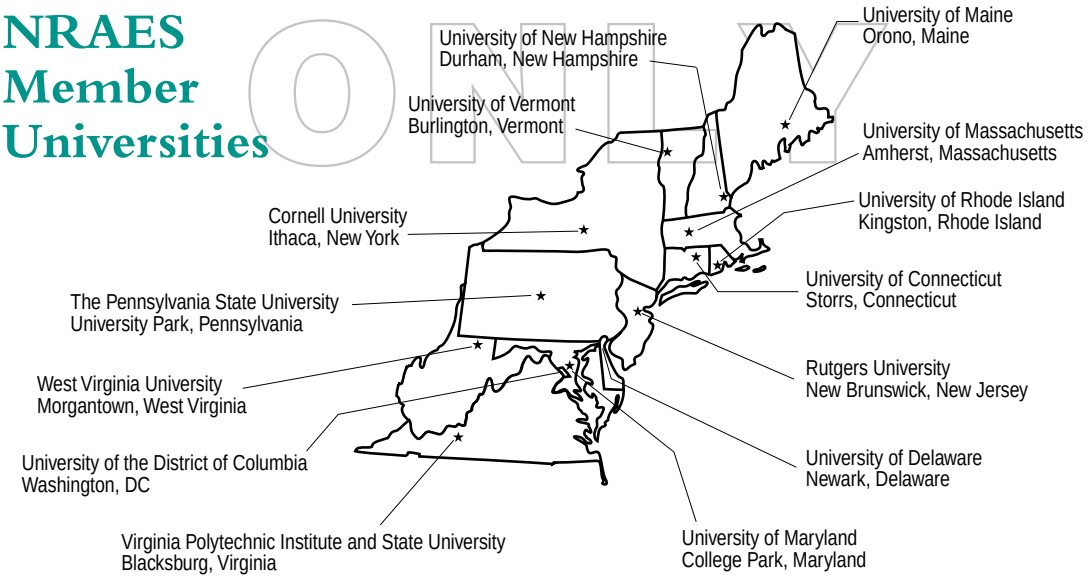

Natural Resource, Agriculture, and Engineering Service (NRAES)
Cooperative Extension
152 Riley-Robb Hall
Ithaca, New York 14853-5701
Phone: (607) 255-7654 • Fax: (607) 254-8770
E-mail: nraes@cornell.edu • Web site: www.nraes.org

Marty Sailus, NRAES Director
Jeffrey S. Popow, NRAES Managing Editor

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ISBN 0-935817-61-6

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