Exploring Urban Integrated Pest Management

Activities and Resources for Teaching K-6

Written and Developed by

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All lessons in this resource as well as updates and links can be found on the internet at: **www.pested.msu.edu**

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We would like to thank all of the individuals who helped test many of these lessons during the 2000-2001 school year at Emerson Elementary School in Saginaw, Michigan. We tested these ideas in a slightly different format as an IPM classroom. Modeled after the G.A.P. Agribusiness classroom, the Integrated Pest Management (IPM) classroom brought facilitated activities/lessons or field trips on related topics to both 4th grade classes at Emerson once a week for the entire school year. **Erica Jenkins, Demetrius Swilley, Kim Thiel and Lorna Keaner** co-taught the class to all 53 4th grade students at Emerson Elementary. We are indebted to all who participated in this endeavor including the following:

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53 4th graders at Emerson Elementary, 2000-2001 school year

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Welcome to the Urban and School IPM Resource for Teachers and Kids in Grades K-6!

Why Should We Teach About Integrated Pest Management?

Integrated pest management (IPM) is "real-world" science in action. IPM involves using knowledge about pest biology and habitats to choose the best combination of common-sense practices to keep pests under control. In greenhouses, fields, yards, and inside homes and schools, IPM uses a series of steps that result in making pest management decisions that control the pests with the least effect on people, pets and the environment.

Pests are everywhere. Everyone has had experiences with pests. Have you been bitten by mosquitoes or horse flies? Has your garden been overrun by weeds or eaten by insects? Have head lice ever spread through the school? Have you ever had a reaction to poison ivy? Whether it is insects and diseases that attack plants, weeds that invade yards or fields, or cockroaches and rats that can get inside our houses and schools, all students have had experiences with pests. By learning about IPM, students get to use science in a context they can relate to.

About This Resource

We have designed this resource as a flexible tool for teachers of kindergarten through sixth grade. We use the topic of integrated pest management in the school and home as a theme to engage the students in multidisciplinary learning in science, math, art, social studies, language arts and health. Through these activities students use skills ranging from reading and writing to problem-solving and analytical thinking.

This resource provides the opportunity for educators in formal and informal settings to use IPM as the real-world theme in which to engage in scientific and interdisciplinary learning. In the

Goals of This Resource

- To stimulate students to think critically about the world and community around them.
- To help protect children's health through increased awareness and behavioral changes related to the safe management of pests.
- To show students how to use science, judgement, and decision-making in a real-world, hands-on setting.
- To increase awareness of the hazards of pests and pesticides and how our actions can lessen these hazards.
- To provide a tool to use in connection with community IPM and school IPM education efforts.
- To show students how their actions, behaviors and choices can impact their environment and community.
- To provide an opportunity for fun, exciting, science education that is relevant to students in urban and all communities.
- To provide an opportunity for students to communicate with the entire school and create an exciting teamwork atmosphere towards integrated pest management in their school.

following pages we provide teachers with background information, hands-on activities, worksheets and resources to help teachers engage the students in real-world learning.

There are many ways to use this resource in the classroom. While some of the lessons build on previous learning, most of the lessons can stand alone. IPM can be used as a theme in the classroom for a whole year or individual activities can be selected as enrichment to regular classroom activities. For example, inspection and monitoring activities can be done weekly, monthly or as often as desired to provide continuity throughout the year and show how things change over time.

We recommend that you use these classroom activities in combination with IPM in the school. In Michigan, IPM is required in all schools. Many other states have mandatory or voluntary school IPM programs, and federal legislation requiring IPM in schools may be on the horizon. (For more information on IPM in your state, see EPA's National School IPM Directory at http://www.epa.gov/reg5foia/pest/ipm/index.html)

Successful IPM programs in schools require participation and behavior changes by everyone who uses the school. Involve the principal and administrators. Talk with other teachers, food service workers and custodians. If the IPM manager is not on staff, but from a Professional Pest Control Company, it is a great idea to invite this person to meet with you and/or the class.

The enthusiasm of the kids that develops by doing the activities found in this resource guide will foster an awareness of how they influence their surroundings, will create a feeling of "ownership" of the building, and can help create overall enthusiam by everyone in the building. From our experience, the students take their responsibilities in these endeavors very seriously. For example, several 4th grade students were shocked at seeing potato chip bags in a fellow student's locker. "Don't you know that will attract pests!" they said.

The Urban Pesticide Misuse Problem

The presence of pests in the home is an issue of major concern in many communities throughout the country. More information is being learned every year about the link between cockroaches and asthma and other health risks created by pests. The stigma associated with having pests in the home, and the dislike and fear of pests, have contributed to homeowners resorting to desperate measures in an attempt to control them. This desperation has resulted in the misuse of pesticides and potentially dangerous exposure of pesticide residues to homeowners and their families.

In 1999, Michigan State University received a grant from the U.S. Environmental Protection Agency (EPA) Region 5 and the Michigan Department of Agriculture (MDA) to establish community IPM working groups in three urban, low-income areas in Michigan. These groups would address pesticide and pest issues in the community and develop educational programs to meet the

Why is IPM in Schools and Homes Important?

The public's concerns about health and environmental risks associated with chemicals are increasing, particularly when children are involved. As the public becomes more aware of the health and environmental risks pesticides may pose, interest in seeking the use of equally effective alternative pest control methods increases. Children are especially vulnerable to chemicals, as well as the health hazards posed by pests. It is important that we make the environments where children spend their time at as safe as possible.

It is in everyone's best interest to reduce exposure to potentially harmful chemicals. Integrated pest management provides a safer alternative to scheduled spraying of pesticides for pest control. In many cases, long term management of pests can be achieved without using any pesticides by following IPM principles.

needs of each community.

The premise behind this project was that preventing pesticide misuse starts with engaging a community and gathering groups of people to communicate and provide input to solve a problem. Schools are a focal point for many urban communities, thus it makes sense to use schools and, by extension, children, parents, and administrators, as a conduit for educating the surrounding community about pesticide misuse, and effective and affordable methods of indoor pest management.

This project collaborated with the Michigan Department of Agriculture and several urban community groups to develop an outreach program that links classroom curricular activities with a broader community educational program using members of the community to implement and deliver outreach programs. We wrote this resource to bring the concept of IPM into the classroom and link what the children were learning with needs in their home and community.

Resources

There are many great resources available to teachers and schools to learn more about pests, pesticides and IPM. There are also many curricular resources that can be used to supplement IPM activities in the classroom. The following links also appear on the MSU Pesticide Education Program website.
http://www.pested.msu.edu/CommunitySchoolIpm/school.htm

IPM in Schools Resources

The National School IPM website

-Sponsored by EPA and maintained by the University of Florida, this is the number one resource site for school IPM.
http://schoolipm.ifas.ufl.edu/

Pest Control in the School Environment: Adopting Integrated Pest Management

The U.S. Environmental Protection Agency, Office of Pesticide Programs, 1993. (EPA 735-F-93-012)
-Provides a simple overview to IPM in schools
In html: www.epa.gov/oppfead1/cb/csb_page/publications/
To order: phone: 1-800-490-9198, or order online www.epa.gov/ncepihom/ordering.htm

IPM for Schools: A How-to Manual

Daar, S., Drilk, T., Olkowski, H. & Olkowski, W. 1997. The United States Environmental Protection Agency, Region 9.
-A comprehensive resource that outlines in detail all the steps to creating an IPM Program in your school, and has specific sections on the management of key school pests such as ants, cockroaches, and yellowjackets.
In pdf: http://www.epa.gov/region09/toxic/pest/school/index.html

IPM Technical Resource Center for IPM in Schools and Daycare Centers

-Funded by EPA, region 5, this center provides information, assistance and links for IPM in schools in EPA, Region 5 (Wisconsin, Minnesota, Indiana, Illinois, Ohio and Michigan)
http:/www.entm.purdue.edu/entomology/outreach/schoolipm/ipmfront.htm

The National Directory for School IPM

-Maintained by EPA region 5, this site lists activities relevant to school IPM on a state-by-state basis, along with contact information for each state.
http://www.epa.gov/reg5foia/pest/ipm/index.html

IPM Institute of North America, Inc. website

-A site maintained by this non-profit group, containing many links and other information related to IPM in schools and agriculture.
http://www.ipminstitute.org

Wisconsin's School Integrated Pest Management Manual

Stier, J., Delahaut, K., Pellitteri, P. & Becker, B. 2000. UW-Extension.
-Outlines the steps for implementing IPM in schools and on school grounds, and includes forms and tips on controlling the most common pests.
In html: http://ipcm.wisc.edu/programs/school/

Classroom Resources

Pennsylvania State University School IPM Education Resources

-The premier clearinghouse for IPM curricular resources, this website includes a comprehensive searchable database on teaching resources related to IPM as well as lessons and links.
http://http://paipm.cas.psu.edu/schools/schoolEduc.htm

Join our Pest Patrol

Minnesota Department of Agriculture, 2000.
-Excellent resource and activity sheets on IPM targeted to upper Elementary students (activity sheets and teacher information in pdf format.)
http://www.mda.state.mn.us/ipm/IPMPubs.html
or call: 651-297-3217

The Insectiganza of Excitement

4-H Cooperative Curriculum System, 1997.
-A 4-booklet set of entomology activities. Purchase the entire set or individual books based on grade level. (for fee only)
Available from the University of Minnesota Extension Service
To order, call: (800) 876-8636
Or order online: http://www.extension.umn.edu/units/dc/item.html?item=06883

University of Florida's Best of the Bugs Website

-This site provides links to websites judged by entomologists at the University of Florida to be the best that the web has to offer on insects. Excellent sites for teachers and kids.
http://pests.ifas.ufl.edu/bestbugs/

Purple Loosestrife Project K-12 Educational Materials

Purple Loosestrife Project, Michigan State University
-Comprehensive and creative lesson plans and resources for K-12. Project focusses on Purple Loosestrife as an invasive species and biological control methods to control it. Classroom tested and aligned with Michigan Curriculum Benchmarks.
http://www.msue.msu.edu/seagrant/pp/html/what_s_new.html

Florida 4-H Bug Club

-An excellent website for kids from the University of Florida. The site provides lesson plans, games, and a lot of information for kids about insects.
http://bugweb.entnem.ufl.edu/bugclub/

Using Live Insects in Elementary Classrooms

Center for Insect Education Outreach, University of Arizona, 1997.
-K-6 curriculum which includes 20 lesson plans that utilize insects to teach all kinds of concepts to young learners. Includes activity sheets, fact sheets, and rearing sheets on the insects used. (free on website)
http://insected.arizona.edu/uli.htm

Katerpillars (& Mystery Bugs) Website

University of Kentucky Entomology Department
-This site is fun and educational for younger kids. It includes activities and links to teaching resources, including lesson plans for field and classroom experiments.
http://www.uky.edu/Agriculture/Entomology/ythfacts/entyouth.htm

The Quest for Less-Activities and Resources for Teaching K-6

United States Environmental Protection Agency, Office of Solid Waste, 2000.
– An excellent complete resource guide on natural resources, waste management, recycling, composting, source reduction and landfills. The Quest for Less provides hands-on lessons and activities, enrichment ideas, journal writing assignments and other educational tools and skills relating to reusing, reducing and recycling waste. (free government publication)
In pdf: http://www.epa.gov/epaoswer/osw/kids/quest/index.htm
To order: Call: 1-800-490-9198, or online at http://www.epa.gov/ncepihom/ordering.htm

Yucky Roach World Website

Discovery Communications
- A great kid-friendly site about roaches. Includes IPM techniques to keep them away.
http://yucky.kids.discovery.com/noflash/roaches/

index.html

The K-8 Aeronautics Internet Textbook
Cislunar Aerospace, Inc., 1997.
-K-8 activities and lessons on aeronautics. The insect section of the lesson plans contains many creative lessons for Elementary and Middle school students on insect flight. Developed by Cislunar Aerospace, Inc. in cooperation with University of California, Davis with funding from NASA.
http://wings.ucdavis.edu/Curriculums/Insects/index.html

EPA Student/Teacher Websites
-The main EPA site for teacher resources, student assistance and kids education. Provides links to lessons, activities and resources from all the divisions in EPA.
http://www.epa.gov/epahome/students.htm

EPA Office of Pesticide Programs Student Website
- Student website with links to interactive activities and information on pesticides, pesticide safety and the environment.
http://www.epa.gov/pesticides/kids.htm

Pesticide Safety Bingo
The United States Environmental Protection Agency, Region 6.
-Lesson plans, bingo cards, and information on pesticide safety and IPM in urban areas for grades K-6.
http://www.epa.gov/region6/6pd/bingo/index.htm

Pests Have Enemies Too: Teaching Young Scientists About Biological Control
Jeffords, M.R. & Hodgins, A.S. 1995. Illinois Natural History Survey, Champaign, IL, special publication 18.
-Excellent resource guide and lesson plans for middle school students on biological control. (for fee only) *To order:* call (217) 333-6880
http://www.inhs.uiuc.edu/chf/outreach/MidSchool.html

IPM

What is IPM?

IPM stands for **Integrated Pest Management**. IPM is an effective and environmentally sensitive approach to pest management that uses a combination of common-sense practices. Knowledge about pest biology and habitats are used to select the best combination of common-sense practices that will keep pests under control. In greenhouses, fields, yards, and inside homes and schools, IPM uses a series of steps that result in making pest management decisions that control the pests with the least effect on people, pets and the environment.

Understanding the needs of pests is essential to implementing IPM effectively. Pests seek habitats that provide basic needs such as air, moisture, food, and shelter. Pest populations can be prevented or controlled by creating inhospitable environments, by removing some of the basic elements pests need to survive, or by simply blocking their access into buildings. Habitat modification may be used in combination with traps, vacuums, biological control or pesticides. An understanding of what pests need in order to survive is essential before action is taken.

By anticipating and preventing pest activity and combining several pest control methods, you can achieve long-term results.

Key Points

- Integrated Pest Management (IPM) is an approach to managing pests effectively with the least effect on people, pets and the environment.
- IPM focuses on prevention of pests through sanitation and habitat modification. We look at why the pests are there.
- The six steps in IPM are: inspect and investigate, identify and learn, monitor, choose control methods, evaluate and educate.
- Proper identification of pests, knowledge of their biology, and careful monitoring allow us to target our control methods where the pests are, resulting in effective management with the least effect on people, pets and the environment.
- When we use pesticides as part of the IPM program, we choose pesticides with the lowest toxicity that are applied with the least exposure to people and the environment.

Through IPM you will:

- Identify the pests.
- Take away their water.
- Take away their food.
- Take away their hiding places.
- Eliminate the existing population.
- Deny entry into the building.

Through IPM we identify and fix conditions that contribute to pest problems.

Why Not Just Use Pesticides Alone?

After World War II, pesticides became a widely available and very effective way to kill pests. They were considered almost magical in what they could do. But by the 1960s it was becoming apparent that there were downsides to the overreliance on pesticides. Some problems include:

- resistance, when the pest is no longer controlled by the pesticide
- movement away from the site of application
- contamination of food, water, air , and people
- exposure to people, pets and wildlife
- high cost from frequent applications
- kill beneficial organisms like lady beetles.

Pesticides can also be misused or used in such a way that people are exposed to them as much or more than the pests are. The presence of pests can create panic that can lead to overuse.

Aladdin's Magic Lamp (circa 1960s) would spread a film of a highly toxic pesticide on all surfaces in the room.

What is a Pest?

A pest is any living thing (plant or animal) that bothers or annoys us, our pets or animals, damages things we value, occurs where we do not want it, or causes or spreads disease. This is a pretty broad definition, and in fact people don't always agree that something is a pest. A dandelion may be a pest to one person and a wildflower to another. A cockroach can be a pest to one person and food to another!

What is a Pesticide?

A pesticide is any substance or mixture of substances used to prevent, destroy, repel pests or reduce the damage pests cause.

While people often think that pesticides are chemicals aimed at insects, common pesticides include household disinfectants such as bleach and kitchen and bathroom cleaners aimed at bacteria. Other common pesticides include those targeted at insects (insecticides), rats and mice (rodenticides), weeds (herbicides), and fungi (fungicides).

All pesticides sold in the U.S. must comply with the requirements of the Environmental Protection Agency (EPA). Most products are registered directly with the EPA and contain their stamp of approval, an EPA Registration Number, on the label.

Some newer products may contain active ingredients that are considered "minimum risk". These are exempt from EPA registration, but must still comply with minimum EPA standards. These products will not have an EPA number.

Additionally, all pesticides must be sold in the manufacturer's original, unopened container with a complete label. It is illegal to sell pesticides in containers without a complete label.

The IPM Decision-Making Process

The IPM approach to pest management uses a basic decision-making process. While the strategies and tactics may change, the steps taken to determine if and when treatment is needed and which methods to use are the same each time. Instead of remembering many specific "recipes" for pest control, pest managers use this decision-making process for all pests. This process helps determine:

- **If** treatment is necessary
- **Where** treatment activity should take place
- **When** action should take place
- **Which** strategies and tactics are best to use

The following pages will provide detail on the overall process that we use to answer these questions.

The IPM Steps

IPM follows six basic steps. Each step is described below with examples. Most of the examples in this resource deal with IPM in schools, homes and other buildings. In managing pests of plants, we would still follow the same basic steps, but the monitoring and control methods would be slightly different.

1. Inspect and Investigate

An inspection reveals where the pests are coming from, what pests might be present, and what conditions are present that can contribute to pest problems. This is the detective stage. Clues gathered from talking to people and inspecting the building and grounds provide a picture of pests, areas, and problems that need to be addressed.

Look for:

- pests
- signs of pests and damage caused by pests (droppings, cast skins)
- conditions good for pests

Discover:

- What pests do you have?
- Where are they coming from?
- What are they eating?

The results of the inspection should be recorded on a form showing what was found in each room or area of the building. Maps of the rooms and building should be made or obtained. The initial inspection helps form the basis for an overall pest management plan. Inspection doesn't end when the management plan is written. Inspections need to occur on a regular basis to monitor and evaluate the pest situations.

2. Identify and Learn

Correct identification of a pest is important in IPM. Knowing that it is a bug is not enough. Since different species have different habits and preferences, knowing the exact identification will aid in the management process.

Once the pest is identified, read about its life-cycle, food sources, preferred habitats, special skills, and natural enemies. The best management plan will take all of these factors into account.

For example, house mice are very curious animals and are constant nibblers. They also travel next to walls and other surfaces and travel the same route over and over. The knowledge of this behavior tells us that snap traps placed next to walls where we have seen signs of the mice (droppings, etc.) should be effective at removing the current population. The Norway rat has different habits and would requires different strategies for control. If the actual animals are not visible, then identification requires knowing the difference between rat droppings and mouse droppings, and looking at damage, footprints, and other signs left behind.

3. Monitor

Monitoring is the regular and ongoing inspection of areas where pest problems are occurring or could occur. Information from these inspections is gathered and recorded. Monitoring:

- helps determine if, where and when treatment is needed.
- helps pinpoint infestations and problem areas.
- allows you to evaluate and fine-tune treatments.

Is the population increasing or decreasing? On plants, is the natural enemy population increasing? Has the population reached a level where treatment is necessary? For many indoor and public health pests, the amount we can tolerate is zero or close to zero. In this case, monitoring helps us detect new populations quickly, thus making control easier.

Aids are available to assist in monitoring for many pests. For German cockroaches, we can place sticky traps in places near where we think they are living. Regular checking of the traps will tell us if the population is increasing or decreasing, if the make up of the population is changing (are we catching more nymphs than adults?), and what direction they are traveling in. Sticky traps and other monitoring traps are available for many pests.

4. Choose Control Methods

As mentioned before, IPM emphasizes prevention. We do this by identifying and removing (if possible) the causes of the problems, rather than simply attacking the symptoms (pests).

The information that was gathered in the

previous steps helps determine the best control methods to pick for a particular situation.

Treatment strategies should be:

- least hazardous to human health.
- least disruptive to natural controls in landscapes.
- least toxic to nontarget organisms.
- most likely to be permanent and prevent the recurrence of the pest problem.
- cost-effective in the short and long-term.
- appropriate to the site.

Possible Control Methods Include:

Habitat Modification

In order to prevent pests, we need to learn what about the building or grounds is providing the pests with the habitat they need to thrive. We then modify the habitat so that it no longer provides the pest with a suitable environment in which to live. Habitat modification may involve:

- **Sanitation.** Frequent and careful cleaning can eliminate food for pests. Reducing clutter takes away hiding places.
- **Designing or altering the structure.** Incorporate pest-resistant structural materials, fixtures and furnishings. For example, in commercial kitchens stainless steel wire shelving on rolling casters reduces roach habitats and facilitates sanitation.
- **Eliminating sources of water.** Fixing leaks and eliminating standing water can take away water and moisture that pests need to survive.
- **Eliminating the pest habitat.** Caulking, filling holes and fixing broken doors or windows helps keep the pests from returning. Removing dense vegetation near building eliminates rodent hiding places.

Physical

Physical control methods generally involve mechanical or non-chemical ways of killing or removing existing pests. Some choices include:

- trapping.
- vacuuming.
- barriers.
- "fly swatters", or removing pests by hand.

Biological Control

Using natural enemies of the pest is one choice for control. Examples of this are cats (who eat mice) or tiny wasps that lay their eggs inside the eggs of cockroaches.

Pesticides

Pesticides may be used in combination with other control methods. Pesticides chosen for the IPM program are usually used when needed to help eliminate existing populations. Other means such as habitat modification keep the pests from coming back.

We choose the least toxic options and target them at where the pests are living and people will not come into contact with them. Fogs and bombs are not used in IPM.

If we use pesticides, we choose and use them as they are intended. This means reading and heeding all instructions on the pesticide label.

5. Evaluate

Evaluation provides a regular opportunity for participants in the IPM program to examine the monitoring records and check to make sure that the program is addressing the pest problems. This step also allows you to adjust and improve the program. Ask yourself the following questions:

- Were the actions we took necessary or would the problem have gotten better without action?
- Did the actions we took and treatments we used solve the problem?
- Could we manage the problem better next time?
- Do we need more or better information to aid in pest management decisions in the future?

6. Educate

Educating others is an important step through all stages of an IPM program. Information that will help change people's behavior, especially in how they dispose of garbage and store food, plays a very key part in successfully managing pests. Even young children can do their part to take food, water and hiding places away from pests.

#1 *Classroom Activity* Grades K-6

Friend or Foe?

Overview

All living things have roles in the environment. Through discussion, activities, and games, students learn how the location of a living thing affects whether it is considered a pest.

Objectives

Students will:

- discuss what makes something a pest.
- learn that being a pest can depend on the situation or location.

Materials

"When is a pest not a pest?" teacher sheet, green and red paper, markers or crayons, pencils, plain paper
optional: scissors, glue or tape

Subjects

science, language arts, art

Duration

1 hour

Background

A pest is any living thing (plant or animal) that bothers or annoys us, our pets or animals, damages things we value, occurs where we do not want it, or causes or spreads disease. This is a pretty broad definition, and in fact people don't always agree that something is a pest. A dandelion may be a pest to one person and a wildflower to another.

We spend a lot of time and money battling pests. It is important to remember that pests aren't "trying" to hurt or bother us. All living things have roles in the environment. Depending on their roles in food chains and food webs, living things can be producers, consumers, predators, prey or decomposers. Each of these roles is important for food webs to function. But what happens when decomposers like termites infest your house? Decomposing old trees in the forest is important. Decomposing your house is a problem, and makes them pests.

Doing the Activity

Step 1: *Discussion.* Ask: *What is a pest? What are things that pests do that make them pests to us?* Key points include: bothers or annoys, damages things, occurs where we don't want it, makes us sick. Ask: *What are some examples of pests?* Write the examples of pests on the board or overhead as the students suggest them. The first suggestions are usually brothers or sisters and insects. Encourage students to give examples of plants or mammals in addition to insects.

Step 2: *Pest or NOT a Pest Game.* Hand out green and red pieces of construction paper to each student. Have the students write "pest" on the red piece of paper and "NOT a pest" on the green sheet. Read examples from the "When is a pest not a pest" teacher sheet. Instruct the students to hold up the red sheet when they think it is a pest, and the

green sheet when they think it isn't. You may wish to start with silly examples like an elephant in your living room or a tree growing through the window into our classroom. With smaller groups you may choose to make one wall in the room "pest" and the other wall "NOT a pest." Instruct the students to run or walk to the correct wall.

Step 3: ***Craft Activity.*** Students choose one plant or animal. At the top of the page each student writes *"Name of living thing* can be:." Divide the bottom half of the page into two sections. On one section write "a pest" and on the other section write a useful purpose for the animal (food, pollinator, decomposer, etc.). Draw pictures for each option. One adaptation of this activity is to make flaps to go over the pictures. Cut out the flaps from another piece of paper and tape or glue the top edge to the paper.

A mouse can be:	
a pest	food

Step 4: *Complete The Story.* Start by saying a sentence about an animal to the class. For example, one day an elephant decided to go to the city. Go around the room and have each student add a sentence to the story. It can get very silly.

Closure/Assessment: Ask the students what a pest is and what makes it a pest. Give students examples of pests, and ask for suggestions on what to do. For example: If I find a ladybug in my living room what could I do? *Take it outside.* If I see poison ivy in the woods, what should I do? *Stay away.*

Enrichment

Ask students to write a story about an animal (real or pretend) that becomes a pest when it goes to the wrong place.

Supplemental Worksheets

From The Minnesota Department of Agriculture IPM Program, *Join Our Pest Patrol-A Backyard Activity Book for Kids- An Adventure in IPM* http://www.mda.state.mn.us/IPM/IPMPubs.html

1. What's a Pest? http://www.mda.state.mn.us/IPM/PestPatrol/WhatsAPest.pdf
2. Insect Pests and Pals http://www.mda.state.mn.us/IPM/PestPatrol/PestsAndPals.pdf

Answers: http://www.mda.state.mn.us/IPM/PestPatrol/Answers.pdf

When is a pest not a pest?

Teacher suggestions: The following are some examples for the *Pest or NOT a Pest* game in step two. As part of the activity, randomly read the name of an organism and where it is or what it is doing. Feel free to develop your own examples and embellish the ones below. For example, say: *a rabbit eating the lettuce in my garden.*

Name	Pest	Not a Pest
raccoon	In house, garage, garbage cans	forest
mosquito	biting us, spreading diseases	food for bats and fish
maggots	making meat or vegetables rotten	decomposing dead animals
termites	eating houses or buildings	decomposing wood in forests
rabbits	garden	field or woods
deer	in a cornfield, in your garden	forest
algae	covering a pond	food for fish
mouse	house, spreading diseases	food for snakes, other animals
fruit flies	inside flying around fruit	eating rotting fruit on the floor of an orchard
bees	sting us	pollinating flowers and making honey
lady beetle	inside your house	outside, eating aphids and other small insects
house fly	annoy us, spread disease	food for birds, decompose animal waste

Adapted from:
"When is a Pest Not a Pest" *in* Jeffords, M.R. & Hodgins, A.S., 1995. *Pests Have Enemies Too: Teaching Young Scientists About Biological Control,* Illinois Natural History Survey, Champaign, IL, special publication 18.

#2 *Classroom Activity* Grades K-6

Create an Animal

Overview

Students use their knowledge of habitats to create an animal and the habitat it lives in.

Objectives

Students will:

- learn about the components of a habitat.
- demonstrate their knowledge through a craft project.

Subjects

science, art

Materials

paper (card stock or tag board are preferable), craft supplies: some suggestions- googly eyes, pipe cleaners, tissue paper, sand, glitter, colored paper, raffia, feathers, glue, markers, scissors

Duration

45 minutes to 2 hours depending on time devoted to follow-up activities

Background

A habitat provides an organism with everything to survive. Habitats vary tremendously in terms of size and appearance. Regardless of size or location, a habitat needs to include important things such as food, water, shelter, protection, light and air.

Pests also need these things. In IPM, we use the knowledge of what specific pests need in their habitat to control them. Once we know what they get from a habitat, we can take things away or modify the habitat. In this activity students use their knowledge of habitats to create an animal (or pest) and its habitat.

Doing the Activity

Step 1: *Discussion.* Ask: *What is a habitat?* A place where a living thing lives and gets what it needs to survive. *What needs to be in a habitat?* Responses may include: food, water, shelter, air, light, space, temperature, humidity, protection from predators, etc. Based on their responses, discuss why each of these things is needed for living things to survive.

Step 2: *Craft Activity.* Tell the students: your task is to create an animal and its habitat out of the art supplies we have brought (or draw.) Keep in mind all of the things needed in a habitat. The animal should also fit into the habitat. For example, if you create a hot-pink animal, then a part of the habitat may need to be hot pink to provide protection for the animal from predators.

Instruct students to write in the top corner of the paper : their name, name of their animal, where it lives, what it eats and what eats it (its predator). Encourage the students to be creative and descriptive. This does not need to be an existing animal! See the student example.

Step 3: ***Create a story. (optional)*** Ask the students to think about the animal they created. Have them write a story about an adventure or typical day for their animal. Older students should include descriptions of the habitat and how it provides food, water, shelter and other needs for the animal. (See student example).

Closure/Assessment: Ask: *How many people created the habitat first? How many people created the animal first? What did you need to think about when you created the habitat?*

Review key concepts by asking: *Who can remind me of one thing that needs to be in a habitat? What would happen to your animal if we took away its food? Water? Shelter? Protection?*

Enrichment/Adaptations

1. Create a pest. Who is it a pest to (humans, other imaginary animals, etc.)? What makes it a pest?

2. Create the natural enemy of the pest.

3. *For older students:* A major part of IPM is modifying the habitat so the pest can no longer get what it needs there. Ask students to write and share with the class what they can you do to the habitat they created so that the animal can't live there anymore. Some solutions include taking away the sources of water and food, changing the temperature, humidity, light, air, or protection, or adding more natural enemies. These are all things we do in IPM with real pests.

Student Example

The Black, Red-eyed Dragon

by Dezi C.
4th grade, Emerson Elementary
Saginaw, Michigan

Name: Black, Red-eyed Dragon
Where it lives: Planet Mercury
What it eats: meat of baby grunts
What eats it: grunts

The Black, Red-eyed Dragon is like a beast. Its habitat is on planet Mercury. It lives on a volcano. Its skin is like an egg. The skin protects its body.

The Black, Red-eyed Dragon eats baby Grunts because that is all there is to eat. Its home is a cave. The Black-Red-eyed Dragon drinks the lava from the volcanoes. Grunts eat Black, Red-eyed Dragons when they are weak. If a Grunt tries to eat it when its healthy, it will fly away.

The Black, Red-eyed Dragon lives for 50 years then it lays eggs. The eggs hatch in 8 months. When its two, it grows spikes on its back. At age 10 its eyes turn red. At age 20, it grows wings and lives on.

#3 Classroom Activity Grades 3-6

What is IPM?

Overview

In Integrated Pest Management (IPM) we use knowledge about pest biology, habits, and habitats to choose the best combination of common sense practices that will keep pests under control. Through reading, discussion, and crafts, students learn the steps in IPM and how they go together.

Objectives

Students will:

- learn the steps in IPM.
- learn how the steps go together.
- learn how their behavior can impact pests.

Subjects

science, art, social studies

Materials

plastic cockroach, mouse, or picture of a pest; student handout; IPM example-photocopy and cut into strips; tag board or construction paper; pencils, markers or crayons; glue sticks or tape; scissors

Duration

1 1/2 hours

Background

Integrated Pest Management (IPM) uses knowledge about pest biology and habitats to choose the best combination of common-sense control methods that will keep pests under control. Whether the pest situation is in a greenhouse, field, yard or inside a home or school, IPM uses a series of steps that result in pest management decisions to control pests with the least harmfull effect to people, pets and the environment.

Review the *IPM Teacher Fact Sheet* and the student handout on the IPM steps. This lesson introduces the concept of IPM to the students and lays the foundation for further exploration and activities.

Doing the Activity

Step 1: *Discussion.* Place a plastic cockroach, mouse or picture of a pest in front of the classroom. Ask: *What is this? Is this something we want in our house or school?* No. Inside a home or school this would be a pest. *What is a pest?* Encourage students to brainstorm about what makes something a pest. Write the suggestions on the board. Answers may include: a pest is any living thing (plant or animal) that bothers or annoys us or our pets or animals, damages things we value, occurs where we do not want it, or causes or spreads disease. *What are some examples of pests?* Students often name insects first; encourage them to suggest mammals (mice, rats, racoons, bats), and plants (dandelions, poison ivy). *How do we get rid of pests?* Often, the majority answers will be pesticides. Encourage the students to think of other methods. For example: *What might I do to get rid of mice?* Trap them. *What might I do to get rid of a mosquito on my arm?* Swat it, smash it.

Say: *I heard a lot of suggestions to use pesticides to kill pests. What are some problems with pesticides?* Like pests, pesticides can make people sick. When you use an insect bomb or fog, the chemical (pesticide) covers all surfaces. This is a

problem because people may contact the pesticide more than the pest does. German cockroaches spend more than 85% of their time in dark, damp enclosed areas. This often means inside walls and under refrigerators and sinks, not on countertops and floors. Spraying pesticides on these areas doesn't get to most of the cockroaches. You may wish to ask: *What happens when your baby brother or sister's toy was in the room? What happens when they pick that up and put it into their mouth?* Another problem is that using pesticides alone does not solve the problem of why the pest is living and thriving there. Ask the students if the pesticides always solve the pest problem.

Write **Integrated Pest Management** on the board. Ask*: Has anyone ever heard of this? What do you think it could mean?* Have the students make suggestions. Define with the class what each word means and what they mean altogether. Integrated means putting things together (think integration). Management means doing things to keep something under control. Integrated Pest Management (IPM) is a way of controlling pests by using several control methods together. We want to keep the pests from coming back.

Step 2: *The Steps in IPM.* Hand out the student sheet on the six IPM steps. Read the steps together. Ask the students to give examples of things to do at each step. *Why do we do each step*? Emphasize that as scientists we want to manage pests scientifically. This means learning what they are, why they are there (how are they getting their food, water and shelter), and using a combination of ways to control them. Investigation, monitoring and prevention are very important in IPM.

Step 3: ***Make Bulletin Board.*** Split students up into 6 groups. Assign one IPM step to each group. Ask the students to write the name of the IPM step in big letters on the tag board. Ask the students to draw pictures and write words around it that are associated with that step. Hang up the student creations on a bulletin board to keep up during the year or duration of this project.

Step 4: *Make Flap Books.* Give each student a 11x17 piece of tag board or construction paper. With the wide side of the paper at the top, draw a line 3 inches from the top. Above the line, write Integrated Pest Management. (See drawing.) Below the line, glue or tape six flaps. Write numbers 1-6 on the flaps. Under the flap write the name of the step and draw and picture and/or write sentences about this step in action.

Closure/Assessment: Photocopy the teacher sheet on the examples of each IPM step. Cut each sentence apart and place in a hat or box. Pull a sentence out and read it. Ask the students which step this is an example of. Continue similarly with the rest of the sentences.

Adaptation: Write each IPM step on its own piece of paper. These will serve as bases. Tape them randomly to the floor in a large room (This works best if they are color-coded with your bulletin board, inspect and investigate is red, identify and learn is blue, etc.). When you read the sentence, have the students move to the step that the sentence corresponds to.

Suggestion

It is helpful to review the steps of IPM before each lesson or activity. Using the bulletin board, the entire class can read the names of the steps together. Ask for examples of what we do in those steps. This serves as a review and helps prepare the students for the new concepts that they will learn.

Internet Fun: Check out this fun site for kids about insects and insect management by USDA. www.ars.usda.gov/is/kids/insects/insectintro.htm

Closure/Assessment Exercise

Examples of IPM

Margaret checked under the sink and around the refrigerator and stove for signs of cockroaches and mice. **#1 inspect and investigate**

Terrance showed his mom, brothers and sisters things they can do to keep pests out of the house. **#6 educate**

Tyesha and her family used caulk to seal the holes and cracks in the walls to keep pests out. **#4 choose control method- habitat modification**

Derrick and his brothers did all of the dishes after dinner, sponged off the counters and swept the floor. **#4 choose control method- habitat modification**

Jasmine and her grandmother placed sticky traps on the floor and counters where they had seen cockroaches and cockroach droppings. Every week they counted and wrote down the number of cockroaches they caught. **#3 monitor**

Students from the school interviewed teachers, custodians and food-service workers to learn what pests they had seen. **#1 inspect and investigate**

Kim and her brother caught some roaches on a trap. They looked through books to identify the type of roaches they have. They learned the type of roach they have, where it likes to live, and what it can do. **#2 identify and learn**

To help control mosquitoes in the city, the City Mosquito Control Department sprayed a bacteria that is a natural enemy of mosquitoes. **#4 choose control method-biological control**

The students looked over records of what pests they found in each part of the building over the last 6 months. They decided that they need to do more in the kitchen and the Kindergarten room. **#5 evaluate**

The IPM team taught the students in the rest of the school ways they can keep pests away by never leaving garbage or food in the lockers overnight or littering. **#6 educate**

All food waste or other garbage is place in sealed bags before they are put in the dumpster. The dumpster lid is kept closed and garbage is never placed outside of the dumpster. **#4 choose control method-habitat modification**

Michael and Brittany collected insects that were eating the plants in their garden. They put the insects in a container and took it to a University for experts to identify it. **#2 identify and learn**

Mrs. Patterson saw ants under her desk. She watched them and saw that they were crawling out of her desk. When she opened the drawer she saw that the ants were crawling all over the candy that she gave out as rewards. **#1 inspect and investigate**

Name: _____ Date: _____

What is IPM?

IPM stands for Integrated Pest Management. It is a way of managing pests with the least effect to people, pets and the environment. You can use this method at school, at home, and on lawns or farms.

IPM has 6 Steps

1. Inspect and Investigate

Look for pests, signs of pests, and conditions good for pests. You are just like a detective. You also want to ask people who spend more time in some parts of the building about what they have seen. Before you investigate, you learn about the pests that could be there so that you know what to look for.

2. Identify and Learn

Identify what pest or pests you have. Some insects you find may have just wandered in and are not serious pests. Knowing what kind it is helps you know whether it is a real pest or just lost. Learning the biology of the pest tells you how fast it reproduces, where it likes to live, what it likes to eat, and special things it can do. In IPM you use this information to figure out ways to control the pest.

3. Monitor

Now you know what pests you have and where they are living. In this step you check problem areas on a regular basis. Depending on the pest, you may use sticky traps for this. Monitoring show you where the pest activity is. By keeping record of the numbers of pests captured, you can learn which methods are working the best.

4. Choose Control Methods

In IPM you want to do things that will control the pests without affecting the people. You use a combination of methods to do this. Some methods include:

Habitat Modification

Careful cleaning to eliminate food and hiding places, fixing leaks, and sealing holes and cracks help take away food water and shelter for the pests.

Physical Methods

These methods include trapping, vacuuming, putting in pest-proof barriers, using fly swatters or removing the pests by hand.

Biological Control

This means using natural enemies of the pest. Examples are cats (who eat mice), or tiny wasps that lay their eggs inside the eggs of cockroaches.

Pesticides

Choose the least poisonous pesticides aimed at specific pests. We place them where the pests are living and people will not contact them.

5. Evaluate

Keep checking to see if the pests are still there and which control methods are working. Change your methods if necessary.

6. Educate

Teach others what they can do to keep pests away.

#4 *Classroom Activity* Grades K-3

In Search of Life

Overview

In this activity students explore the school grounds as scientific explorers in search of living things. Students make a survey of living things present in different habitats, count the different examples they find, and compile their results.

Subjects

science, math

Objectives

Students will:

- learn about habitats and what living things need in them.
- observe and investigate for living things in different habitats.
- count and divide different types of living things into categories.

Materials

hula hoops or rope/tape to lay out different areas to look in, clipboards (optional), pencil, student worksheet

Duration

1 hour

Background

A habitat provides a living thing (organism) with everything it needs to survive. Habitats vary tremendously in terms of size and appearance. Regardless of size or location, a habitat needs to include food, water, shelter, protection, light and air.

School grounds, even in a city, can provide many small habitats that we can observe and discover. Discovering what is living within a habitat requires careful inspection and observation. This activity provides hands-on experience using these skills.

Getting Ready

Select distinct areas of the school grounds that provide different habitats. For example, good choices may be near woodchips or plantings, under a tree, in a damp area, or in the shade. Try to select places that will have different living things. Place a hula hoop or rope circle in the chosen places. This will be where the groups of students will survey for different living things.

It is always a good idea to check the outdoor study areas prior to the activity. Remove any hazards or caution students about them. It helps to have parents, volunteers, aides, or older students as helpers in this activity.

Doing the Activity

Step 1: *Discussion.* There are many different living things all around us. Ask: *What are some groups of living things we might find outside?* Answers might include insects, birds, mammals (squirrels, chipmunks, dogs, cats, etc.), plants, worms, fish, algae, fungi (mushrooms, mold), etc. *Do they all live in the same place?* As age

appropriate, discuss what living things need to survive in a habitat: food, water, shelter, air, protection, space. Discuss how these needs are a little different for every living thing. For example, plants need soil to get water, food, and to stay upright (without blowing away or falling over.) Humans don't need soil in the same way. One place can be a habitat for many different living things. In just one tree, many animals and other organisms can live. Insects can live in the bark. Other insects eat the leaves. Fungi can live on the trunk. Birds can have nests in the branches. Squirrels can collect acorns. When we look very closely, we can find a lot of living things in a small area.

Step 2: ***Outdoor Activity.*** Tell the students that they are scientific explorers looking for signs of life. Their mission is to find as many different types of things living in different habitats at the school as they can. Explain that when they go outside they will change into scientists who are very careful to look for things and write or draw what they see. Tell the students that in addition to looking for plants and animals, they should look and listen for signs of animals. Ask: *How do we know an animal has been there if we don't see it.* Ask the students for suggestions of examples that animals can leave behind. Answers could include: insect egg masses, animal tracks, holes or burrows, droppings, sounds, nibbled leaves or wood chips, tunnels in bark, candy wrappers and garbage (signs of people.) Remind students that humans are living things too, and we leave a lot of signs behind.

Divide the students into small groups and lead them to their different locations. Ask them to write or draw the types of things they find, counting all of the examples for each. For younger students, plants, insects, birds, etc. may be the level of detail you expect. Older students can break these categories into smaller groups. Give the students a set amount of time to do this. Encourage the students to really dig around. Ask them to look under things and examine everything very carefully. If they don't see an actual plant or animal do they see signs that it has been there?

Closure/Assessment: Bring the students back together. Give the students time to draw and/or write what they found. Have each group report on what they found. On the board, write the number of living things in each category (bird, insect, etc.) that the groups counted. Add the numbers for the whole class together. Remind the students that if they kept looking, these numbers would probably be even higher.

Discussion: *Did each group find the same exact things? Why not? How do many different living things live in the same area or habitat?* Answers can include: they find different food to eat; they become food for other living things that live there; they are small enough to share the space with others; they live in different parts of the habitat (one might live above the soil, another might live below the soil). *Are there things people do to make it better or worse for other living things? What are some examples?*

Focus Questions

What are three things all living things need to survive?

Name four examples of things animals can leave behind to show that they were there.

Name four types of living things we see all the time outside.

Name: _____ Date: _____

We Found Signs of


Birds

Number	


Insects

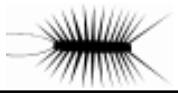
Number	


Mammals

Number	


Plants

Number	


Other

Number	

#5 *Classroom Activity* Grades 4-6

Inspect and Investigate
Interviewing

Overview

In this activity, students are detectives with a mission to gather as much information they can about pests in the school. They interview people in the school to learn what they have seen or heard.

Objectives

Students will:

- gather information about pest problems in the school.
- learn interviewing skills.
- learn to compile and evaluate results.

Subjects

science, social studies

Materials

student interview form, pencil, clipboard (optional)

Duration

½- 1 hour

Background

Inspecting and investigating is the first step in IPM. We need to know what pests we have and where they live to target our management efforts at those pests and places. Interviewing people can help us focus on the problem areas.

Keep in mind, interviewing is a tool. People see and interpret things differently. Interviewing helps narrow the focus, but doing your own inspection is needed to confirm what is there. Because most people do not like seeing pests, they often do not clearly see what they are.

Another reason interviewees may give incorrect information is that many people do not know the specific signs of different pests. When you visit a doctor because of a stomachache, the doctor will ask you specific questions. You may tell them what you think caused the stomachache. It is then the job of the doctor to use the information from you in combination with their own examination to come to a diagnosis.

Inspecting and investigating in IPM works the same way. The IPM team learns some from the interviews and then conducts their own investigation to confirm the specific pests and where they are living.

Getting Ready

It is helpful to inform the people that you intend to interview about this project before you send the students out. Some choices for interviewees: custodians, food service workers, teachers (especially in Kindergarten, Home Economics, and other rooms that may have food or sinks), hall aides, principal and secretary, other students.

Tell the interviewees about the overall project (see introduction to this resource). The students are simply gathering information to learn how you find about pests. Explain that we are teaching the students interviewing and investigating skills, and showing how their own behavior can influence pest problems in the school.

Doing the Activity

Step 1: *Discussion.* Review the steps of IPM (see Lesson #3). Discuss why inspecting and investigating is important in IPM. In IPM we need to find where in the building the pests are living and how they are getting in. Asking people gives us clues. We ask other people in a building what they have seen so that we can start our inspection and investigation in places where we are more likely to find the problem. The next step is to do our own inspection. Remind the students that when we interview, we ask people who spend more time than us in certain parts of the building what they have seen. Ask students who they should interview to learn more about what pests may be in the school. Write the suggestions on the board.

Step 2: *Interviewing.* Hand out the interview worksheets. Assign each student or team a person to interview. They may also choose the person they wish to interview, but beware, the day custodian could be interviewed 20 times, which can be ok for some individuals, but a little much for others!

Step 3: ***Presentations.*** After the interviews, ask the students to present what they learned to the class.

Closure: Make a chart of the types of pests or signs of pests people have seen and where they saw them. Ask the students how we can use this information. Discuss with the class what parts they liked and disliked about interviewing.

Focus Questions

Were you surprised by the answers from the people that you interviewed?

Did they see more pests in the school than you?

Why is is important to ask people where they have seen pests?

What is the first step in IPM? In addition to interviewing what do we do in the first step?

Based on what you learned today, what rooms and places in the building should we focus on when we inspect?

What pests do we need to learn more about?

Interviewing People

Date:_____
Name(s) of interviewer(s):_____
Name of person being interviewed:_____

Read the following to the person you are interviewing. Write down their answers.

My name is (your name or names) and I am from (name of teacher) class. We are learning about a new way to control pests called integrated pest management or IPM. Before we do anything to control pests, we first need to learn what pests are here and where they are. Will you let us interview you as part of this project?

What part or parts of the school do you spend most of your time?

_____

_____

What pests or signs of pests have you seen?

name of pest	*place it was seen*
_____	_____
_____	_____
_____	_____
_____	_____
_____	_____
_____	_____

Have you ever told anyone else at the school about the pests? What have they or you done about the pests?

_____

_____

_____

Do you want any information on any kind of pest? What ones?

_____

_____

Thank you for your time!

#6 *Classroom Activity* Grades 4-6

Wanted Dead or Alive

Overview

In this activity students create wanted posters on pests that could be in or around their school.

Objectives

Students will:
- read about common indoor pests.
- apply that knowledge to create wanted posters.

Materials

All about pest sheets, wanted poster worksheets or posterboard, markers or pencils

Subjects

science, language arts

Duration

½-1 hour

Getting Ready

This activity can be done by individual students or in groups. You can photocopy the blank wanted poster worksheet or have the students create their own posters from scratch.

Doing the Activity

Step 1: *Discussion.* On the board write *Wanted* and a big question mark. Tell the students: *I have a problem. I want everyone in the school to help us be on the look out for pests. What things do they need to know?* Take suggestions from the class. Answers should include the name, a description or what it looks like, signs that it has been there or what it might leave behind when it isn't there (droppings, damage), and where to look for it. *Today we are going to make wanted posters for pests. What other things might be on a wanted poster?* Suggestions might include alias, warning, reward, etc.

Step 2: *Reading About Pests.* Assign each student or group a pest to read about. Give the student/group the *All about* sheet on the assigned pest. You may also decide to read the descriptions aloud as a class.

Step 3: *Making Wanted Posters.* Ask the students to complete the wanted poster using the information they read. Use the blank wanted poster sheets or make posters from scratch.

Step 4: *Sharing Knowledge.* Each student/group presents their poster to the class. Since the students read about different pests, this is the opportunity for the students to learn about all of the pests. Hang the posters around the school.

Closure/Assessment:

Discuss what they learned about each pest. You may wish to use the following questions.

Focus Questions

Name three characteristics you can use to identify your pest.

What are three things that your pest likes to eat?

Name three locations (inside) that you can find this pest.

Name one other interesting fact about this pest that you didn't know before.

Technology Extension

The students can use the internet to find out more infomation about specific pests. The following sites are recommended:

1. Dennis Kunkel Microscopy, Inc.

http://www.denniskunkel.com/PublicHtml/Education05.asp

This site contains rap sheets on many insects. Each rap sheet has an amazing micrograph (picture) of the insect taken by an electron microscope. Very cool site for students.

2. Koday's Kids

http://www.ivyhall.district96.k12.il.us/4th/kkhp/1insects/bugmenu.html

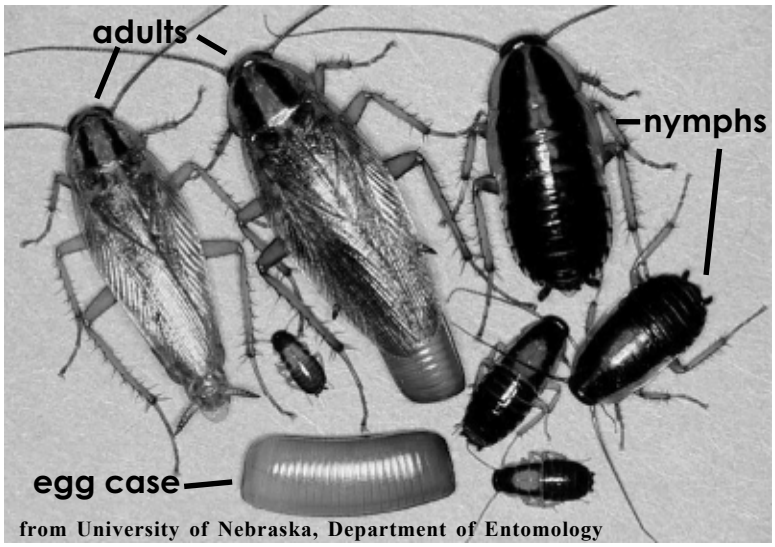
This site has pictures and facts on many insects, not just pests. Designed by the technology director at Ivy Hall School in Illinois, this site is very kid friendly.

3. MicroAngela

http://www.pbrc.hawaii.edu/bemf/microangela/index.html

Another electron microscopy site, this site features electron micrographs of insects and insect pests as well as other microorganisms, cells, and more.

All About the German Cockroach



What It Looks Like

Like all insects, they have six legs, three body parts and two antennae. The adults have wings, and are brown with two black stripes on their thorax (behind the head). Cockroaches do not go through complete metamorphosis. Their young look similar to the adults but do not have wings. These young are called nymphs. The adults can grow as big as 5/8 inch, and the nymphs can be as small as a poppy seed. Eggs are kept in a hard case that the female carries with her until they hatch. German cockroaches are fast runners.

Why it's a Pest

The German cockroach is the most common cockroach found inside houses. They contaminate food and surfaces in the kitchen or bathroom and leave behind droppings that look like black dots. Cockroaches also smell unpleasant and annoy people. The most serious problem with cockroaches is that they cause or trigger asthma. Asthma is a very serious breathing disease. Many people with asthma are very sensitive to cockroaches (dead bodies, old skins, and droppings).

Where it Lives

They like warm, tropical, wet weather. Inside houses they often find these conditions in kitchens, bathrooms and basements. Favorite spots include: under refrigerators, under sinks, near leaky plumbing, near the appliances like stoves, dishwashers, and washing machines, and inside walls. German cockroaches like the dark and spend at least 85% of their time in the dark. They also like pressure on at least two sides of their bodies. If you see a lot of German cockroaches in light, open areas (like countertops), it usually means that the walls are too crowded! You will never see most of the cockroaches.

What it Eats

The German cockroach will eat almost anything. They are scavengers. They will eat any food that people eat or throw away. Leftovers, crumbs, dirty dishes and garbage provide a feast for cockroaches. They also love pet food. They even eat things we don't think are edible like hair, leather, wallpaper, wallpaper paste, soap, and soap scum in bathrooms!

Other Facts

Like all insects, cockroaches have skeletons on the outside of their bodies. This is called an **exoskeleton**. When they grow bigger they need to shed that skin. A new one will harden underneath. When a cockroach goes from one nymphal stage to the next and sheds a skin, we call it **molting**. Each German cockroach can molt as many as 7 times. This means for every adult cockroach, there are 7 old skins lying around. If you have 100,000 cockroaches, that is a lot of skins. German cockroaches can also multiply very quickly. Starting with one female, you can have 100,000 by the end of the year including her babies and their babies and their babies.

All About the House Mouse

What It Looks Like

The house mouse is a rodent with brownish-gray fur. It can be six inches long including the tail. The tail is the same size or longer than the body. The nose is pointy, and the ears are large. The ears are big enough to cover the eyes if someone pulled the ears down (although nobody would!) Like all rodents, mice have whiskers and four legs. Mice do NOT turn into rats!

Why it's a Pest

Mice are linked with many diseases. The common diseases that they spread are often called "food poisoning." One common disease spread by mice is *Salmonella.* Mice leave droppings and urine everywhere that they travel, eat or sleep. When they leave droppings and urine on dishes or in food, they also leave disease-causing germs. When we put our food on that plate or eat that food, we can get sick. Mice also chew wires which can lead to electrical fires. Many fires with "unknown" or "electrical" causes, are caused by the chewing of mice or other rodents.

Where it Lives

House mice like to live near people and often make their nests inside where it is warm and close to food. They shred paper, furniture stuffing, fabrics, and other soft materials to make nests. They rarely travel more than 30 feet from their nest. When food is nearby, they may travel only a few feet.

What it Eats

Cheese is NOT the favorite food of mice. They will eat it, but there are many other foods that mice like better. Mice prefer cereal, grains (oatmeal, wheat, rice, flour), nuts, bird seed, dog food and other related foods. Peanut butter is great to put on traps because the mice like it and have trouble stealing it. They also will eat most types of edible food including crumbs and food left on dirty dishes. Mice nibble, or eat tiny amounts constantly. Mice get most of the water they need from the food they eat, but they will drink if water is around.

Other Facts

Mice can fit through holes the size of a dime. They are very curious and nibble constantly. Mice have poor eyesight and use their whiskers to help them travel around in the dark. In addition to a good sense of touch, mice have excellent senses of smell and hearing. They are most active at night. Animals that are active at night are nocturnal.

Mice travel the same path over and over. Since they leave droppings everywhere, we can find the path and put snap traps along it. Because mice are very curious, they can usually be caught easily. Besides droppings, we can tell mice have been around by nibbling marks, holes in bags and boxes, nests, tracks and noise in the walls.

All About the Norway Rat

What It Looks Like

The Norway rat is the most common rat pest in the United States. It is a rodent with brown to black fur. It can be sixteen inches long including the tail. The tail is shorter than the body. The nose is blunt or rounded, and the ears are small. Rats have very large feet compared to mice. Like all rodents, Norway rats have whiskers and four legs. Rat and mice are different animals. Mice do NOT turn into rats!

Why it's a Pest

Rats can cause many diseases including *Salmonella*, plague and rat bite fever. Some diseases that they spread are often called "food poisoning." Rats leave droppings and urine everywhere that they travel, eat or sleep. When they leave droppings and urine on dishes or in food, they also leave disease-causing germs. When we put our food on that plate or eat that food, we can get sick. Rats bites can also cause people to become sick.

Rats chew wires which can lead to electrical fires. Many fires with "unknown" or "electrical" causes, are caused by the chewing of rats or other rodents. Their constant chewing can damage a lot of property including walls, pipes, and furniture.

Where it Lives

Rats often live in nests made in burrows in the ground. You may see holes to the burrows near concrete, garbage storage areas, in plantings, yards or gardens, or near brush piles. They can also make nests in walls, cluttered areas or storage rooms, or in sewers and storm drains. Rats often travel 100 to 150 feet from their nests in search of food. This means they can have a nest in someone's yard and travel over 100 feet to a different house or dumpster for food. For this reason, everyone in a community needs to be involve in controlling rats. Trying to control them in one house doesn't usually work.

What it Eats

Rats like to eat food high in protein including meat, fish, insects, pet food, nuts and grain. They will eat garbage or most edible food. Peanut butter is a good food to put on traps. Rats hoard or store food in hidden places. They are very cautious about new things. Trapping is often not as successful as with mice, because the rats will be cautious of a new trap. They may also already have food stored away, so they don't need new food. Rats need water every day and prefer nests where water is nearby.

Other Facts

Norway rats can fit through holes the size of a quarter. They are excellent swimmers and can tread water for three days! Their teeth are extremely sharp and can chew through almost anything. They can even chew through metal pipes. Rats are active at night. Animals active at night are nocturnal. Rats have poor vision, but have excellent senses of touch, smell, and hearing. In addition to droppings, you can tell there are rats around by noticing burrows (holes in ground), tracks, gnawing damage, or noises.

All About Ants

What They Look Like

This is a picture of a black carpenter ant queen. All ants are social insects, which means that they live in colonies. There are usually three types of ants in each colony: workers, queens, and males. All ants go through complete metamorphosis. This means they go through four life stages: egg, larva, pupa and adult. There are many different kinds of ants. They are different sizes, colors and eat different things. Like all insects, all ants have three body parts, two antennae, and six legs. All ants have a " thin waist" between the thorax and the abdomen. Termites, which are sometimes confused with ants, have "thick waists." Since there are so many types of ants, the best way to know what type you have is to take it to a University for identification.

Why They are Pests

There are more ants than any other type of social insect (insects that live in colonies). Entomologists, people who study insects, believe there are over 1,000,000,000,000,000, or 1 quadrillion, ants on earth at any time. Most of these are not pests. Black carpenter ants, big black ants, chisel out nests in wood with their jaws. If they are nesting in a house, the chiseling may weaken the house. Another type of ant, the pavement ant, leaves mounds of sand, dead ants, and debris on sidewalks and sometimes in basements or locker rooms. In the South, fire ants sting people. Even if the ants do not sting or cause damage, people do not usually like seeing a lot of them inside!

Where They Live

Black carpenter ants nest outside in hollow trees and stumps or inside in wood or spaces in walls. Inside, they prefer very humid or moist conditions around windows, doors, showers, bathtubs, dishwashers, leaky pipes and drains, and under leaky roof shingles. Even if they nest outside, they may come into houses in the spring or summer looking for food. Pavement ants often nest outside under rocks, at the edges of sidewalks or pavements, door stoops and patios. Inside they are often found in basements or locker rooms, or near cracks in the foundation.

What They Eat

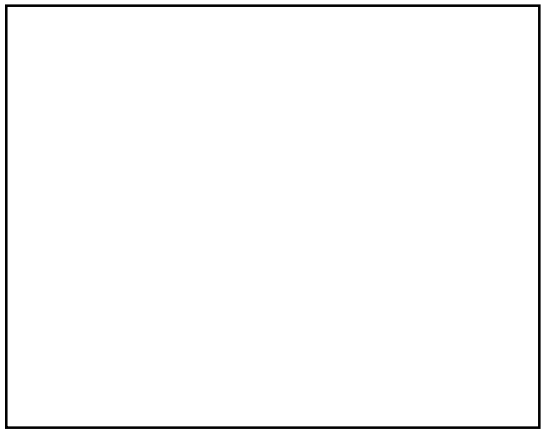
Different types of ants like different foods. Black carpenter ants like to eat fruit juices, sweets, meats, and moist kitchen garbage. They do not eat wood; they just nest in it.

Other Facts

Both black carpenter ants and pavement ants are very tidy. Workers clean out their nests all at once. This results in piles, mounds or dump sites. For black carpenter ants, these piles will contain sawdust, wood pieces, dead ants, and ant parts. The mounds for pavement ants usually contain sand, dead ants, and ant parts. In the Midwest, these are the ants that commonly cause mounds in the cracks in the sidewalk.

IPM TEAM'S MOST WANTED

Pest: _____



Identifying Characteristics:

_____

_____

_____

_____

_____

_____

Wanted for:

_____

_____

Likes to live:

_____

_____

Likes to eat:

_____ _____

_____ _____

Look/Listen for:

_____ _____

_____ _____

Special skills:

_____

_____

_____

IPM TEAM'S MOST WANTED

Pest: House Mouse

Identifying Characteristics:
brown and furry
tail as long as body
5-7inches long (with tail)
makes squeaky noises
whiskers
mammal-4 legs

Wanted for:
spreading germs and making people sick
causing fires by nibbling wires, damaging property

Likes to live:
inside or outside near buildings
in dark, warm places that are close to food

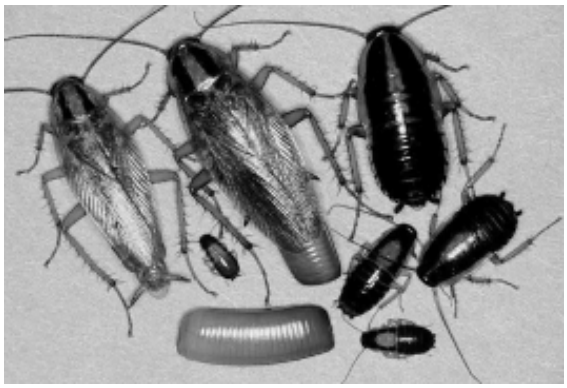
Likes to eat:
peanut butter
cereal
rice, oatmeal and flour
bird seed, dog food

Look/Listen for:
droppings
tracks
nibbling marks and holes
noise in the walls

Special skills:
House mice can fit through holes the size of a dime. They travel the same path over and over. They are very curious and nibble most of the time.

IPM TEAM'S MOST WANTED

Pest: German Cockroach



Identifying Characteristics:
6 legs, 2 long antennae
brown with two black stripes on their back above the wings
adults are 5/8 inch long
fast runners
females carry egg cases

Wanted for:
being the #1 pest causing asthma, making asthma and allergies worse, spreading germs

Likes to live:
in dark, wet places like under sinks and refrigerators, warm areas close to food

Likes to eat:
almost anything
crumbs and leftovers
wallpaper glue
soap

Look/Listen for:
live or dead roaches
old skins or legs
egg cases
droppings-black dots

Special skills:
Starting with one female you can have 100,000 by the end of the year(including her babies and their babies and their babies!)

IPM TEAM'S MOST WANTED

Pest: Norway Rat

Identifying Characteristics:
brown to black hair
tail shorter than body
16 inches long (with tail)
rounded nose, large feet
whiskers
mammal-4 legs

Wanted for:
spreading germs and making people sick
causing fires by nibbling wires, damaging property

Likes to live:
outside: in sewers, storm drains, and tunnels in ground
inside: cluttered areas, storage rooms, in walls

Likes to eat:
peanut butter
fish, meat, garbage
cereal, flour, grain
pet food

Look/Listen for:
droppings
gnawing marks
tracks
burrows in ground

Special skills:
Norway rats can fit through holes the size of a quarter. They are excellent swimmers and climbers. They can gnaw through almost anything.

#7 Classroom Activity Grades 4-6

Inspect and Investigate

Inspecting The School

Overview

Students inspect their school for evidence of pests and conditions good for pests and suggest changes that can be made to help fix the problems.

Objectives

Students will:

- learn the needs of several common indoor pests.
- apply their knowledge by looking for signs of pests and habitats.
- discuss how to modify the habitats they discover.
- learn how the behavior of people affects pests.

Materials

Knowing What to Look For worksheets (one per student per pest. For example, if you do mice, cockroaches, and ants, each student should get three sheets. It may help to copy them on different colored paper), inspection sheets (one per group or per student), clipboard (optional), pencil, flashlight, maps of school

Subjects

science, art

Duration

two class periods- 2 hours

Background

Inspecting and investigating is one of the most important steps in IPM. In this step we check to discover:

- What pests do we have?
- Where are they coming from?
- What are they eating and drinking?

Since we target control methods at the places where pests are living and getting in, the information we learn in the inspection tells us where to start. We discover things that need to be fixed or cleaned. After we learn what pest we are dealing with we can do some research to discover what it needs to live and where it likes to live. All of this information helps us choose the best way to control the pest and focus our energy in the right place.

The key things we are looking for in an inspection are:

- pests (live or dead mice, cockroaches, etc.)
- signs of pests (cast skins, droppings, tracks, damage they have caused)
- conditions good for pests (cracks and holes, clutter, damaged doorways and window, leaky faucets, dirty dishes, etc.)

Getting Ready

Before this activity, talk with the building manager or IPM coordinator for the building about the problems pests and areas for your school. If possible, walk through the building with this person. Choose pests

and places to focus on based on previous problem areas and any new areas you find when you walk through the building. Obtain permission for the students to inspect these areas of the school from the principal and others as your school's policies dictate. For example, the kitchen, teacher's lounge and custodian's closet are often good places for pests, but you should obtain permission before you take the students into these areas. Instead of inspecting the whole school, you may also choose to inspect just specific parts like the cafeteria, lockers, playground, classroom, hallways and doorways, and bathrooms.

It is helpful to have adult helpers for this activity. With the support of your administrator, you may wish to ask the custodian(s) and/or food service workers, the IPM coordinator or pest management personnel to assist the groups in this inspection.

Doing the Activity

Class period 1

Step 1: *Discussion.* Review the IPM steps with the students. Ask: *Why is inspecting and investigating so important?* Emphasize the need to know what pests we have and where they are coming from. If the students interviewed people in the school, review what they learned from the interviews. Remind the students that we need to have proof that the pests are here. Talking to people is the first step. The next step is gathering clues on what pests we might have in our school.

Step 2: *Learning About Pests.* Remind the students that since we are scientists, we need to know as much as we can about what we are looking for before we look for it. Review the wanted posters if completed. Based on your conversations with the IPM coordinator or pest management personnel and your own inspection, choose the pests you wish to focus on. Complete pest profile worksheets with the class on the these pests. You may wish to copy the pest profile sheets onto overhead projector sheets and complete the pest profile sheets with the class.

Class period 2

Step 3: *The Inspection.* Split the students into smaller groups (groups of 5 or less tend to work better). Assign an adult and a part of the school to each group. Review the inspection form with the class so they know how to fill it out. Review the procedures before you hand out the clipboards and flashlights! Give a flashlight, clipboard and inspection worksheet to each group. They should also bring one set of the pest profile worksheets. It may help to assign students specific jobs (for example: recorder, flashlight holder, person who will report to the class). Each group inspects their assigned part of the building or grounds. After about 15 minutes students should return back to the classroom and complete the inspection sheet.

Step 4: *Presenting Findings.* Each group should choose a person to present their findings to the class. When they report to the class, they should say who was in their group, where they inspected, what they found, and what they decided people could do to change what they found.

Closure/Assessment. Enlarge the maps of the school so that they are poster-size. Develop a color-code for each pest (ie. green=cockroaches, red=mice, blue=ants, yellow=other). Have a member of the group put a colored thumbtack or use a marker to show what they found in their part of the building. Discuss with the class what they found. The following questions may aid in discussion.

Focus Questions

What pests are problems in our school?

Where do we need to monitor for pests?

Why did some areas of the school show more signs of pests than others?

What can we do to prevent or keep out pests in these areas?

What do adults need to do?

Places to Inspect

Inside:

Teacher's lounge (refrigerator, pop machine, sink, furniture)

Bathrooms (sinks, seals around toilets)

Cafeteria

Kitchen

Doorways

Hallways

Classrooms (windows, baseboards, sinks, closets, near desk, cluttered areas, art supplies, snacks)

Locker rooms and lockers

Outside:

Dumpster

Doorways

Plantings next to the building

Gutters and overhang of roof

Windows

Holes or damage on building

The Inspection
Guidelines for Adult Helpers

Each group should have:

- Clipboard
- Flashlight
- Pencil
- Inspection sheet
- Wanted poster
- One copy of each *Knowing What to Look For* worksheet

1. Familiarize yourself with the information on the pest profile forms as well as the questions on the inspection forms.

2. Take your group to the assigned room/place in the school.

3. Remind them that they are looking for signs of cockroaches, mice and other pests as well as conditions that are good for pests (leaks, holes/cracks, space around doors or windows, clutter, food/crumbs).

4. Have them inspect the area with one person recording what they find on the sheet.

5. As they inspect, point out to the students what each has found. Remind them that they are looking for things the pests can eat, places they can hide, ways they can get in, as well as signs of the pests themselves.

Return to the room and allow the students complete the section on the inpection sheet on what kids can do and what adults can do.

Conditions Good for Pests

Inside

1. Dirty dishes
2. Food or crumbs on the floor, carpet, counters
3. Grime around drains, sinks, refrigerators, stoves
4. Leaky pipes, sinks, faucets, water fountains
5. Pet food or water (and the spills around them)
6. Food in unsealed bags or boxes
7. Empty pop cans and other cans for recycling (not rinsed or in sealed containers)
8. Garbage cans without tight-fitting lids
9. Garbage or litter
10. Cracks around doors and windows
11. Holes or cracks in walls or floors.
12. Clutter (piles of stuff that pests can hide in or behind)

Outside

1. Holes in the building
2. Broken gutters
3. Cracks around doors and windows
4. Plants growing on or into the building
5. Dumpster- garbage not in bags or outside the dumpster, no lid

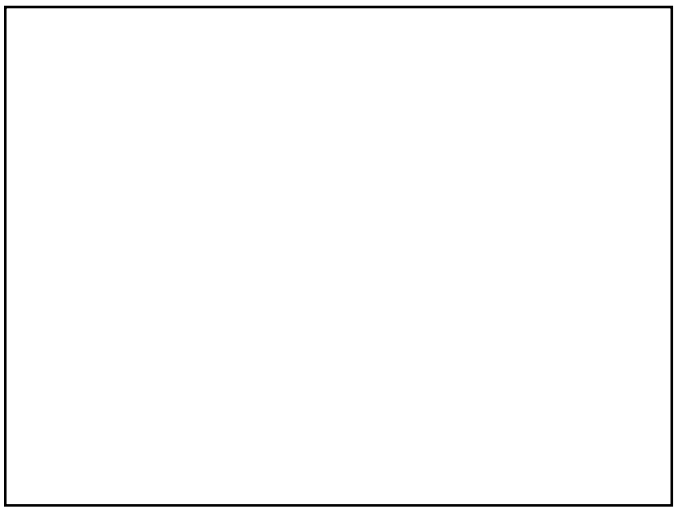
Things People Can Do To Keep Pests Away

1. Keep dishes washed or rinsed
2. Don't eat food around the house or school
3. Clean everywhere, especially where food is.
4. Vacuum and clean floors and furniture-move furniture
5. Fix any leaks
6. Keep food in tightly sealed containers
7. Put empty pop cans inside sealed bags. Do not let huge numbers pile up in the room.
8. Keep garbage in cans with lids and empty often.
9. Don't leave wrappers or garbage and litter around!
10. Fix doors and windows so they seal tightly
11. Fix all holes and cracks
12. Place garbage in sealed bags before putting in dumpster. Keep the lid shut.

Name: _____ **Date:** _____

Knowing What to Look For

Pest name: _____



Likes to eat:

_____

_____

_____

_____

_____

_____

This pest needs these things to survive:

_____ _____ _____

Where in the school would you look for it?

_____ _____

_____ _____

_____ _____

List evidence of this pest that you can look for.

_____ _____

_____ _____

_____ _____

List conditions of the school you could look for that can make this a very good place for pests to live.

_____ _____

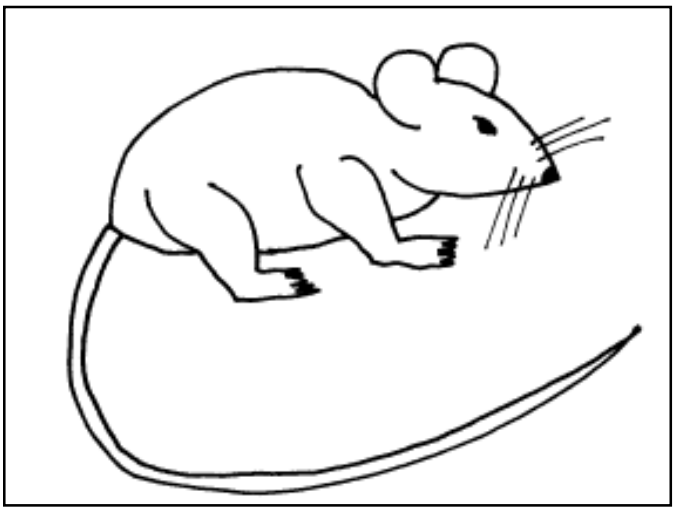
_____ _____

_____ _____

Name: KEY **Date:** _____

Knowing What to Look For

Pest name: House Mouse



Likes to eat:

- peanut butter
- cereal
- grains- rice, oatmeal
- flour
- fruits and vegetables
- nuts, butter, candy bars

This pest needs these things to survive:

food water shelter

Where in the school would you look for it?

- doorways
- kitchen
- janitor closets
- basement
- storage rooms
- in walls, under sinks

List evidence of this pest that you can look for.

- droppings
- chewed holes
- tracks/footprints
- noises in walls
- bad smell
- spilled or nibbled food

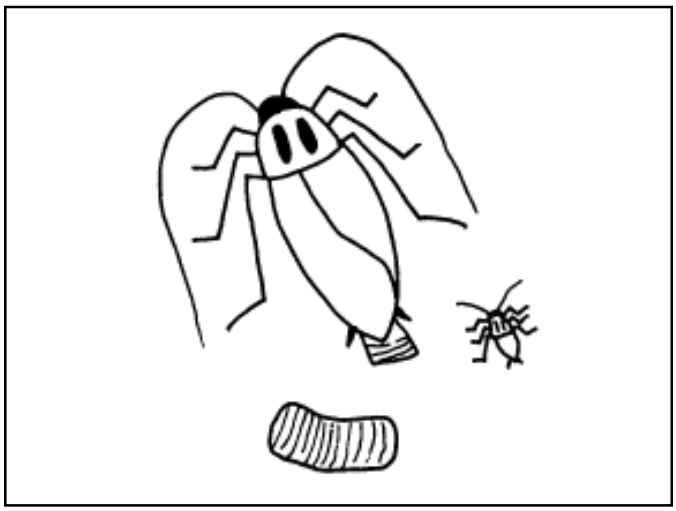
List conditions of the school you could look for that can make this a very good place for pests to live.

- space around doorways
- open containers or boxes
- holes-size of dimes
- broken windows or screens
- dirty dishes
- clutter or piles of stuff

Name: KEY **Date:** _____

Knowing What to Look For

Pest name: German Cockroach



Likes to eat:

- almost anything
- crumbs and leftovers
- soap and soap scum
- wallpaper glue
- pet food
- food waste/garbage

This pest needs these things to survive:

food water shelter

Where in the school would you look for it?

- kitchen
- food storage
- garbage
- cabinets
- Kindergarten room
- Art room

List evidence of this pest that you can look for.

- live or dead roaches
- old skins or legs
- egg cases
- droppings-black dots
- rustling noise
- smell

List conditions of the school you could look for that can make this a very good place for pests to live.

- pet food storage
- litter in rooms and lockers
- leaky faucets or sinks
- unrinsed pop cans
- food in unsealed containers
- grime in food areas

What We Found

Date: _____
Room/Location in school: _____
Team members: _____

We found evidence of pests

In the lines below write what you saw. Examples are: the actual pest, its droppings, gnawing, damage, nest/anthill

cockroaches 

_____
_____
_____

mice or rats 

_____
_____
_____

ants 

_____
_____
_____

other 

_____
_____
_____

We found conditions good for pests

In the lines below write what you saw. Examples are: open dumpsters, garbage or clutter, cracks or holes, drips or leaks

_____
_____
_____

_____
_____
_____

Things that we can do to make this place worse for pests.

_____
_____
_____

Things adults can do to make this place worse for pests.

_____
_____
_____

#8 *Classroom Activity* Grades 3-6

May I Take Your Order?

Overview

Pests, like all animals, have specific needs for survival. In this activity, students create a restaurant and menu for pests. Fun and creative, this activity challenges students to use their knowledge of needs such as food, water, shelter, air, space, etc., to create the perfect dining experience for pests.

Objectives

Students will:

- describe the things living things need to survive.
- read and learn the needs of several common household pests.
- apply their knowledge by creating a restaurant that meets the needs of one or several types of pests.

Materials

needs cards (for each group), shoe boxes, thick paper (card stock or tag board), scissors, colored paper, glue, tape, markers, other art supplies (feathers, cotton, toothpicks, pipe cleaners)

Subjects

science, art

Duration

1 hour

Doing the Activity

Step 1: *Discussion.* Ask the students what animals need to survive. Generate a list on the board or overhead. Review what a habitat is. Ask the students: *What is needed in a habitat?* Food, water, shelter, air, space, protection. *Do all living things live in the same habitat? Describe different habitats.*

Step 2: *The Task.* Split students up into groups (pairs or 3-4 people). Say: *Today you are restaurant owners starting a new business. Your job is to create a restaurant to serve (one or several types of) pests.*

Assign or decide how many different pests each student or group needs to address. Hand out need cards. Using the need cards ask students to write down ways they can meet all of the needs of their different customers. The more pests, the more complicated the restaurant will need to be.

Step 3: *Craft Activity.* Ask the students to create a restaurant with the shoe box and art supplies. Remind them that they need to accomodate the needs of all of the customers.

Step 4: *Write Menus.* Have students write menus. Before they begin, ask the students if the menus would be the same or would they need to have different menus for different customers.

Closure: Ask: *What was the hardest part about making a restaurant for pests? How can so many different pests live in a house?* There are many small habitats within a house. Many different pests can live in the same place if they are not taking away each other's food, water or space.

Needs Card

Name: **House Mouse**

Food: grains, nuts, cereal, fruits or vegetables

Water: alone or in the food

Shelter: warm and next to walls

Light: active in the dark

Other: nibbles (small portions)

Needs Card

Name: **Mosquito**

Food: females drink blood from living animal, males drink nectar and plant juices

Water: need still water for larvae

Light: feed at dusk

Shelter: near water and food

Needs Card

Name: **Dandelion**

Food: makes its own, needs nutrients from the soil

Water: through roots from soil

Shelter: anchored in soil outside

Light: sunlight

Other: needs to be in soil

Needs Card

Name: **German Cockroach**

Food: any food, soap, pet food, wallpaper paste

Water: moisture, high humidity

Shelter: enclosed areas

Light: dark

Other: prefer pressure on body

Needs Card

Name: **Fruit Fly**

Food: very ripe or rotting fruit, spilled food or drink that is not cleaned up

Water: from the fruit, damp areas

Shelter: near food

Other: reproduce very quickly

Needs Card

Name: **Cat Flea**

Food: blood of cats (also people, dogs or other mammals)

Water: moisture, high humidity

Shelter: carpet, hair, bedding, furniture, damp soil

#9 *Classroom Activity* Grades 3-6

Preferred Destinations

Overview

A building or a yard contains many places that are perfect for pests to live and get food and water. Focussing on the needs and preferences of a specific pest, students design a travel brochure or poster highlighting one or several "preferred destinations" in the building or grounds.

Objectives

Students will:

- describe things necessary in a habitat
- apply their knowledge of pest needs

Materials

assorted travel brochures, *All About Pest* worksheets from lesson #6, markers, paper, colored paper, scissors and glue

Duration

1 hour

Subjects

science, art

Background

All living things have roles and places that they normally live. The place where a living thing lives and gets what it needs to survive is called its habitat. In IPM we pay a great deal of attention to the habitat and biology of a pest. We ask: what is it about my kitchen that makes cockroaches want to live there? We learn about why pests may be in certain places so we can do things to change or modify the habitat so it is no longer conducive to pests. In IPM, habitat modification may include cleaning and fixing things so that we take away food, water, hiding places, and their way in.

Doing the Activity

Step 1: *Discussion.* Display several real travel posters and/or brochures. Holding them up, ask the class: *What do we like in a place to live or visit? What would our perfect location be? Would a mouse or a cockroach like the same thing? Why not? Does a pest need the same conditions as us? What does every living thing need in a habitat?* During the discussion write key responses on the board or overhead.

Step 2: *Favorite Pest Habitats.* Students can work alone or in groups for this activity. Assign a pest to each student or group, or allow them to select their own. You may wish to have the students read the wanted posters or *All About Pest* worksheets from lesson #6 for background information on specific pests. Ask the students to write down the places the pest likes to live and why. For example, German cockroaches like to live in walls because they prefer dark, damp places where they have pressure on at least two sides of their bodies.

Step 3: ***Create Travel Brochures***. Ask the students to select a location that the pest likes and design a brochure/poster for that place. Depending on the pest, the location may be: under the kitchen sink, in the basement, under the refrigerator, in drains, etc. Some suggestions to include in the

brochures or posters are: a fun, catchy name of the resort, description of location, slogan that describes why the pest should come there, and what this location has to offer. If they are having trouble, suggest to them that this is like creating a vacation spot for Oscar the Grouch on Sesame Street. The perfect spot for him is very different than for us.

Step 4: ***Presenting to the Class.*** Ask each student or group to present their posters or brochures to the class. Hang the creations around the classroom or school.

Closure/Assessment: Discuss with the class what they did today. Use the focus questions to generate discussion. Ask the students to write a paragraph on how they would shut down the resort they created a brochure for.

Focus Questions

What preferred destinations for pests do we have in our classroom?

What could we do to get rid of them?

Are there other parts of the school that would be a preferred destination for pests?

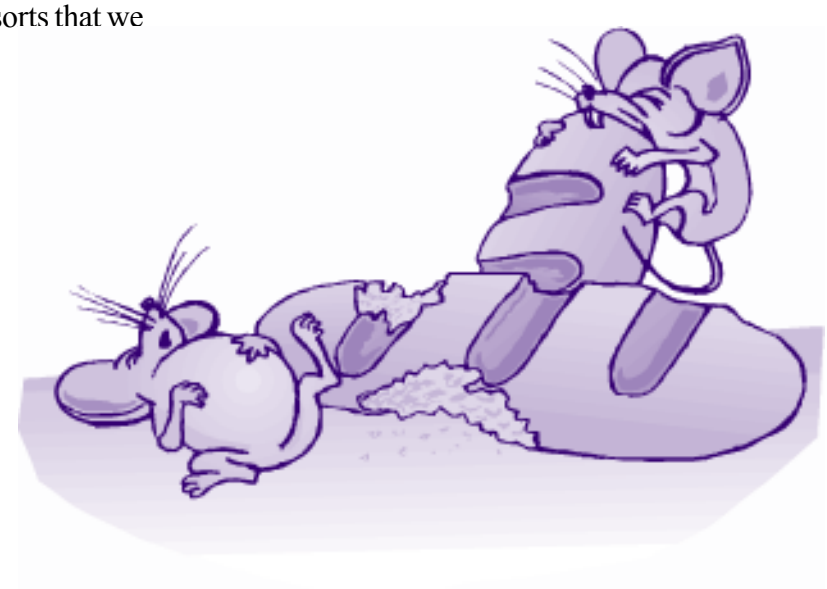
What could we do there?

How would we shut down the resorts that we created today?

Enrichment

1. Make a map highlighting the preferred destinations, like a walking map from "hot spot" to "hot spot."

2. Ask the students to write a story about a pest visiting the resort that they described in their brochure or poster. What did the pest do there? What was the favorite attraction? Was it crowded?



Rodents

What are hairy (usually), warm-blooded and produce milk for their young?

Mammals

A Quick Refresher on Mammals

Mammals are **vertebrates**, or animals with backbones. All mammals are warm-blooded and produce milk for their young. Most have hair or fur and have teeth that help them cut or chew their food. All young mammals rely on the mothers for food when they are born and stay with them until they are able to fend for themselves. Mammals have a very well developed nervous system and a high degree of intelligence and resourcefulness not found in other animals.

Mammals evolved from reptiles and first appeared 200 million years ago. These first mammals lived in trees and were only 5cm (2 inches) long. Now there are over 4,500 species of mammals that come in all shapes and sizes. Most mammals live on land and walk on four legs, but there are also mammals that hop (kangaroos), walk on two legs (humans), live in water (whales), and fly (bats).

Mammals that are alive today belong to three groups. Below are some examples of animals that belong to each group.

Monotremes are the smallest group of mammal with only three animals. They are found in Australia, Tasmania, and New Guinea. Unlike all other mammals, monotremes lay eggs. Although the mothers produce milk for the young, they do not suck from a nipple, but rather, lick up the milk from a patch on the mother's belly!

Examples: duck-billed platypus, spiny anteaters

Marsupials are often called pouched animals. They give birth to live young, but the young are born when they are still very undeveloped. They nurse on their mother's milk in a special pouch on her abdomen while they complete their development. About two-thirds of the 250 species of marsupials live in Australia, Tasmania, or New Guinea. The only marsupial that lives in North America is the opossum.

Examples: kangaroo, koala, bandicoot, wombat, Tasmanian devil, opossum

Placental mammals are by far the largest group of mammals. When most people think of mammals these are the ones they think of. Compared to marsupials, young placental mammals spend a long time developing inside the mother's womb. While inside they are nourished by the placenta which absorbs nutrients from the mother's blood and delivers them to the developing animal.

Examples: rodents, bats, carnivores (dog, bear, hyena, coyote, weasel, wolf, fox, racoon, otter, skunk, tiger, lion, cat, sea lion, seal, walrus), cetaceans (whale, porpoise, dolphin, manatee), primates (humans, monkeys, apes, chimpanzees), elephants, insectivores (hedgehog, mole), hoofed mammals (horse, zebra, rhinoceros, pig, hippopotamus, deer, giraffe, camel, llama, moose, antelope, goat, sheep, cow), anteaters and aardvarks, rabbits and hares.

Mammals come in many shapes and sizes.

All About Rodents

What is a Rodent?

The largest group of mammals by far is the rodents. More than one-third of all mammals (over 2,000 species) are rodents. They are found all over the world except Antarctica, New Zealand and a few small islands.

Characteristics

So what makes a rodent different from other mammals? The most distinguishing characteristic is their teeth. All rodents have a pair of upper and a pair of lower teeth called **incisors**. Unlike our teeth, these incisors don't have roots, and they never stop growing! To keep these teeth from growing into their brains, rodents grind their teeth against each other. This friction is similar to using a grindstone to sharpen a knife. "Self-sharpening" not only keeps the teeth short, but it also keeps the edges very sharp, almost like a chisel.

You might have guessed that the word *rodent* means "to gnaw." In addition to grinding their teeth together, gnawing on objects (pipes, furniture, buildings, wood molding, etc.) helps keep their teeth short and sharp.

Did You Know?

Not only do rodent incisors keep growing, they are very hard too. Rodent teeth are harder than lead, aluminum, copper, and iron. Rats often gnaw through metal pipes. After that, gnawing through PVC pipes, plastic containers or cereal boxes is easy.

Rat incisors and the damage they can do on plastic garbage cans.

Yes, These are Rodents

mouse, rat, hamster, guinea pig, woodchuck, muskrat, gerbil, squirrel, chipmunk, prairie dog, gopher, beaver, porcupine, chinchilla, vole, lemming, agouti, marmot, capybara

Mammals, but NOT Rodents

bats, rabbits, moles, shrews, hedgehogs

Rodents as Pests

While most rodents spend their lives away from people, there are a few rodents that spend their lives near people. These are called **commensal** rodents. The word commensal means "sharing one's table". The most common commensal rodent pests in the United States are the house mouse and the Norway rat.

Rats and mice cost billions of dollars in lost crops each year, and some are carriers of human diseases such as bubonic plague, typhus, and Hanta fever. However, various rodent species are economically important as sources of food or fur in many parts of the world, and others are used extensively in biomedical research.

Can't go over it, Can't go under it, Might as well go through it

Rodents use their incisors to gnaw through wood, plastic, lead, aluminum siding, glass, and cinder blocks. They can also squeeze through very small openings. Rats can fit through holes the size of a quarter, and mice can fit through holes the size of a dime.

Eew, Gross

Mice and rats leave droppings and urine wherever they go. A house mouse can produce 50-100 droppings a day, while a rat can leave as many at 50!

Gross (but, cool)

Rodent urine glows a blue-white color under ultraviolet light. Some pest managers and food inspectors use black lights to check for rodent trouble.

Life Cycle of the Norway Rat

The Norway rat is the most common and economically important rat in the United States. It is sometimes called the brown rat, house rat, sewer rat, and wharf rat. A mature female rat can give birth to about 20 young (pups) a year (four to six at a time), if she lives that long. In the wild, the average life span of a rat is less than one year. The females generally live longer than the males. The young are born in a nest. They are hairless, and their eyes and ears are closed. Within two weeks their eyes and ears open, they become furry, and they begin exploring the nest area.

If the mother rat has become wary of rodenticides or traps, many of her young will learn to avoid them. Young are totally weaned at 4-5 weeks old when they weigh approximately 1.5 ounces. At three months old, the pups are independent of their mother. They will mate and live in the same location or move to a new nest area. Rats are aggressive and live in colonies. The dominant males and ranking females will have the best nests.

Rats Can:

- fit through holes the size of a quarter.
- leap up three feet from a horizontal surface.
- jump horizontally over four feet.
- reach things 13 inches above them.
- fall more than 50 feet and survive.
- dive and swim underwater for 30 seconds.
- tread water for three days.
- swim as far as ½ mile in open water.
- gnaw through wood, lead pipes, cinder blocks, aluminum, sheet metal, exposed edge of glass.

Look, smell and listen: Top 10 signs you have a rodent problem

10. odor
9. sounds
8. live or dead rodents
7. urine stains
6. grease marks
5. runways
4. burrows
3. gnawing damage
2. tracks
1. droppings!

Life Cycle of the House Mouse

Environmental conditions such as the availability and quality of food can influence the frequency of pregnancies, litter sizes, and survival. Under ideal conditions, females can produce as many as ten litters (about 50 young) in a year. The life span is generally less than one year.

Mice, like rats, are born hairless with closed eyes and ears. By three weeks old, the young begin to take short trips away from the nest and start to eat solid food. They are sexually mature at five to nine weeks old.

Mice Can:

- fit through holes the size of a dime.
- leap up one foot from a horizontal surface.
- run up almost any vertical surface.
- travel upside down clinging to wire mesh.
- swim, but usually do not dive under.
- survive in freezers for several generations.
- easily run on electrical wires or rope.

#10 Classroom Activity Grades 3-6

All About Rodents

Overview

In IPM we need to learn about the biology, habits and abilities of pests in order to manage them effectively. Students take notes and learn about the characteristics, capabilities and life cycles of mammals, rodents, and two common rodent pests: the Norway rat and the house mouse.

Objectives

Students will:

- learn the characteristics of rodents and mammals.
- learn the differences between rats and mice.
- learn ways to keep rats and mice away

Materials

student worksheet, teacher key, teacher rodent information sheet, pet mice and pet rat (optional)

Duration

1 hour

Subjects

science

Getting Ready

Review the teacher rodent information sheet to learn and review characteristics and capabilities of mammals, rodents, and rodent pests. If you use live animals for this lesson, you may want to keep them covered or hidden until you are ready to introduce them to the students. Live animals are very interesting and can become a distraction when you want the students to concentrate on listening and writing!

Doing the Activity

Step 1: *Discussion.* Tell the students that today we will learn more about mammals, rodents, and some rodents that are pests. Ask: *How does knowing the biology of pests help us manage them?* Emphasize the importance of knowing how quickly a pest reproduces, what they need to live and how they behave. When we know this, we can take away the things that they need to survive. We can trap them easier if we know the places they like to live and travel. We can keep them out if we know how they come in and what they are capable of doing.

Step 2: *Taking Notes.* Hand out the student worksheet. You may wish to copy the worksheet onto overhead film so that you can fill the worksheet in together with the class. Fill out the worksheet with the class by asking them the questions first and writing down the answers together. Ask students what a mammal is. What makes something a mammal? Fill out the answers. Do the rest of the worksheet in the same manner. When you are discussing this topic with the students, add fun facts about rodents (found in the rodent teacher page) to make it more interesting. With some classes it is fun

to have the students write with you when you write facts about rats and mice (don't read aloud first). This will elicit various "wow" and "eew, gross" reactions as they begin to comprehend what they are writing.

Step 3: ***Introduce Live Pet Mice. (optional)*** If you plan on doing the experiments with mice, this is a good time to introduce the students to the mice. If you have access to a pet rat, that is also useful for comparison. When introducing animals to the students, always lay out ground rules first.

Say: These are live animals. I trust that you will not hurt them. When I take them out of the cage, I will bring them to you. Stay in your seat. If you do not want to touch it, say "pass". I would like you to have a chance to hold and pet them, but will never force you to. Stay calm. If you are holding an animal and decide you don't want it anymore, tell me and I will take it away. Never throw or drop an animal. Pets depend on you to stay safe.

Tell the students that these are pet rodents that do not have the diseases that pest rodents do. Ask them to look carefully at the feet, ears, teeth and noses to see if they can see what we talked about. The best way to introduce animals to a large class is to bring the animal around to each child. Hold the mouse or rat in your hands and allow the students to see them or pet them. With the mice you can place them in the hands of each child so they can get used to holding a small animal.

Closure/Assessment: Discuss with the students what they learned.

Focus Questions

What are some things we can do to take away habitats for mice and rats in our school or homes?

Internet Fun

Check out this fun site about mammals from EnchantedLearning.com. The site includes information and activity sheets on mammals. http://www.enchantedlearning.com/subjects/mammals/

Enrichment

Ask the students to write and illustrate a book about rodents. You may wish to collect old magazines with pictures of mammals and rodents that the students can cut out and put into the book.

Name: _____ **Date:** _____

All About Rodents

Facts About Rodents

Rodents are **mammals**. All mammals are **warm-blooded**. This means that their body temperature stays the same in cold and warm temperatures. Female mammals make milk in their bodies to feed their babies. Humans are mammals too. Mammals are vertebrates. This means that they have a **backbone** and a skeleton inside their body.

Rodents are covered with fur. They have teeth called **incisors** that never stop growing. They need to grind their teeth together or chew and gnaw on things to keep their teeth from growing into their skull!

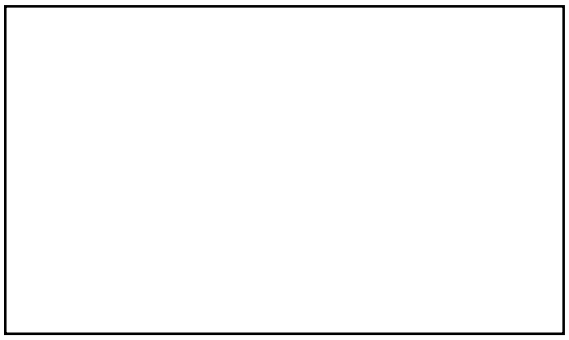
List some different kinds of rodents:

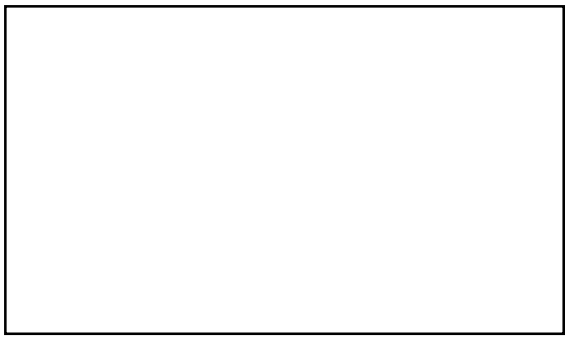
_____ _____ _____

_____ _____ _____

_____ _____ _____

Two Major Rodent Pests





_____ _____

_____

_____

_____

_____

_____

Name: _____ **Date:** _____

Comparison of House Mouse and Norway Rat

	House Mouse	Norway Rat
Nose		
	_____	_____
Feet		
	_____	_____
Nest	_____	_____
Babies	_____	_____

Can fit through holes the size of:

_____	_____

_____

_____

_____

_____

_____

_____

Name: KEY **Date:** _____

All About Rodents

Facts About Rodents

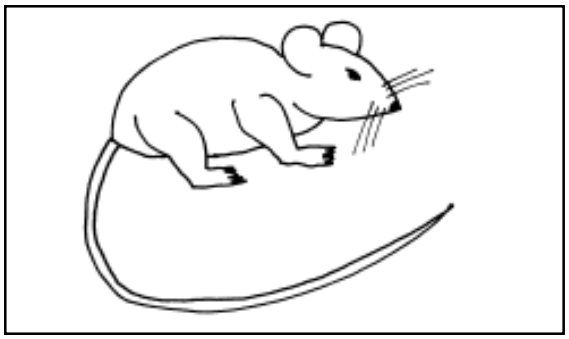
Rodents are **mammals**. All mammals are **warm-blooded**. This means that their body temperature stays the same in cold and warm temperatures. Female mammals make milk in their bodies to feed their babies. Humans are mammals too. Mammals are vertebrates. This means that they have a **backbone** and a skeleton inside their body.

Rodents are covered with fur. They have teeth called **incisors** that never stop growing. They need to grind their teeth together or chew and gnaw on things to keep their teeth from growing into their skull!

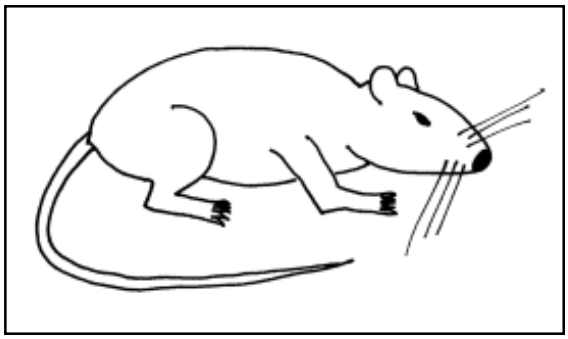
List some different kinds of rodents:

mouse	chipmunk	guinea pig
rat	squirrel	gerbil
hamster	beaver	hedgehog

Two Major Rodent Pests



House Mouse



Norway Rat

Mice and rats spread diseases.

A mouse does not grow into a rat.

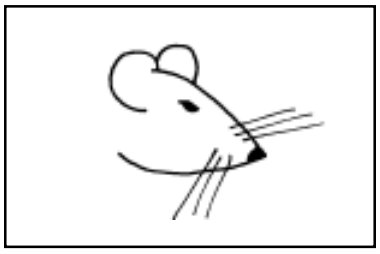
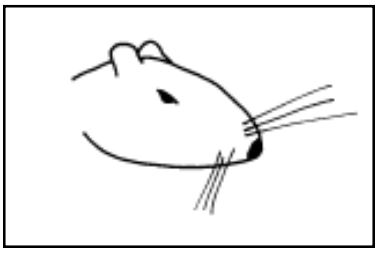
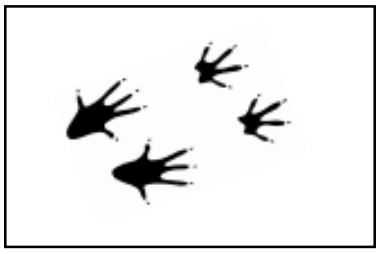
Mice and rats do not see well.

They use whiskers to feel their way in the dark.

Animals that are active at night are called nocturnal.

Name: KEY **Date:** _____

Comparison of House Mouse and Norway Rat

	House Mouse	Norway Rat
Nose		
	pointed	blunt
Feet		
	small	big
Nest	inside/warm	outside/burrows
Babies	50 a year	20 a year

Can fit through holes the size of:

	
dime	quarter

Mice can jump up 12 inches (1 foot).

Mice nibble food and are very curious.

Mice travel the same route over and over.

Rats can jump up three feet.

Rats store food and are very cautious.

Rats can swim 1/2 mile and can

Classroom Experiments with Mice

Using live rodents in the classroom can add a great deal of enrichment and can really aid in teaching science to students. Students love working with live rodents. While simply the presence of pet animals in the classroom can add enrichment, some students will learn more than others. Some children can observe the animals for hours if given the chance and learn a great deal from it. Others will scarcely give the animals a glance. Conducting simple experiments with them makes every student engaged in the activity. Students gain hands-on experience conducting real experiments. For elementary students, being trusted to conduct scientific experiments with real animals can be very empowering.

If you have the means and the desire to conduct experiments with mice in the classroom, I strongly recommend purchasing the book:

Kneidel, S., 1999. *Classroom Critters and the Scientific Method.* Fulcrum Publishing.

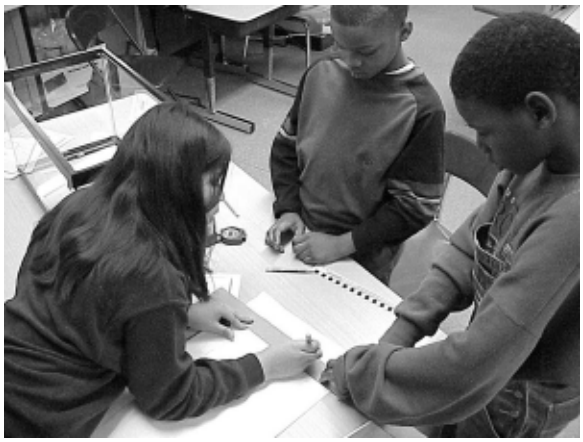
In addition to experiments with mice, Dr. Kneidel describes experiments with fish, hamsters, gerbils, lizards, kittens and puppies. The experiments with mice are the most relevant to teaching IPM.

Due to copyrights, I have not included the actual experiments here. Below are some IPM extensions to use with some experiments found in the book. Adult helpers are highly recommended to assist with these activities. For younger students (3rd and 4th grade), one adult with each group is almost essential.

1. Are Mice Wall-Seekers?

(Classroom Critters, page 1)

Materials: one of each of the following for each group: mouse, aquarium (15 gallon works well) or similar sized box, paper to fit in the bottom of the box or aquarium (cut to size prior to class period), rulers and straight edges, permanent marker. Also clock and worksheet for each student.



Doing the Experiment:

Follow the experiment as described. Walk the students through the experiment before they go to their station. Have them repeat the procedure to you. Reiterate rules for working with live animals (see lesson #10 in this resource). Emphasize that you trust that they will be real scientists today and be careful around the mice and each other. It is helpful to assign jobs to each student in the group (ie: *timer*-watches the clock and says "time" every 10 seconds, *mouse watche*r- watches the mouse and says "wall" or "center" every 10 seconds, *recorder*-records tallies of mouse position, etc.) After the experiment, have each student complete the graph for their group's results (included in the book). Have each group report on their results. Add the data for the entire class together and create a graph of the entire class' data. Have students write their conclusions on their worksheet. The results to this experiment are pretty predictable. The data will show that mice are clearly wall-seekers. Mice that have already experienced this experiment with one

class, however, may be a bit more daring (more counts away from the wall) for the second class.

Discussion/IPM Extensions:
In addition to the valuable experience of conducting scientific experiments, this activity clearly shows one behavior of mice that we use to help us control them. Ask: *What does this experiment tell us about mice? How can we use this information to help control them?* Put traps against the wall. *Why did you need to do an experiment? If you didn't record the position of the mice, but just observed them, would you have known that they spent so much more time against the wall than in the middle?*

Other Experiments

- Do mice prefer tunnels of a particular diameter? p. 6
- Do mice prefer tunnels open on one end or two? p. 11
- How fast can a rodent learn to make the correct turn consistently to find a food treat in a T-maze? p. 16

Keeping Mice in the Classroom

Mice are inexpensive and easy to maintain. Many pet stores sell mice primarily as food for reptiles. You can usually return them to the store after you use them in the classroom. While it is a fact of life that all organisms need to eat, many students will have trouble with the knowledge that their class pet may become food for a snake. Use discretion in deciding what to tell your students about the fate of the classroom mice, saying they went back to the pet store is usually sufficient.

Where to get them: pet store

What to put them in: small aquarium or cage designed to hold mice. A 5 ½ gallon aquarium with a wire mesh lid is adequate for 6 mice.

Bedding: recycled paper bedding is the best (at most pet stores), the oils in some wood chips can irritate their skin. Change the bedding often; mice are smelly.

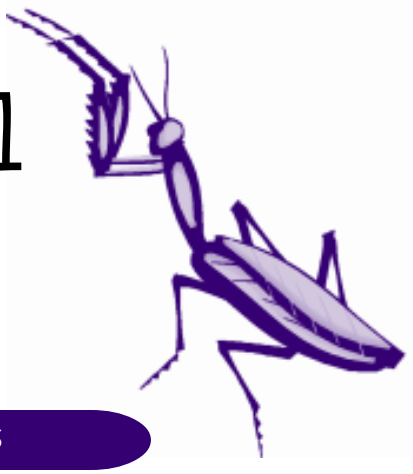
What they eat: mouse or small rodent food from pet stores. Supplement that with treats that contain water like carrots, apples, and other fruits and vegetables. Mice often do not drink readily from bottles or bowls, so it is important to give them some moist food.

Enrichment: wrapping paper rolls or toilet paper rolls will provide a place for the mice to run through, sleep, hide, and even shred for their nest. Putting too many extra things in their cage can affect how they respond in experiments.

Note: Withhold food prior to experiments that involve food treats! We didn't do this once, and the mice were very content to just sit in the maze.

#11 Classroom Activity Grades 4-6

Biological Control



Overview

Biological control is a method of managing pests by using natural enemies. In this lesson students learn about three groups of natural enemies of pests and how they can be used in an IPM program.

Objectives

Students will:

- learn about biological control and how it is used in IPM.
- see how food chains apply to biological control.
- recognize three groups of biological control agents.

Materials

video: *Biological Control: Learning to Live with the Natural Order* (see the next page for information on ordering your free copy), TV and VCR, slide show or pictures at http://www.pested.msu.edu), worksheet

Duration

1 hour

Subjects

science

Background

Biological control is an important control method that can be used in an IPM program. Biological control is a method of managing pests by using natural enemies. This lesson focusses on natural enemies of insect pests. Natural enemies can also be used for controlling weeds and other pests. (For excellent classroom lessons on biological control of purple loosestrife, a serious weed in wetlands, see the classroom resource list on page 6.)

In IPM we can introduce natural enemies to a situation, or we can take steps to preserve the natural enemies that are already there. For example, as part of a cockroach IPM program, we may order tiny wasps that find cockroaches and inject their eggs into the cockroach eggs. As the wasps inside the eggs grow and eat, they will kill the cockroach eggs. For the second situation, one reason that we only use pesticides if they are absolutely necessary is that pesticides often kill the natural enemies that are already there. This is especially important in agriculture and landscapes. When we kill the natural enemies, we can make a pest situation much worse becausepest insects often reproduce and recover faster than the natural enemies.

Doing the Activity

Step 1: *Discussion.* Review the steps in IPM. Review the choices for control methods (refer to "What is IPM" student handout from lesson #3 or bulletin board). Biological control is using natural enemies to manage or control pests. Ask: *What are some ways that pests can be controlled by their natural enemies?*

a) they can be eaten-*predators*
b) they can have other insects living inside or on them- *parasites*

c) they can get a disease - *pathogens*

Step 2: *Taking Notes.* Complete the worksheet with the class. Ask the students for examples. You may wish to transfer the worksheet to transparency film, and complete the worksheet together using the overhead projector.

Step 3: *Show the Video*. The video (see end of this lesson for ordering information) sequentially describes the phases of a classical biological control program against a serious agricultural pest, the Russian wheat aphid. The video includes wonderful close-up footage of natural enemies in action provided by Walt Disney World Co.

Closure/Assessment: Test students' knowledge with a slide show (available in PowerPoint on our website: http://www.pested.msu.edu). Read the slide and have students record what they think each picture represents (predator, parasite, pathogen). Go over the answer before you move to the next slide. If you do not have the means to show the slideshow, read the descriptions to the class, show the pictures on page 66, or print out pictures from the above website.

Enrichment

Guest Speaker or Field Trip: Check to see if your county or city has a mosquito, gypsy moth, or purple loosestrife control program. These programs often have employees who visit classrooms. Biological control is a major part of many of these programs, and a guest speaker or field trip can provide real-world experience on these concepts to the students.

Biological Control pictures from the University of Nebraska, Department of Entomology
http://entomology.unl.edu/images/beneficials/beneficials.htm

Resources

USDA's National Biological Control Institute (NBCI)

Suggested free resources for students available from NBCI:

- *Biological Control: Learning to Live With the Natural Order* is a 25 minute videotape geared towards elementary, middle, and high school students.
- *Natural Enemies are Your Allies*- a color poster with great pictures of natural enemies of insects. University of California, Davis. 1990.

Web order form: http://www.aphis.usda.gov/ppq/nbci/nbcistor.html *or call* NBCI at (301)436-4329.

Other Resources

Weeden, C.R., Shelton, A.M., & Hoffman, M.P., *Biological Control: A Guide to Natural Enemies in North America*, Cornell University
http://www.nysaes.cornell.edu/ent/biocontrol/
-Great background information (geared to adults).

Jeffords, M.R. & Hodgins, A.S. 1995. *Pests Have Enemies Too: Teaching Young Scientists About Biological Control.* Illinois Natural History Survey, Champaign, IL, special publication 18.
-Excellent resource guide and lesson plans for middle school students on biological control. (for fee only) *To order:* call (217) 333-6880.

Supplemental Worksheets

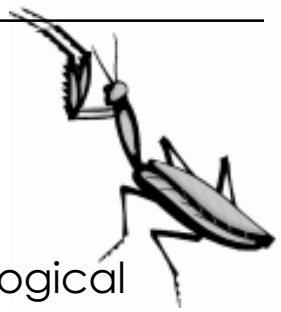
From Minnesota Department of Agriculture IPM Program, *Join Our Pest Patrol-A Backyard Activity Book for Kids- An Adventure in IPM*
http://www.mda.state.mn.us/IPM/IPMPubs.html

3. Fighting Pests with the Three Ps
   http://www.mda.state.mn.us/IPM/PestPatrol/FightingPestswith3Ps.pdf
14. Pests Have Enemies Too: Aphids and Ladybugs
   http://www.mda.state.mn.us/IPM/PestPatrol/PestshaveEnemies.pdf

Answers: http://www.mda.state.mn.us/IPM/PestPatrol/Answers.pdf

Name: _____ **Date:** _____

Biological Control



Biological control is the use of _____ _____ to manage or control pests. Biological control is one choice in the _____ step of IPM. Three types of biological control agents we use are _____ , _____ , and _____ .

Predators _____

List some predators and their prey.

_____ _____

_____ _____

_____ _____

_____ _____

_____ _____

_____ _____

Parasites _____

_____

List some examples of parasites.

_____ _____

_____ _____

Pathogens _____ . _____

List some types of pathogens (things that cause disease).

_____ _____

_____ _____

Name: _____ **Date:** _____

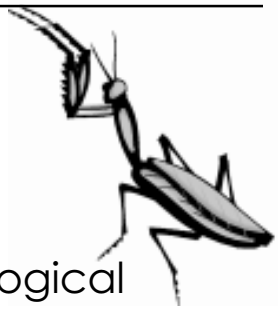
Predator, Parasite or Pathogen?

Watch the slide show and circle the type of natural enemy you think matches the slide.

1.	predator	parasite	pathogen
2.	predator	parasite	pathogen
3.	predator	parasite	pathogen
4.	predator	parasite	pathogen
5.	predator	parasite	pathogen
6.	predator	parasite	pathogen
7.	predator	parasite	pathogen
8.	predator	parasite	pathogen
9.	predator	parasite	pathogen
10.	predator	parasite	pathogen
11.	predator	parasite	pathogen
12.	predator	parasite	pathogen

Name: KEY **Date:** _____

Biological Control



Biological control is the use of natural enemies to manage or control pests. Biological control is one choice in the choosing control methods step of IPM. Three types of biological control agents we use are predators, parasites, and pathogens.

Predators hunt and kill other animals for food.

List some predators and their prey.

owl/mice	fox/rabbits
cat/mice	eagle/mice
ladybug/aphids	dragonfly/insects
frog/flies	snake/mice
bat/mosquitoes	praying mantis/insects
spider/insects	lion/antelope

Parasites live on or inside other animals and may kill them as they grow.

List some examples of parasites.

a wasp lays eggs in a larva	a fly lays eggs in a bug adult
a wasp lays eggs in a cockroach	a wasp lays eggs in eggs

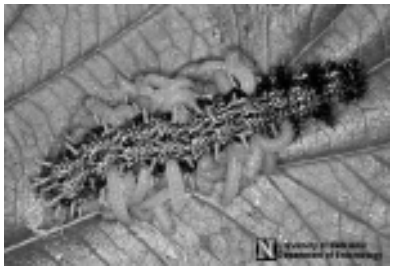
Pathogens cause diseases inside animals.

List some types of pathogens (things that cause disease).

bacteria	virus
fungus	nematodes (tiny worms)

Predator, Parasite or Pathogen?

1. Wasp larvae coming out of a caterpillar



2. Long-legged fly with a captured leafhopper

3. Wasps coming out of aphid bodies

4. Wasp pupae on a caterpillar

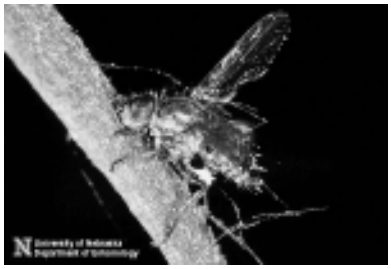
5. Rove beetles eating a maggot

6. The bottom caterpillar is infected with a virus.

7. Caterpillars infected with a fungus

8. A wasp injects eggs into a plant bug nymph.

9. A fly infected with a fungus



10. Scorpion eating a cricket

11. The grub on the right is infected with a bacteria.

12. A spider eating a captured insect

1. parasite, 2. predator, 3. parasite, 4. parasite, 5. predator, 6. pathogen, 7. pathogen, 8. parasite, 9. pathogen, 10. predator, 11. pathogen, 12. predator

Insects

What have 6 jointed legs, 2 antennae 3 body parts and an exoskeleton?

Insects!

Insects can be considered the most successful animals on Earth. The fossil record shows that insects have been around for about 350 million years. Cockroaches appeared about 310 million years ago. By contrast, humans have only been on Earth for 10,000 years. There are over 1 million species of insects that have been identified and named. They make up about 80% of all known animals. Insects play essential roles in the environment including predators, parasites, scavengers, decomposers and as prey for other animals. Some reasons they are so successful are their exoskeleton, small size, ability to fly and ability to reproduce quickly.

Insects are arthropods (Phylum: Arthropoda). The word arthropod comes from the Greek, meaning "jointed foot". In addition to jointed legs, all arthropods are covered with a hard shell called an exoskeleton. Arthropods that are not insects include spiders, ticks, mites, centipedes, millipedes, lobsters, crayfish, shrimp and crabs.

In addition to the exoskeleton and jointed legs, insects have three body divisions (head, thorax, and abdomen), six legs, two antennae, and usually wings.

Scientific Classification

The naming system that we use for naming organisms was developed by Linnaeus over 200 years ago.

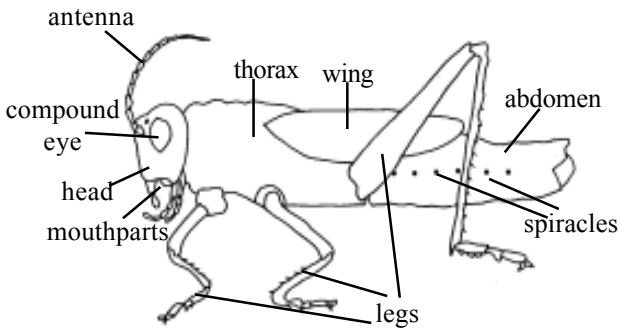
Category	House Fly	Humans
Kingdom	Animalia	Animalia
Phylum	Arthropoda	Chordata
Class	Insecta	Mammalia
Order	Diptera	Primates
Family	Muscidae	Hominidae
Genus	Musca	Homo
Species	domestica	sapiens

About Exoskeletons

Exoskeletons do not grow with an animal like the endoskeletons in vertebrates. The exoskeleton is gives the arthropod support and protection. As the animal grows, it sheds the exoskeleton and creates a new one underneath. This process is called molting. Students may think that this is the same as snakes and other reptiles shedding their "skin". While it is somewhat similar, reptiles shed their scales (which do not grow), but they are vertebrates and have skeletons inside their bodies.

Trick to remember: You can tell which skeleton is which by looking at the first two letters in the words. "Ex" reminds us of "exit", or to go outside. "En" reminds us of "enter", or to go inside.

Insect Anatomy



Head- The head is for eating, sensing things, and gathering information. The antennae, eyes and mouthparts are located here. Sensory hairs may also be located on the head.

Thorax- All wings and legs are attached to this middle body part. This makes the thorax full of muscle.

Abdomen-The third body part contains all the organs for breathing, digestion and excretion, and reproduction. Containing the "guts" of the insect, this is usually the "squishy" part of an insect. Although insects have a heart, the blood flows around freely in the body.

Compound Eye-Compound eyes can have several thousand lenses.

Legs-All insects have three pairs of legs (six). Legs look different depending on their purpose (grasping, capturing, jumping, digging, swimming, climbing).

Antennae-This pair of sensory appendages is located on the head. Antennae come in many forms and are used to feel, smell and even taste.

Mouthparts-There are many different types of mouthparts including chewing, piercing-sucking, sponging, siphoning, cutting and more. This grasshopper has chewing mouthparts.

Wings-Most adult insects have two pairs of wings (four). True flies (order: Diptera) only have one pair of wings (two).

Spiracles-Air enters the insect through these holes in the abdomen. From here the oxygen is transported throughout the insect through tracheae. When disturbed, Madagascar hissing cockroaches make a loud noise by forcing air through the spiracles.

Reproduction

Insects have an incredible capacity to reproduce. Large queen termites in Africa can lay as many as 36,000 eggs in 24 hours! This ability to reproduce is one reason why some insects can become pests. Most insects have males and females that mate and reproduce sexually. However, in many cases the males do not need to be there all the time. In cockroaches, the male leaves a sperm sack in the female's body after they mate. In some species she just uses the sperm from the sack when she needs it for several batches of eggs. In some aphids the female can reproduce without mating at all, producing clones of herself that are all female and also able to reproduce without mating!

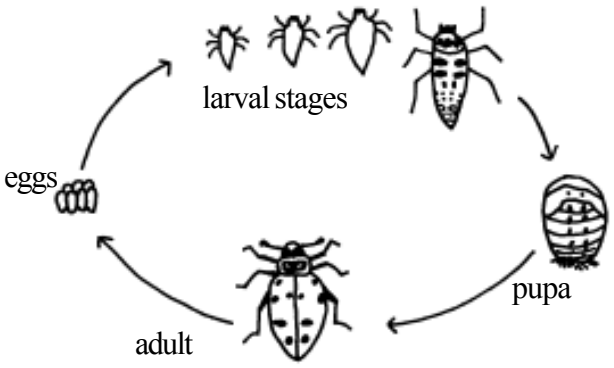
Insect Growth and Development

As part of their life cycles, insects go through a process called metamorphosis. Metamorphosis means a change from one form to another. Complete metamorphosis has four life stages: egg, larva, pupa and adult. In complete metamorphosis each life stage looks very different. The larvae and adults usually eat different foods and often have different mouthparts. This allows a large number of adults and larvae to live in an area and not compete with each other for resources. Insects that go through complete metamorphosis include beetles, butterflies and moths, flies, fleas, wasps, bees and ants.

Incomplete metamorphosis has three life stages: egg, nymph, and adult. The nymphs look similar to the adults. Nymphs are not reproductively mature and do not have fully developed wings. Insects that go through incomplete metamorphosis include cockroaches, earwigs, head lice, grasshoppers and crickets.

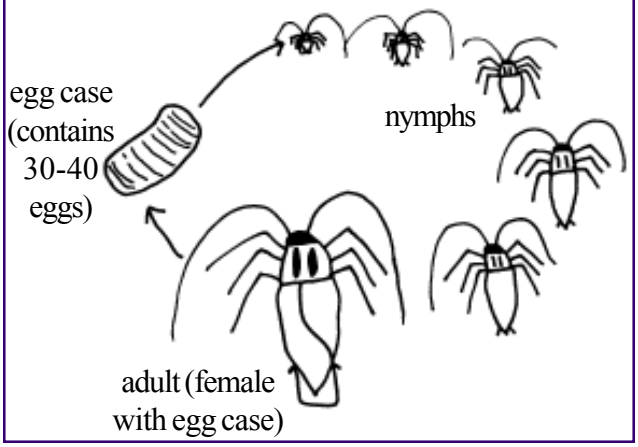
Complete Metamorphosis

Life Cycle of a Lady Beetle



Incomplete Metamorphosis

Life Cycle of German Cockroach



#12 Classroom Activity Grades 3-6

All About Insects

Overview

In IPM we need to learn about the biology, habits and abilities of pests in order to manage them effectively. Students take notes and learn about the characteristics, capabilities and life cycles of insects.

Objectives

Students will:

- learn characteristics of insects
- learn parts of insects
- learn about metamorphosis
- observe live insects

Materials

student worksheet, teacher key, teacher insect fact sheet, live insects

Duration

1-2 hours

Subjects

science

Getting Ready

Live insects bring this lesson to life. You may wish to rear insects in the classroom, or you may wish to collect some insects from outside to observe. For more information on either option see the resource list on the following page.

Review the teacher insect fact sheet to learn and review characteristics and capabilities of insects. If you use live animals for this lesson, you may want to keep them covered or hidden until you are ready to introduce them to the students. Live animals are very interesting and can become a distraction when you want the students to concentrate on listening and writing!

Doing the Activity

Step 1: *Discussion.* Tell the students that today we will learn more about insects and some insects that are pests. Ask: *How does knowing the biology of pests help us manage them?* Emphasize the importance of knowing how quickly pests reproduce, what they need to live and how they behave. When we know this, we can take away the things that they need to survive. We can trap them easier if we know the places they like to live and travel. We can keep them out if we know how they come in and what they are capable of doing.

Step 2: *Taking Notes.* Ask the students what they know about insects. Write the facts on the board. Hand out the student worksheet. You may wish to copy the worksheet onto overhead film so that you can fill the worksheet in together with the class. Fill out the worksheet with the class by asking them the questions first and writing down the answers together. Explain the function of each body part. Add some fun insect facts from the teacher fact sheet.

Step 3: *Introduce Live Insects. (optional)* Walkingsticks and Madagascar hissing cockroaches work well to demonstrate parts of an insect becuse they are large. If you do not have large

insects, have students collect an insect to observe. petri dishes or clear containers with tight fitting lids (readily available at restaurant supply stores) work well for this. Ask students to write down as many characteristics that they see. Entomologists use these characteristics to tell different insects apart. Ask the students to try to find all of the insect parts that they labeled on their worksheet on the live insect.

Closure/Assessment: Discuss with the students what they learned.

Extensions

1. Have students cut out pictures of insects from old nature magazines or print from the internet (see sites below). Ask them to glue the pictures onto a piece of paper and label as many of the parts as they can see.

2. Using insect nature guides or live or pinned insects, have the students study different types of insect characteristics. Break the students into groups and assign each student a different insect part (head, thorax, abdomen, eyes, antennae, legs). Each group draws a new insect with each student drawing their part. This can also be done as a relay.

Internet Fun

There are many excellent internet sites on insects for kids. Here are a few to check out.

Yucky Roach World Website
Discovery Communications
- A great kid-friendly site about roaches. Includes IPM techniques to keep them away.
http://yucky.kids.discovery.com/noflash/roaches/index.html

Madagascar Hissing Cockroaches
Information and stories about raising and using these insects in the classroom.
http://www.geocities.com/CapeCanaveral/Lab/5466/

Enrichment

There are many excellent resources available for teaching about insects in the classroom. The following are just a few.

Using Live Insects in Elementary Classrooms
Center for Insect Education Outreach, University of Arizona, 1997.
-K-6 curriculum which includes 20 lesson plans that utilize insects to teach all kinds of concepts to young learners. Includes activity sheets, fact sheets, and rearing sheets on the insects used. (free on website)
http://insected.arizona.edu/uli.htm

Pennsylvania State University School IPM Education Resources
-The premier clearinghouse for IPM curricular resources, this website includes a comprehensive searchable database on IPM classroom resources as well as lessons and links.
http://http://paipm.cas.psu.edu/schools/schoolEduc.htm

Health Teacher with WebMD
Easy to follow online lesson plans on health and safety topics including head lice.
http://www.healthteacher.com/lessonguides/default.asp

CityBugs
A collaborative project between the University of California-Berkeley and the Oakland Unified School District. Contains lesson plans.
http://www.cnr.berkeley.edu/citybugs/

Carolina Biological Supply, Inc.
One source of insects and other scientific supplies for schools.
http://www.carolina.com/

Name:_____ **Date:** _____

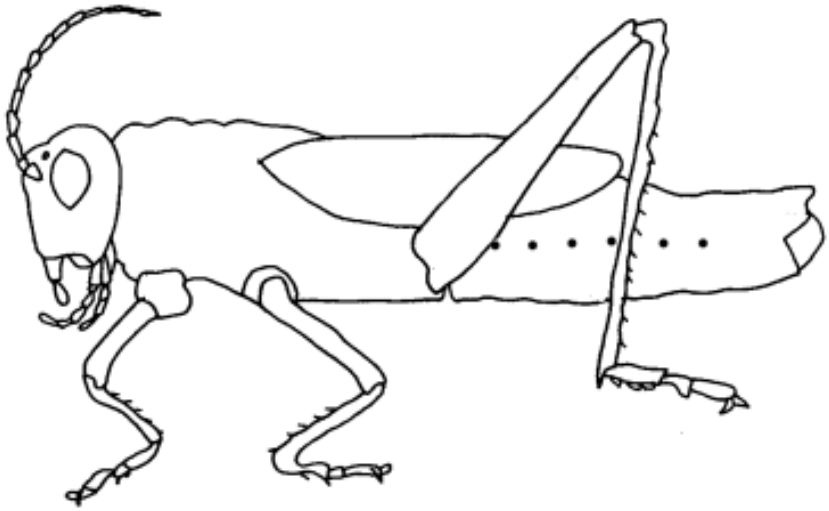
All About Insects

Facts About Insects

Most animals on Earth are insects. There are about 1,250,000 species of animals and about _____ are insects. That is _____ percent of all animals. Insects have been on Earth for a very long time. Fossils show that insects were here _____ million years ago.

Insects have ____ body parts, _____ antennae, and ____ jointed legs. Most adult insects have wings. Flies only have _____ wings. All other insects with wings have _____ . All wings and legs are attached to the _____ body part. All insects are covered by an _____ , a skeleton covering the outside of their bodies like armor. When an insect sheds this covering it is called _____ .

Parts of an Insect



head
thorax
abdomen
compound eye
legs

antenna (plural = antennae)
mouthparts
wings
spiracles

Name: _____ **Date:** _____

Metamorphosis

Metamorphosis _____

Complete Metamorphosis _____

_____

_____

Examples: _____

Incomplete Metamorphosis _____

_____

_____

Examples: _____

_____

Name: KEY **Date:** _____

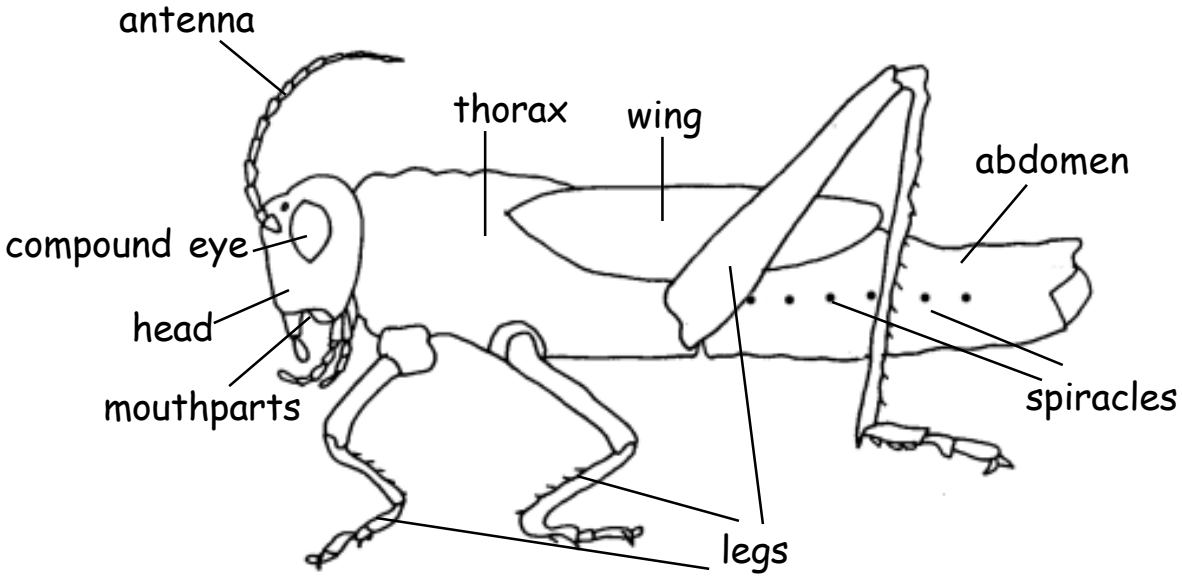
All About Insects

Facts About Insects

Most animals on Earth are insects. There are about 1,250,000 species of animals and about 1 million are insects. That is 80 percent of all animals. Insects have been on Earth for a very long time. Fossils show that insects were here 350 million years ago.

Insects have 3 body parts, 2 antennae, and 6 jointed legs. Most adult insects have wings. Flies only have 2 wings. All other insects with wings have 4 . All wings and legs are attached to the thorax body part. All insects are covered by an exoskeleton , a skeleton covering the outside of their bodies like armor. When an insect sheds this covering it is called molting .

Parts of an Insect



head
thorax
abdomen
compound eye
legs

antenna (plural = antennae)
mouthparts
wings
spiracles

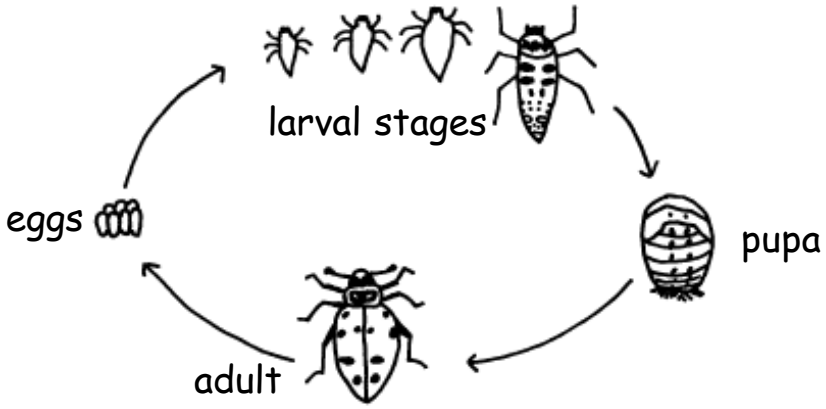
Name: KEY **Date:** _____

Insect Life Cycles

Metamorphosis is a change from one life form to another.

Complete Metamorphosis has four life stages. They are egg, larva, pupa and adult. The larva looks very different from the adult. The adults and larvae do not eat the same food.

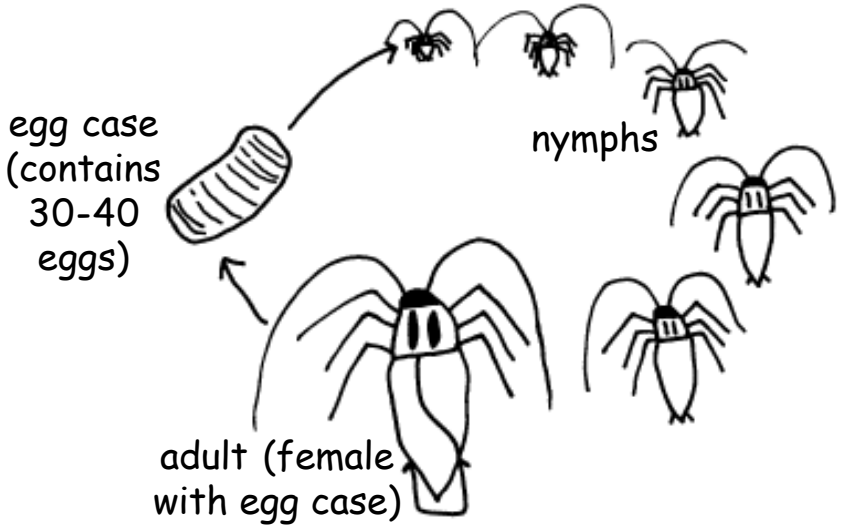
Life Cycle of a Lady Beetle



Examples: beetles, butterflies and moths, flies, fleas, wasps, bees, ants

Incomplete Metamorphosis has three life stages. They are egg, nymph, and adult. The nymphs look similar to the adult but they cannot lay eggs yet and do not have fully developed wings.

Life Cycle of the German Cockroach



Examples: cockroaches, earwigs, head lice, grasshoppers, crickets