Lesson 1 – Discovering Pests (building observation skills, investigating)

Introduction
This lesson starts with what the students know. It enables students to start investigating in familiar environments, such as school and home. It encourages them to think more broadly about all of the other organisms in an environment. It might be helpful to refer to Eco-Tag throughout this lesson if students are having trouble visualizing more than just students and teachers at school or more than just their family members at home. This lesson introduces students to the concept of a pest.

Duration 2.5 – 3 hours

Objectives
Students will:
- Build reasoning skills by critically thinking about the other organisms that may exist in the same environments as them.
- Build observation skills by searching for pests in their habitat
- Build observation skills by making notes of their surroundings
- Build communication skills as they conduct interviews
- IPM objective - discover and define the meaning of a pest

Vocabulary
Pest
Symptoms
Signs

Materials
Paper
Pens or Pencils
Copies of scavenger hunt worksheets
Colored pencils, crayons, or markers

Discussion
Begin by having a brainstorming session with your students. Ask them questions that will heighten their observation skills. Get them to think about the other critters that might share their living or learning space. Write their ideas on the board. The following are some questions you may choose to help begin the discussion.

1. Who uses the school?
   - Students, teachers, principals, cafeteria people, custodians, nurse, parents
2. Are these the only school inhabitants? Could there be other living things in the school?
   - No, people are not the only inhabitants, and yes other organisms are in the school
3. Who are these other organisms?
   - Bugs, ants, cockroaches, flies, bees, wasps, spiders, mice, rats
4. Where do you find them?

- Classrooms, hallways, closets, bathrooms, lunch room

5. Do they live inside or outside?
   - Some live inside, and some can live outside, some live in both places
6. Do you see them during the day or at night?
   - Some you might see in the dark and others in the light
7. Do people want them? Why?
   - No, they are not wanted, because they are dirty and spread sickness. It is not healthy for them to be in our school
8. Are they unwanted? Are they harmful?
   - Yes because they are in our habitat, but they don't really cause us any harm.

Use these questions to lead into a discussion of what defines a pest. Pests can be any unwanted organism (that occurs at any trophic level) in your personal environment, from weeds and fungus to insects. Usually students think of insects as pests, mostly because they think insects are scary walking around on more legs than us! Help them to understand that in nature there really is no such thing as a pest and that every living being has some purpose. Pest is a name that people give to those critters that are unwanted in the school or house because when they are abundant they can cause harm to our homes or schools, our health, well being, and can cause a financial burden. It is true that some pests, such as mice, can be dangerous in our living space. This is due to their ability to possibly spread harmful diseases.

Activity 1

School Scavenger Hunt:

Send your students around the school in search of pests. Have them fill out the scavenger hunt worksheet. Explain that it should be difficult for them to find most pests, assuming the school has a pest management program. But in their search for pests they may find evidence that a pest was present (symptoms or signs). Such evidence may include droppings, chewed areas, cast skins, eggs, etc. It is just as appropriate to find symptoms and signs of pests as it is to find the pest itself.

For younger students it will probably be best to do this activity with supervision. Also be sure to inform appropriate administrative staff and parents of your students' mission.

Activity 2

Home Scavenger Hunt:

The next part of this activity is to expand what they have learned about pests in school, into the home. In most areas there will be similar pests inside the home as there is in the home, so you may choose:

- not to do a second scavenger hunt
- to change the pests that they were searching for in school to different pests at home
- to see if they can find the same pests
- to compare what they found at home to what they found in school

Variations of Scavenger Hunt:
For grades 6-7 you may choose to give students a blank scavenger sheet and have them completely fill in the boxes.
For grades 4-5 you may choose to give students a mixture of hints, rather than only the pest name, in order to make the lesson more challenging.

Enrichment
The following websites contain activities that will correspond to this lesson. You may choose to use these lessons as enrichment or assessment.

"What's a Pest?" Minnesota Department of Agriculture
http://www.mda.state.mn.us/IPM/IPMPubs.html#PestPatrol
"Inspect our House" portion of IPM Super Sleuth by the IPM Institute of North America
http://www.ipminstitute.org

Activity 3 Follow-Up
After students have investigated their school and home surroundings, they should begin to have more questions about pests. This follow-up activity is a precursor to the next set of lessons, and the next step in IPM.

The students should begin by developing questions to conduct interviews about current IPM practices that are used in school and at home. They may interview parents, teachers, custodians, and administrators. Help them to formulate questions such as:

- Which pests have you discovered?
- Where have you discovered them?
- How have they been monitored?
- How have they been controlled?
- When do you control them?
- How many of a particular pest must you see before you control it?

After your students have conducted the interviews in school have them to continue practicing their new knowledge at home.

This lesson, "Inspect and Investigate – Interviewing," is from Exploring Urban Integrated Pest Management by Erica Bosley Jenkins of Michigan Sate University Pesticide Education, and more details can be found at:
http://www.pested.msu.edu/CommunitySchoolIPM/Curriculum.htm

Name_____

School Scavenger Hunt (grades 2-4)

IPM Lesson 1 – Discovering Pests

Pest	**Did you find this pest, yes or no?**	**What evidence of the pest did you find (symptoms and signs)?**	**Where did you find the pest?**	**Drawing or description of the pest.**
Cockroach			In a dark corner	
Mouse		droppings		
Spider				Has 8 legs
Ants		Ant hills near a door		
Bee or wasp				Has a yellow and black body

*Name*_____

School Scavenger Hunt (grades 5-7)

IPM Lesson 1 – Discovering Pests

Pest	**Did you find this pest, yes or no?**	**What evidence of the pest did you find (symptoms and signs)?**	**Where did you find the pest?**	**Drawing or description of the pest.**

Lesson 1
Corresponding activity - 1
Discovering Pests
Teacher Information Sheet: What is a Pest?

Ecologically, pests do not exist. In natural ecosystems, every organism has some specific role. This specific role that each organism must fulfill is its niche. Without that organism present to fulfill its role that niche is left empty, or may eventually be filled by some other organism. In natural ecosystems, groups of populations interact among each other fulfilling their individual niches. It is a complex system of checks and balances, and competition determines which individuals in a population will best fulfill the niche, while the others remain unsuccessful.

The Random House Webster's Unabridged Dictionary states that a pest is "an insect or small animal that harms or destroys garden plants, trees, etc." Webster's Third New International Dictionary (1981) says that pests are "(a) plant or animal detrimental to man or his interests." Lastly, the United States', Federal Insecticide Fungicide and Rodenticide Act (FIFRA) has defined a pest as “any organism that interferes with the activities and desires of humans."

The commonality among all of these definitions is that a pest is a human defined concept. It is an organism that is aesthetically (a nuisance), or monetarily intolerable to humans, or is in competition for a human resource. Humans consider undesirable organisms pests for several reasons. People consider pests a nuisance in their homes because they are aesthetically not pleasing. Pests in the home can represent uncleanness and contamination. They can also be indicators that there is something physically wrong with the home or building structure, for example termites may be feeding on rotting or decaying wood. Other animals such as cockroaches and ants find crumbs and left over food bits that have been missed. Larger pests such as rats and mice in our homes and schools are considered pests because they can be the source of health hazards. Mice and rats have been documented to carry deadly diseases such as the black plague and the Hanta virus.

Undesirable animals or pathogens in vegetable gardens and on farms are considered pests because they compete for human food resources or in some way inhibit the health of crops and cause growers to invest in control thereby forcing them into some monetary loss. If pest population densities are high growers could suffer both yield and economic damage.

We consider unwanted organisms in our flower gardens and greenhouses pests because they decrease the aesthetic value of our crop. Humans grow these ornamental crops for enjoyment or perhaps for the benefit of helpful insects, and when they become infested with pests we suffer aesthetic and monetary loss.

Sources:
Metcalf, Robert L., and William H. Luckman. Introduction to Insect Pest Management. New York: A Wiley-Interscience Publication, John Wiley & Sons Inc., 1994

Norris, Robert F., Edward P. Caswell-Chen, and Marcos Kogan. Concepts in Integrated Pest Management. New Jersey: Prentice Hall, 2003.

Lesson 1
Corresponding activity - 1
Discovering Pests
Teacher Information Sheet: Symptoms and Signs

Pests can be present in our homes, schools, gardens, yards, and greenhouses, yet we may not see them. We may be aware that pests have been in our habitats. The evidence pests leave behind can be characterized into two categories, symptoms and signs. It is important to know the difference between these two types of evidence, since they are characteristics of the pests that we hope to find.

Signs are biological remnants of the pest. Some examples of signs might be, fecal material from mice or rats, fecal material (i.e. black specks or frass) from insects, slime trails of snails or slugs, eggs laid by insects, cast skins or shed skins from insects, hairs, whiskers, or spores of fungal pathogens. Signs are indicators that have been left by a specific pest.

Symptoms are the reaction of the host in response to the pest. Some examples of symptoms may be chewed leaves, yellowing or browning of leaves, bored holes in wood, and allergic reactions. Symptoms are usually some change that is seen in the host. Also it is not uncommon to find symptoms of the pest long after the pest has left the host.

Source:
Norris, Robert F., Edward P. Caswell-Chen, and Marcos Kogan. Concepts in Integrated Pest Management. New Jersey: Prentice Hall, 2003.

Lesson 1 - Discovering Pests
Teacher Information Sheet: Ants

Photo courtesy of DR creations.net

Ants are members of the insect order Hymenoptera. Other members of this order are bees and wasps. They are social insects, and there are several thousand species of ants in existence. Being social insects, they dwell in colonies and often two or more generations inhabit one colony at the same time. Adult ants are divided into three categories, or castes. There are reproductive kings and queens, non-reproductive worker ants, and soldiers. Adult ants provide some care in young. Ant colonies are generally stable, worker ants have a life expectancy of 4-7 years and queens can live up to 15 years.

Ants fulfill important niches in the ecosystem. Living in the soil and ground litter habitat they can serve as predators, parasites, carnivores, and herbivores. Some of the carnivorous ants hunt smaller insects and other animals also living in the soil environment. Several ant species feed on honeydew that is produced by other insects such as aphids and leafhoppers, while others feed on the internal juices of fly larvae.

Pest Status: Ants are considered pests in homes and other structural dwellings because of their ability to compete for human resources by nesting and foraging inside. They can also cause serious economic damage to some field and orchard crops. Ants are visible during daylight, and often appear in large numbers. They are usually seen following each other to some food source or congregating around some other nourishment source. Indoors they are almost always found in kitchens attracted to human food. In metropolitan areas, ants have been the cause of major sidewalk cracking and settling because of their soil excavation under these structures. This can result in economic costs for city governments. Some ants are considered pests because of their aggressive biting and stinging behaviors. One example of this is the Red imported fire ant in the southern United States. Because of their ability to bite, ants can also be considered vectors of pathogenic bacteria, especially in hospital environments.

Food: There are several thousand species of ants and they feed on a wide variety of sources. Worker ants, the primary food gatherers, do not eat dry foods; instead they crush the food with their large mandibles and suck the juices. These juices are later regurgitated for other worker ants, and the queen. This method of feeding is important for control. Ants do not have a single diet but feed on various organic matter including plant and animal materials, and foods rich in, oils, sugars, carbohydrates, and proteins. This non-specific diet makes them a rather unusual insect. They gain nourishment from small insects, animals, honeydew, and larval nectars. Ants that invade our homes are

often in search of some type of food that is scarce in their normal habitat. Those ants have adjusted their food resources to the limited supply provided by humans. Other ants, such as carpenter ants often inhabit the human environment in wood used for home heating, cooking, or construction.

Biology: There are three categories of ants in every colony, workers, males, and females. Workers are the largest caste in the colony. They are non-reproductive females and perform a variety of different tasks, such as gathering food feeding and caring for the immature ants, nest sanitation, and defense. The reproductive caste is composed of queens and males. The queen mates only one time and continues to lay eggs her entire life. The workers care her for. They clean and feed her for her entire life. The colony is not limited to one queen. Depending on the ant species, there could be 1-30 queens in a colony. The queen lays eggs continuously, the workers take the eggs to various parts of the colony where they will develop into legless grub-like pupa and larvae (immature life stages) and finally into adults. If there are threats to the colony the worker ants will remove the immature forms to safer areas of the colony.

Shelter: Colonies can exist under the soil surface, in logs, or in other wooden structures that provide shelter and space ants need to carry out their daily activities. The queen starts colonies. After mating in flight she drops to the ground, sheds her large wings, and burrows a chamber into the soil, under a rock, or into tree bark and begins to lay eggs. The queen nourishes the first group of larvae by reabsorbing the muscle tissue that was used for operating her large wings. She reabsorbs and regurgitates this tissue and feeds it to her young. This first brood of ants then takes care of the queen and subsequent young. The queen will produce further generations that will yield more queens, males, and workers.

Behavior: Ants communicate through the release of pheromones in combination with touch and sound production. Being social insects they recruit nestmates for food retrieval, nest construction, colony defense and emigration to new nests through the release of pheromones (chemicals), their most effective use of communication. Ants create trails to food and other resources through the release of pheromones from glands at the posterior end of their abdomen near the stinger.

Control: Control methods are difficult for ants since their nests are very secluded. It is important to practice measures of sanitation in homes and schools. Keeping floors swept and table tops clean of crumbs and other debris will deter ants from alternate food sources. If infestations are intolerable, locate the nest and apply an insecticide liquid, dust or granular formation. Since ants are capable of adapting to several environments, biological control is difficult.

Sources:
Robinson, W.H., Urban Entomology: Insect and Mite Pests in the Human Environment. London: Chapman & Hall, 1996.
Interesting Facts about Ants: http://www.lingolex.com/ants.htm
Ant Colony Developers Association: http://www.antcolony.org/

Lesson 1 - Discovering Pests
Teacher Information Sheet: Cockroaches

Photo courtesy of University of Nebraska
(http://entomology.unl.edu/images/cockroaches/cockroaches.htm)

Cockroaches are pests to humans in every part of the world. They require a very general diet, and are able to use a wide variety of plant and animal materials as food. They are considered to be a pest simply by their presence, which disturbs a sense of well being and aesthetics, their ability to carry pathogens, and the general phobia many humans have towards them. Cockroaches are sometimes associated with unsanitary conditions. The majority of cockroach species live in natural habitats in the tropics and subtropics and are not associated with people. There are only about 10 species that have adapted to the human environment. The human environment is often high in relative humidity but rich in carbohydrate and protein food sources, which cockroaches prefer. The most common cockroaches found in human habitats are the German cockroach, the American cockroach, and the oriental cockroach.

For about 280 million years, cockroaches have remained virtually unchanged. Today's household pests have similar body structures and wing shapes as those found in fossils of carboniferous rock. From these fossil records, scientists have been able to hypothesize about the foraging habits of prehistoric cockroaches and compare them to today's cockroach behavioral patterns.

Even though cockroaches are pests, in some areas of the world they may have useful functions. There are some reports of cockroaches being used for medicinal purposes. A first century Greek naturalist advised mixing the intestines of cockroaches with oil as a cure for ulcers, tumors, itching, and earache. In some areas of the world such as China and Southeast Asia, cockroaches are still used to treat illnesses and diseases.

Pest Status: Cockroaches are most often associated with disease and illness. They can be carriers of fungi, viruses, protozoa, and bacteria. They also serve as hosts for several species of flatworms. Even though they may be carriers of these pathogens there is little evidence that cockroaches transfer these pathogens to humans.

The pathogens that naturally infect cockroaches can carry a variety of diseases, some examples of these are: leprosy, bubonic plague, dysentery and diarrhea in children, urinary tract infections, boils and abscesses, intestinal tract infections, typhoid fever and

food poisoning. Another very important illness associated with cockroaches is asthma. Sensitive adults and children can exhibit harsh allergic reactions when exposed to cockroach secretions such as feces, or cast skins. Allergic reactions to cockroaches have been reported to be as high as 79%.

Emotional responses to cockroaches have been another reason for their pest status. Cockroaches are often associated with uncleanness, poor house keeping, and low socioeconomic status. They are most often found in areas that are difficult to keep sanitary and free of water, such as kitchens and bathrooms. Control for cockroaches is difficult and can be very expensive. So those people with lower incomes can spend a great deal of their economic income on control, which gives reason for the association between low economic status and cockroaches.

Food: Cockroaches are not specific in their diet. They have chewing mouthparts that enable them to be generalist (non specific) feeders. They feed on a range of plant and animal material and prefer foods that are rich in carbohydrates, lipids and proteins. In human habitats adults and nymphs will also feed on starch and sugar-based foods. If these preferred foods are not available, cockroaches will feed on dead insects, excrement, glue, paper, and other materials. They are nocturnal animals and will forage for food and water in cracks and crevices. Cockroaches prefer habitats with a continuous water source and high relative humidity. If their food resources are dry they will search for a water source, such as leaky faucets, condensation under refrigerators, condensation on water pipes, bathtubs, and sinks.

Biology: The female cockroach emits a volatile chemical, or pheromone to attract a mate. This compound is sensed on the antenna of the male and the pair begins mating behavior. For the German cockroach, the male contacts the female through pheromones and a period of antenna-to-antenna contact is made. Soon after this behavior copulation begins. Once the female's eggs are fertilized, she begins the production of an egg case. During the protection of the egg case, eggs are produced in groups of 10-40. The female may deposit the egg case in a protected location, which she created with her mouthparts or keep it with her until the first stage nymphs are ready to hatch. The egg case is very sturdy and able to protect the developing nymphs from desiccation and harmful environmental compounds.

The cockroach has a gradual metamorphosis, in which each life stage resembles an adult. The first-stage nymphs may remain close to the egg case after hatching, but soon go in search of food. Nymphs will pass through five to six instars (juvenile stages), each time shedding skin and growing larger before reaching adulthood. After the final molt, for both male and female, the wings and reproductive organs are fully developed and functional, though in some species, the wings may be reduced or absent. Adults have a flattened body, and a sensitive cuticle that requires moisture to prevent desiccation.

Shelter: Because cockroaches are nocturnal animals they will remain inactive in dark cracks, crevices and other protected areas during the day. The adult German cockroach can fit its flattened body in crevices as small as 1.6 mm, and nymphs only need cracks as

large as 0.5 to 1.6mm wide. They prefer humid areas where temperature and water vapor can directly influence the level of infestations. Low temperatures and humidity promote inactivity, whereas high temperatures and high humidity promote activity.

Behavior: Cockroaches are active at night with two specific periods of foraging activity; the first is a few hours after sunset and the other at an hour before dawn. During these hours, males, nymphs, and females (without egg cases) will leave their safe harborages (dwellings) to forage for food resources and to mate.

Control: Cockroaches are successful in human habitats because they can find adequate amounts of food, water, and shelter. Eliminating one or more of these necessities will inhibit cockroach populations in the home.

Reducing water availability and high humidity are some of the most effective ways to control cockroach infestations. Making sure faucets of bathtubs and sinks are tightly closed, and by sealing potential leaks can decrease the possibility of cockroaches from inhabiting our homes.

Another way to limit cockroach infestations is to limit their food supply. They are generalist feeders and can live easily on scraps and crumbs of humans. To prevent these pests from invading your homes and schools, availability of food to the cockroaches should be reduced. Sanitation is the best way to reduce the food supply; sweeping, mopping, washing counters, and properly disposing of trash will limit food for these pests.

Eliminating shelter for cockroaches is another effective control measure. During construction fittings should be tight, and proper sealing of openings can prevent entrance of cockroaches into the home. Identifying, sealing, and treating any openings can also prevent and deter cockroaches.

There are several insect species that are valuable to the biological control of cockroaches. The house centipede and a pholcid spider are two predators that feed on early instar cockroaches. Some parasitic wasps also exist that will seek a vulnerable egg case, and deposit an egg within it. As young parasitic wasp develops, it consumes the eggs of the cockroach. Those that it does not consume, fail to develop.

Insecticides are a final method for control of cockroaches. Proper identification of the insect's harborage is necessary. Using care and other precautions, injecting liquid or dust into or near infested cracks and crevices prior to active hours in uniform and proper quantities will provide effective results. Insecticides should be used as an alternative means of pest control and in conjunction with other control practices.

Sources:
Robinson, W.H., Urban Entomology: Insect and Mite Pests in the Human Environment. London: Chapman & Hall, 1996

UC IPM Online: Cockroaches:
http://www.ipm.ucdavis.edu/PMG/PESTNOTES/pn7467.html

University of South Carolina Roach Camera: http://cricket.biol.sc.edu/usc-roach-cam.html

Asthma and Indoor environments: http://www.epa.gov/asthma/triggers/pests.html

Entomology Websites – Cockroaches:
http://www.isis.vt.edu/~fanjun/text/Link_specc01.html

Lesson 1- Discovering Pests
Teacher Information Sheet: House Flies

Photo courtesy of Do It Yourself. Com

Flies are members of the insect order Diptera. Other members of this order are biting midges, horse flies, and mosquitoes. The housefly, *Musca domestica* is a dipteran that is seen in human environments all around the world, from the equator to the poles including some of the most extreme environments.

They are soft-bodied insects with two pair of wings that are very adept for long flights. Flies have large, well adapted eyes and a keen sense of smell. They have varying mouthparts, depending on the species. These mouthparts range from piercing-sucking, sponging-lapping, to an intermediate cutting. All of these morphological features make flies very successful at adapting to human environments.

Flies have been associated with human environments since the domestication of animals in early agriculture. Flies prefer the feces of pigs, humans, and horses to that of large grazing animals. When these animals became an important part of the human environment, flies also became more common. Some changes in fly biology occurred during this adaptation to the human environment. Egg laying females strayed away from their natural habitat and found more suitable conditions within the human environment.

Flies are considered pests in the human environment because of their association with disease. The housefly and its relatives breed in human feces, and other animal dung, where they acquire a range of pathogens. Significant diseases carried by flies worldwide are malaria, yellow fever, and encephalitis. Other diseases are indirectly associated with flies are typhoid fever and dysentery.

Pest Status: The primary reason for flies' pest status is their ability to transmit disease. They are most commonly associated with human garbage and animal feces. These two waste items are perfect breeding sites for flies. They can acquire several types of bacteria, including *Salmonella* and *Shigella*, as well as other pathogens. In these feeding sites habits of flies are rather disgusting to humans. Flies land on their food source, namely rotting flesh or excrement, where they defecate and regurgitate some fluids from their stomach onto their food. Flies then move into a human environment and repeat the process. This can result in bacteria transmission leading to sickness.

Flies have the ability to be a great nuisance. Some types of flies will swarm, and in great numbers they will enter homes, schools, hospitals and other buildings. Some flies, such as horse flies and mosquitoes bite and feed on human blood. This is often very much a nuisance as well as painful for a human host.

Food: Flies feed on the waste products of humans. They feed on human and animal feces, garbage, crumbs, and decaying vegetation. Feeding sites are also the breeding areas for flies. They feed two or three times per day on food and water during the hottest and driest daylight hours, and ingest foods that are soluble through their salivary glands and sponging mouthparts. Biting flies feed on the blood of humans and animals.

Biology: Female houseflies are attracted to warm and moist substrates that will provide nourishment for her offspring. A female normally mates only once during her life. She has an internal structure that allows her to store sperm, and when she is ready will fertilize her eggs and lay several batches of eggs. Flies exhibit complete metamorphosis (life transformation) in which each life stage is different from the adult. Flies begin their life stage as an egg, which has been deposited in excrement or garbage. Next they transform into a larva. The larva are wingless and legless. Their mouths are internal at the posterior portion of their bodies. At this stage they will go through four molts. Following the final or third molt, the larva become inactive, stop feeding and begin to form a pupa. After the pupal stage the adult emerges, and unfolds its wings to dry and harden. The life cycle can take up to 10 days to complete and there can be as many as 12 generations in one summer.

Shelter: Flies have adapted to the human environment. They do not require any distinct protection for shelter. They live and breed among the interactions of humans and the human environment. They require warm, moist materials in which to lay their eggs, and allow their offspring to complete a metamorphosis.

Behavior: Flies are very strong and mobile insects, and can travel long distances. Adults generally follow an odor stimulus, and are active fliers when temperatures are between 11° C and 32° C. They are inactive at temperatures below 7° C, and temperatures below 0° C are lethal to adults. They rapidly and frequently fly between food sources. Flies have become resistant to most modern insecticides.

Control: Flies have become very resistant to many insecticides; the best methods of control are those that make the environment unfavorable for the pest. Potential fly feeding or breeding sources should be removed. Household garbage should be sealed and disposal should be handled properly. Inside and outside debris should also be cleaned up. Other methods of control include traps that attract flies away from the human environment. An example of this is an electronic device that has a fluorescent light source (for some flies), that will draw the fly's attention and kill it upon contact. Other traps include sticky traps, and flypaper help in reducing pest populations in the human environment.

Source:
Robinson, W.H., Urban Entomology: Insect and Mite Pests in the Human Environment. London: Chapman & Hall, 1996

Clemson University Entomology – Fact Sheet
http://entweb.clemson.edu/cuentres/eiis/hands/hs16.pdf

Virginia Tech – Virginia Cooperative Extension – Fact Sheet
http://www.ext.vt.edu/departments/entomology/factsheets/housemag.html

Lesson 1 - Discovering Pests
Teacher Information Sheet: Spiders

Photo courtesy of the Clifford W. Estes Company
(http://www.estesco.com/projects/oct02/oct02.html)

Spiders are Arachnids that are commonly mistaken for some type of insect. Spiders are not insects, and their most distinguishing characteristic is four pairs of legs. They are among the most common insectivores in a natural ecosystem and are predatory and can be beneficial. Spiders have easily adapted to any ecosystem that provides a sufficient food supply. They are primarily insectivores that prey on both beneficial insects and insect pests. Spiders are able to easily transition from natural ecosystems to agricultural and urban ecosystems by their swift ability to move across plant surfaces and by ballooning, or sailing on wind currents attached to a thin line of silk. Spiders are well camouflaged to their surroundings and prey on a multitude of insect species. They are solitary animals that often remain hidden in dark, protected corners on or near our homes and schools. Spiders and their prey enter our homes and schools through openings of unsealed doors and windows. Spiders that have adapted to our homes and other dwellings are those who prefer to forage at night and have limited interactions with humans. They often occur in undisturbed areas of our homes such as our storage areas, cellars, and basements where relative humidity and temperature is ideal for both spiders and their prey.

Pest Status: The pest status associated with spiders is fear of being bitten. People have taught their children over time that spiders are dangerous. Children have learned that spiders are unpredictable, due to their quick and unexpected movements. Children have also learned that the bite of a spider can be deadly. These teachings have benefited both these beneficial arthropods and children. Spiders may bite humans but their bite is rarely harmful. Some spiders have mouthparts that are capable of penetrating human skin or produce venom that is not toxic to people but mildly irritating. Thus a spider bite may be very painful, causing skin irritations, welts, and swellings but is not associated with any long-term health problems. Black widows and the Brown recluse are associated with painful bites.


The Brown Recluse

The Black Widow

Food: Spiders are predators that feed on insects and to some degree on other arthropods. They have powerful jaws (chelicerae) that they use to restrain their prey. These jaws are equipped with venom glands that aid in the immobilization of their prey. Spiders can also bind their prey with strong threads of silk. They cannot consume large prey; instead they secrete venom-rich enzymes into their prey's body that dissolves the internal organs. The spider can then feed on this degraded material.

Biology: Copulation for spiders can be very difficult. Male spiders have a pair of specially developed first pair of legs that aid in reproduction. The male uses these unique pair of legs to transfer sperm to the female genital orifice. Females briefly engage their predatory instincts during copulation and then quickly resume them following the act. Reproduction can be very dangerous for male spiders, because the female often consumes them after copulation. The female's body size determines the number of eggs she will produce. Eggs are placed in a silken sac and the female will raise her young until they are fully-grown. Spiders produce several generations per year.

Silk is a protein that is exuded from spinnerets at the abdomen of the spider. It is very elastic and is able to stretch five times its length without breaking. Silk is composed of one or more strands of silk and is specific to use, such as egg sacs, webs or nests. All spiders, with the exception of a few species, produce silk.

Shelter: Spiders prefer dark, protected, undisturbed areas, rich in prey for their web spinning and nest building. Spiders will abandon webs that are in areas that do not yield a sufficient amount of prey.

Behavior: Spiders are predatory nocturnal animals who catch and devour their prey in solitude. They will consume large amounts of prey, and then because of their slow metabolism will not feed for a considerable amount of time. Spiders are also very unpredictable in their movement and well camouflaged into their surroundings.

Control: Control for spiders is generally not necessary because they are beneficial arthropods. However, because they are nocturnal hunters, they may be found on the outside of human dwellings at night feeding on insects that are attracted to our outside lights. Removal of those lights or changing the color of the light bulb will deter

attracting spiders prey. Removing and destroying egg sacs will also reduce the number of spiders in the environment.

Sources:
Robinson, W.H., Urban Entomology: Insect and Mite Pests in the Human Environment. London: Chapman & Hall, 1996

Texas Agricultural Extension Service, Texas A&M University:
http://insects.tamu.edu/extension/bulletins/l-1787.html

Photos courtesy of Conservation Commission of Missouri:
http://www.conservation.state.mo.us/nathis/arthopo/mospider/kinds.htm

Lesson 1 - Discovering Pests
Teacher Information Sheet: Wasps, Yellowjackets, and Hornets

Photo courtesy of Keith Edkins' insect photo collection (http://www.gwydir.demon.co.uk/insects/index.htm)

Wasps, yellowjackets, and hornets are members of the order Hymenoptera, and of the family Vespidae. They are social insects that live in colonies with one or more queens. They often form their nests out of paper-like material. These animals can be pests to humans seasonally. They are strong fliers, and skillful foragers.

These vespids seasonally establish their nests in the soil, trees, shrubs, and in the eaves and rafters of our homes and schools. The nests often have a great amount of worker activity, which attracts the attention of people, and when peoples' attention is drawn fear because of the possibility of being stung. Despite the fear many people have of these insects, they may be beneficial, fulfilling the niche as predators, and parasites feeding on other insects. They are also important in the pollination of some plants and flowers.

Vespids were originally found in the tropical regions of the world, but are now found in more temperate zones. This change from tropical to temperate climate is most likely due to the changes in their biology, and from limitations of their resources.

Pest Status: People often consider wasps, yellowjackets, and hornets as pests because of their threatening behavior and ability to inflict a painful sting. The stinger of most of these insects contains venom that causes a severe allergic reaction to sensitive people. Though the venom is designed to immobilize the prey and not kill it. Among highly allergic people it can result in death.

The swarming and unpredictable behavior of these insects also causes alarm. When present in great numbers, economic damage can occur when outdoor recreation areas, dumps, and landfills are closed. Vespids are scavenger insects that often forage for food on animal dung, and in garbage dumps. These feeding habits can result in them carrying harmful bacteria such as *Escherichia* and *Salmonella,* transmitting disease when they visit human food.

Food: In natural environments, vespids serve as predators and parasites when they feed on other live arthropods. They also scavenge on decaying flesh of dead animals, visit flowers for sweet nectars, pollinating their host. In the human environment where there may not be a large numbers of insect prey, vespids forage in garbage dumps, on animal

dung, in trash cans, and on beverage cans to supplement a lack of protein and carbohydrates.

Biology: In the early spring a female wasp will emerge from a protected burrow, usually from under a rock, in an attic, or some other type of wall void. This female will then create a small embryo nest that contains 40-60 cells. This founding queen will produce the first brood of workers. She will care for them until they are mature. After the first brood, the workers will care for future generations. Worker wasps forage during the day, capturing prey, and collecting decaying tissue to bring back to the developing larvae. The maximum number of workers will occur in the colony about three months after colony establishment. After this peak period, there will be a shift in activities from producing worker wasps to producing reproductive wasps. Males and new queens will emerge. They remain with their colony until they are strong and nourished enough to leave and mate, a period of about 7-10 days. After mating, fertilized queens will look for protected sites to overwinter.

Shelter: Vespids create their own shelter. Their hives are generally made from paper-like material, such as the bark of trees. Hives contain combs in the inside for laying eggs and rearing new vespids. Hives are usually formed in trees, bushes, under eaves, in the corners of doors, under bridges and in other undisturbed and protected areas.

Behavior: Wasps, yellowjackets, and hornets are social insects. They communicate with each other through pheromones (chemical signals), and body movements. They will invade but rarely attack humans in inhabited areas in search of food.

Control: Wasps, yellowjackets, and hornets are beneficial insects that regulate detrimental insects in gardens and on farms. Unless populations become very problematic no control is recommended. When they impede on a human environment control may be necessary, for example when they are seen in public places in relatively large numbers they create a nuisance and cause concern for human health.

A method of control to be considered first is sanitation for the prevention of invading vespids. Proper disposal of trash, cleaning, and maintaining the inside and outside of our homes and school will deter these insects from searching our areas for food.

Another very effective method of control is baiting. Sometimes it is difficult to locate the hive, or dangerous to destroy it, so injecting an insecticide into high protein baits such as tuna fish, salmon, beef, or poultry is very effective. The slow acting insecticide allows the workers to continuously visit the meat product and return to the hive, thus infiltrating the hive with the poison until the entire hive is eliminated.

Sources:
Robinson, W.H., Urban Entomology: Insect and Mite Pests in the Human Environment. London: Chapman & Hall, 1996

University of Kentucky Entomology:
http://www.uky.edu/Agriculture/Entomology/entfacts/trees/ef411.htm

UC IPM Online – Yellowjackets and other social wasps:
http://www.ipm.ucdavis.edu/PMG/PESTNOTES/pn7450.html

Lesson 1 – Discovering Pests
Teacher Information Sheet: Gray Mold

Photo courtesy of: University of Florida

Gray mold is a very common disease that is found on vegetables, fruits, ornamental plants, and agricultural crops. It is a common pathogen that thrives in greenhouse and grocery store environments. Gray mold is caused by the fungus *Botrytis cinerea*, and is called gray mold because of the gray, fuzzy sporulation that is found on decaying plant material. *Botrytis* commonly invades plant material that has been broken, cut, or somehow damaged, though it can also infect healthy material.

Symptoms: The symptoms of gray mold include spots and brown or tan lesions on stems and leaves, some plants may even produce cankers in response to the pathogen. Other symptoms include water-soaked lesions, and necrotic areas. Pictures of symptoms can be seen at the following websites:

- University of Guelph
  http://www.uoguelph.ca/~gbarron/MISCELLANEOUS/botrytis.htm
- University of Toronto
  http://www.botany.utoronto.ca/ResearchLabs/MallochLab/Malloch/Moulds/Botrytis.html

Biology: *Botrytis* overwinters in the soil in decaying plant debris. Botrytis does not generally infect the plant as the plant emerges. *Botrytis* can infect most any plant part under the right environmental conditions. The pathogen does not often infect seeds, but it can infect bulbs, corms, tubers, roots, petals, stems, leaves, and fruits. Cool and damp weather are optimal conditions for growth, sporulation, spore release and germination, and infection. Small conidia germinate on the plant surface, and then mycelia grow into plant tissues. Mycelia enter plant tissues through wounds. The pathogen produces enzymes which degrade plant tissue. *Botrytis* continues to grow by spreading more mycelium throughout the plant tissues. The mycelium then produces conidiophores, which produce balloon-like conidia. The gray branching conidiophores with conidia are easily seen on rotting fruit, such as strawberries. The presence of these conidia is a detectable sign of infection.

Control: Management for *Botrytis* is easy without the use of chemicals. If symptoms or signs of this pathogen are observed removal of the infected material is necessary. Prevention of *Botrytis* can be practiced by monitoring the environmental conditions, such as warm temperatures that will prevent moisture, and proper spacing of plants that allow for ample air flow for drying. Plants that are wounded can be protected with fungicides or removed from the environment.

Experiment: Study the development of *Botrytis* conidia by obtaining over ripe and mushy strawberries. Place them in a plastic bag for a few days. Observe the development of the mold as the strawberry breaks down, after a few days use a microscope to view spores or conidia.

Sources:

University of Guelph -
http://www.uoguelph.ca/~gbarron/MISCELLANEOUS/botrytis.htm

Ohio State University Extension Fact Sheet –
http://ohioline.osu.edu/hyg-fact/3000/3070.html

Agrios, George N. Plant Pathology 4th Edition. San Diego: Academic Press 1997.

Daughtrey, Margery, L., Robert L. Wick, and Joseph L. Peterson. Compendium of Flowering Potted Plant Diseases. APS Press, 1995.

Lesson 1 – Discovering Pests
Teacher Information Sheet: House Mouse

Photo Courtesy of: Bugbustersgsy.com

The house mouse is a common household pest. It originally arrived in North America on ships traveling from Central Asia, and has been able to adapt to a variety of environments. They are found around homes, commercial structures, in agricultural lands and in open fields. They are usually active at night and give off a distinct musky odor, which can assist in their detection. The house mouse has not been found to be a carrier of Hantavirus, though other mice have. Its relatives the deer mouse, and white-footed mouse have been documented as carriers of the virus.

Pest Status: The house mouse is considered a pest because it lives in close association with people, pets, and livestock and consumes and contaminates food and dwellings. It can cause considerable damage to structures and property. The house mouse has been documented as a carrier of disease causing pathogens such as *Salmonella*. They often emit a very pungent musty odor, and leave behind fecal pellets, which can be bothersome. They are very difficult to control because of their abundance, rapid adaptation and rapid reproductive rates.

Food: The house mouse is a "nibbler." It prefers cereal and grain foods, but will eat almost any food available. They will also eat structural components such as wood materials and will chew through cable and telephone wires.

Biology: The house mouse is a small rodent with very large ears and small dark eyes. It weighs approximately ½ ounce, is usually light brown to gray in color. Adults are about 5-1/2 to 7-1/2 inches long, including a 3- to 4- inch tail. It has very keen senses of taste, hearing, smell, and touch. Females can have 5 to 10 litters of 5-6 young per year. Young are born 19 to 21 days after mating and reach reproductive maturity in 6 to 10 weeks. The life span of a mouse is 9 to 12 months.

Shelter: The house mouse is a very adaptable organism and will seek shelter almost anywhere. It creates its nest from fine shredded paper or other fibrous materials. It can create nests in home attics, in insulation materials, and between walls. The house mouse also can be found in open fields and in agricultural lands.

Behavior: The house mouse is most active at night, but can sometimes be seen during daylight hours. They are proficient climbers and can run up any vertical surface. They are capable of running horizontally along wire cables or ropes and can jump up to 12 inches from the ground up onto a flat surface. They can fit through openings that are slightly larger than ¼ inch across.

Control: There are a variety of control options for the mouse pest problem. Preventative tactics are always the best option. Sanitation is the first option for preventing mice in the home. Remove mouse food and shelter sources when ever possible. Any dropped or left food items should be cleaned up and fibrous materials that could be a good source for a nest should be removed. Any holes, cracks, or gaps that are ¼ inch or larger should be sealed. Steel wool is a good temporary option. Cracks or openings around pipes, vents, and utility cables should be sealed. Doors and windows should fit tightly. If a population already exists, traps are an option. Wood-based traps and live traps can be purchased at a local hardware store. Traps should be placed along walls, in dark corners, and places where there have been signs of mouse activity. Predators such as cats and dogs are also effective methods of keeping rodent populations down. A final option of rodent control is the use of baits. These usually consist of an attractant such as a food and a rodenticide, and can be purchased at hardware stores. These baits can be harmful to household pets and small children so product labels must be followed.

Sources:
University of California, UC IPM Online
http://www.ipm.ucdavis.edu/PMG/PESTNOTES/pn7483.html

Bosley Jenkins, Erica. Exploring Urban Integrated Pest Management. Michigan State University Pesticide Education. http:// www.pested.msu.edu