Before They Were Pests (Grades 3-5)

Lesson Overview

In this lesson, students will explore the native habitats and behaviors of common pests to understand why and how household pests enter our homes. Students will examine the relationship between humans and pests and the limited habitat and resources shared by both.

National Science Education Standards

This lesson correlates with the following standards issued by the National Science Teachers' Association:

- Science as Inquiry, Content Standard A: Abilities necessary to do scientific inquiry.
- Life Science, Content Standard C: The characteristics of organisms, life cycles of organisms, organisms and environments, diversity and adaptations of organisms.
- Science in Personal and Social Perspectives, Content Standard F: Personal health, changes in environments.
- History and Nature of Science, Content Standard G: Science as a human endeavor.

Key Concepts

- Habitat
- Adaptation
- Observation
- Life cycle
- Communication
- Ecology
- Animal Behavior

Vocabulary Words

- Adaptation
- Ambient temperature
- Antennae
- Colony
- Decomposition
- Evolve
- Exoskeleton
- Filamentous
- Habitat
- Host
- Immature
- Larvae
- Metamorphosis
- Microclimate
- Nymph
- Overwinter
- Parasite
- Pheromone
- Pupae
- Pupate
- Reproduce
- Scavenger
- Species
- Territory

Procedure

Preparation:

1. Make copies of “Incomplete Metamorphosis of a Dragonfly” and “Complete Metamorphosis of a Lady Bug” and the readings (found in the Visual Aids and Handout Sections)
2. Review the procedure and schedule 3 – 4 sessions.
3. For “Pest Life Cycles”, step 3, students may need access to a computer lab to conduct their research.

1. Introduction

To understand why pests enter our homes, it is important to understand the concept of **habitat**. All living things require a suitable habitat in order to survive. A habitat must provide four things — food, water, shelter (a place to hide, build a nest or lay eggs), and space (**territory** — to avoid competition). Each animal **species** is unique in the kind of food it eats, how it gets water, where it hides and **reproduces**, and how much space it needs apart from others of its kind. Therefore, different animal species require different habitats. And furthermore, any given plot of land can contain a variety of habitats and support a variety of species.

Pests that enter our homes are simply in search of a suitable habitat.

Complete the activity entitled, "Could Your Dream House be a Mouse House?" Then look at the habitats of other pest species. Have students read the short background information about the Indian meal moth. Discuss with students whether this species would be able to survive in the wild today without the presence of humans. It is likely that prior to exploiting human stockpiles of grain, the ecology of this species was quite different. It would have been difficult for an adult moth to find a naturally occurring stockpile of grain in which to lay its eggs' Discuss the terms **adaptation** and **evolution**. Use the story of the Indian meal moth as an example of a species that became successful because it was able to adapt and evolve over time. Using the background readings provided as well as library and electronic resources, assign each student or small group of students one pest species to research. Have them create a report with the following information, and share what they've learned with the class.

Identify their pest's habitat today, using the four habitat requirements described above.

Describe how their pest's habitat may have changed over time and/or with the presence of humans. Is its habitat in the "wild" different from its habitat when there are human structures nearby?

Speculate whether their pest could survive today without the presence of humans.

Activity — Could Your Dream House be a Mouse House?

Everyone daydreams from time to time about their dream house. Discuss the concept of habitat with students and have them each describe their ideal dream house, noting how the four habitat requirements would be met. What kind of food would they need and how and where would it be stored? Where would their water come from? (If necessary, discuss plumbing systems, pipes and wells.) Then read the following story of a house mouse describing its habitat:

My favorite thing to eat is seeds that come from grasses. When the wind blows in the fields where the grasses grow, the ripe seeds are scattered all around. I spend lots of time searching for and gathering these seeds, and every so often, I stop to nibble. However, if there aren't any seeds around, I'll eat just about anything! I usually don't need much water; I get enough from what's trapped inside the food I eat. I can have babies at any time of the year, as long as I can find a place that's warm enough. I like warm protected places; they are good for building nests. I don't like being out in the open, though, especially during the day — too dangerous! I travel in tunnels of earth, grass, wood, rocks, or whatever I can find. I don't mind living with friends or relatives but when it gets too crowded, we fight over the food, so I go in search of someplace else to live. This happens a lot, but it doesn't bother me; I'm very ***adaptable*** *and don't mind trying different things.*

How are the four habitat requirements met for the house mouse? What else can you learn about the house mouse from this story? If a house mouse found its way into the students' dream houses, could it stay? What could they do to make their dream house less inviting to a house mouse?

2. What's for Dinner?

Now that students are familiar with the habitats of these pest species, challenge them to identify the single most important factor that leads pests into our homes — *to find food*. Most pests we find in the kitchen, living room, or basement are just plain hungry. Complete the activity "Tasty Paste" in which students list all the items in their homes that could be considered dinner to a pest.

Activity — Tasty Paste

Write the following list of items typically eaten by cockroaches in homes on a chalkboard, white board, or overhead projector. Ask students to brainstorm other items that cockroaches might like to eat and, using the background readings provided, add things that other pests like to eat as well. Where are these items stored in their homes? Would their homes be inviting to a hungry cockroach or other pest? Choose a few of the items and have students suggest ways they could protect them from being eaten by a pest.

- o cereals
- o sugary foods
- o meat products
- o cheese
- o beer
- o leather
- o hair
- o wallpaper
- o artwork
- o paper documents
- o postage stamps
- o draperies
- o paper currency
- o books
- o book bindings (they like the paste beneath the binding!)
- o plants
- o soft fruits such as strawberries, mangos, and bananas

As an extension, note that some pests, like bed bugs and mosquitoes, make their meals out of us and not food and other items in our homes. Discuss the physical properties of blood and why these species depend on it. Make comparisons to other animal species that feed on blood such as leeches and bats.

3. Pest Life Cycles

All species experience a life cycle. It is the certainty of birth, growth, reproduction, and death that all living things share. Humans and other mammals have relatively simple life cycles — beginning life as babies, growing larger until becoming adults, and dying. Insects, however, experience unique life cycles involving the process of **metamorphosis**, which means "change." Most insects experience either **complete metamorphosis** or **incomplete metamorphosis**. In complete metamorphosis there are four stages — egg, larva, pupa, and adult. An adult female lays eggs, which hatch into larvae. The larvae do not look like adult insects — they usually have a worm-like shape (caterpillars, maggots, and grubs are all insect larvae). The larvae **molt**, or shed their skin several times as they grow larger. Finally, they **pupate**, or make cocoons around themselves, and stay inside while their bodies change into an adult form. The adult breaks out of the cocoon and is ready to reproduce and begin a new life cycle. In incomplete metamorphosis there are only three stages — egg, nymph, and adult. An adult female lays eggs, which hatch into nymphs. Nymphs look much like adult insects but usually don't have wings. The nymphs molt 4-8 times, stopping when they reach adult size and finally grow wings.

Activity — The Metamorphosis of Pests

Discuss the concept of life cycles with students, using humans and pets as examples. Have students share what they know about different types of life cycles. Introduce the term metamorphosis if necessary and outline the two types — complete and incomplete. Use the two visual aids, Incomplete Metamorphosis of a Dragonfly and Complete Metamorphosis of a Lady Bug. Assign small groups of students to research the life cycles of the following pest species — Indian meal moth, German cockroach, Bed bug, House ant, mosquito, and Paper wasp. Have each team produce a poster or booklet with drawings of each species' life cycle stages. Species should be classified according to whether they undergo complete or incomplete metamorphosis. Challenge students to look for answers to the following questions as part of their research. A good place to start your students' research is the "Pest Guide" section of PestWorldforKids.org.

1. Which type of metamorphosis do most insects experience? (Approximately 88% of known insects undergo complete metamorphosis and 12% undergo incomplete.)
2. Are there any insects that show no metamorphosis? (Yes — they are called ametabolous insects. The immatures look exactly like the adults except for the presence of reproductive organs. The silverfish is an example.)
3. What is the term used to describe the different stages of larval or nymph development as they molt? (instar)

4. How much time does it take for each species to complete its life cycle? How many generations will it experience in a year?

As an extension, discuss molting in greater detail. As an immature insect grows, it forms a new, flexible skeleton beneath its existing exoskeleton. When it's ready to molt, it takes in extra air to expand itself and split open the old skin. Then it crawls out and the new skin begins to harden. To demonstrate this, blow up a balloon, leaving room for more air. Clamp the open end in vice grips or using a strong clothespin, chip clip, or binder clip, so that later you can blow more air into the balloon. Then cover the balloon with a thin layer of paper mache and let it dry. Once dry, remove the clips or vice grips, being careful not to release any air, and blow more air into the balloon until the "exoskeleton" splits open.

Field Observations

Activity — Moth or Butterfly?

Moths and butterflies belong to the order Lepidoptera. They are flying insects and share similar life cycles and anatomy. However there are differences. Invite students to observe moths and butterflies in their backyards or in a park. Butterflies typically fly by day, while moths are mostly night-flying. Butterflies can be found feeding on the nectar of flowers or drinking from puddles on the ground. They will also be attracted to fermenting fruit or molasses placed on a dish. Moths can also be attracted with baits of sugar, molasses, and fruit, although it may be easier to use light. Moths are disoriented by lights and will often fly towards them. At dusk, have students hang a white sheet outdoors and place a black light or lantern in front of it for several hours. Observations can be made either that evening or the next morning as many of the moths will have laid to rest on the white sheet for the day.

Look for the bright colors and clubbed **antennae** on butterflies. At rest, they hold their wings closed or together, upright over their back. Moths do not have clubbed antennae, and the antennae are usually **filamentous** or feathered. Most moths rest with their wings folded, roof-like, over their back. Finally, moths in general are typically less colorful than butterflies (but there are exceptions in both cases).

Activity — Bed Bugs and Bird Bugs

Modern homes tend to be better sealed and sanitized than homes occupied 50 years ago or more, and consequently bed bugs are less common than they were then. However, their occurrence is on the rise. Discuss their behavior with students and if necessary, have students use a metric ruler to get a sense for how small a bed bug can be (6-10mm). Mention that bird bugs are relatives of bed bugs and prey upon their hosts in essentially the same way as bed bugs upon humans. Many backyard birds that make nests around homes, such as swallows, martins, and bluebirds, are **parasitized** by bird bugs.

Activity — Ant Trails

Locate an ant colony or a trail of active ants. Look for small mounds of dirt, which are the entrances to nests. (Some ants such as fire ants can sting you, so avoid any ants that are not black. Also avoid large mounds of dirt with red ants nearby—that may a fire ant colony.) Ants can also be found under stones or logs. Find a hard surface nearby, such as a sidewalk, and have students place a small amount of honey a few feet away from where the ants are active. Observe the ants and record how long it takes for a foraging ant to locate the honey. Eventually the ant will return to the nest and recruit others to return to the honey — by leaving a chemical trail for them to follow. Once the trail has been established, and there are several ants actively traveling along the trail, demonstrate to students how to rub a finger across the trail to remove the pheromone. Emphasize that only adults should do this in case the ants are fire ants.

How do the ants react? Do the ants eventually repair the trail? How long does it take? Experiment further by placing different food sources, such as vegetable oil, peanut butter, and sugar near the active ants and determine which food source is preferred.

Activity — Mosquito Habitat Hunt

Discuss how mosquito **larvae** and **pupae** develop. Just before or after recess, walk around the school yard and search for natural breeding grounds in the days after a rainfall. These include puddles, tires, clogged gutters, pitcher plants, and tree hollows. Point out how that eggs can be laid singly or can be connected together like tiny rafts. Discuss how eggs hatch into larvae that are known as "wigglers" because as they swim, they wiggle their tails from side to side. The larvae grow larger by feeding on algae, bacteria, and organic matter, and eventually molt to become pupae. Pupae do not move around, but rather live suspended from the surface of the water, breathing air through tiny respiratory trumpets, like straws. Pupae are known as "tumblers" as when they are disturbed, they tumble chaotically in somersaults.

Once you've discovered the breeding areas, return to the classroom. Discuss how after a few days, mosquito pupae give way to the emerging adult mosquitoes. Given the many diseases carried by mosquitoes, discuss with students their responsibility in limiting the ability for mosquitoes to reproduce. Acknowledge that though it is virtually impossible to eliminate mosquitoes from any habitat, some species can be controlled. The easiest way to do this is to dump out and remove any objects that contain standing water from their backyards or the schoolyard. These include buckets, tire swings, planting containers, clogged roof gutters, and anything else that can hold water for more than five days (ample time for there to be enough bacteria and algae to sustain developing mosquito larvae).

Visual Aids and Handouts

Readings

Indian Meal Moth

Indian meal moths have been invading human stores of grain for thousands of years. Native to Asia, they most likely evolved out of and benefited from the emergence of agriculture around 10,000 to 12,000 years ago, which followed changes in climate associated with the retreat of the last ice age.

Today these moths make their homes among all sorts of grain products, including flour, corn meal, dried fruits, bird seeds, graham crackers, nuts, powdered milk, chocolate, candies, and pet food.

The larvae web together the flour with strands of silk and feed for about two weeks. The full-grown caterpillars then crawl up out of their edible homes to pupate, emerging 30 days later as a small gray and reddish-brown moth.

German Cockroach

Cockroaches are **scavengers** and will eat just about anything they encounter. They have been on earth for as many as 350 million years — long before dinosaurs came and went. No one knows for certain where they originated, although it is likely to have been in a tropical region of Asia or Africa. They are highly adapted for survival, preferring a humid environment and living in dark burrows. They are typically active at night, and are unlike most insects in that their **exoskeleton** is coated not with a waxy layer but a greasy one. This characteristic enables cockroaches to slide into narrow cracks and crevices.

Cockroaches are so adaptable that they are able to survive even in winter by exploiting small **microclimates** where the temperature is higher than the **ambient temperature**. Such habitats include garbage dumps, were **decomposition** releases heat, cavities below ground that are adjacent to heated basements and other structures, and areas around sewage pipes. Cockroaches in the "wild" will eat plants, insects, fungus, and algae.

Bed Bugs

Unlike house mice, Indian meal moths, and cockroaches, bed bugs do not follow our food into our homes, they follow us! They are a member of a group of insects that feeds on the blood of birds and mammals. Before bed bugs discovered humans, they fed primarily on bats living in caves. When humans began to occupy these same caves, the bed bugs adapted to feed on them, and were carried with them and spread as humans moved about and interacted with other groups. Increased world trade finally brought them to northern Europe about 500 years ago.

Bed bugs range in size from about 6-10mm long. They are so small that they are easily transported from one house to another in furniture and clothing. Once in a house, bedbugs can

hide almost anywhere and spend their days hidden in cracks and crevices in walls, furniture, behind wallpaper and wood paneling, or under carpeting or in mattress seams. They tend not to range far and can survive more than a year without feeding.

It is very difficult to distinguish between species in the bed bug family (Family Cimicidae), and while each species tends to have a favorite **host**, most will readily feed on any available bird or mammal.

Odorous House Ants

More than 10,000 species of ants exist worldwide. However, fewer than 10 are considered major pests in the United States. Different ant species vary greatly in their physical characteristics, behavior, and food preferences. They are social insects and generally live in large **colonies** below ground or in trees. An ant colony may have one or many queens, depending on the species, developing **immatures**, and lots of wingless workers. Most of the ants we see are worker ants, foraging for food that will be brought back to the nest to feed the queen, immatures, and other workers. They are tireless scavengers and will feed on a wide range of foods, including liquid sugars such as nectar and honeydew, sweets, greases and oils, starches, seeds and plants, insects and other sources of protein. Odorous house ants are native to North America and can be found almost universally across the continent. They nest in the soil beneath sidewalks or in piles of things such as lumber, firewood, bricks, and trash. While they can form nests indoors — in walls or beneath the floor — they usually enter homes simply on a quest for food. Ants use chemical substances called **pheromones** to communicate between members of their species. When an ant finds a food source she leaves a chemical trail on the ground to lead her and the rest of the colony back to the food, which is why ants are often seen marching along in single-file lines.

Mosquitoes

Like bed bugs, mosquitoes are insects that have evolved to require bird, mammal, or even reptile blood to complete their life cycle. They can be found worldwide, from the tropics to the Arctic. Female mosquitoes need the rich protein found in blood to build and nourish their developing eggs. Males feed primarily on nectar and other plant juices. While female mosquitoes will readily follow us into our homes in search of a blood meal, they cannot live indefinitely indoors. The immature stages of mosquito reproduction require an aquatic environment in which to hatch and develop. Any source of water, either flowing or stagnant, is a potential breeding site for a mosquito.

Paper Wasps

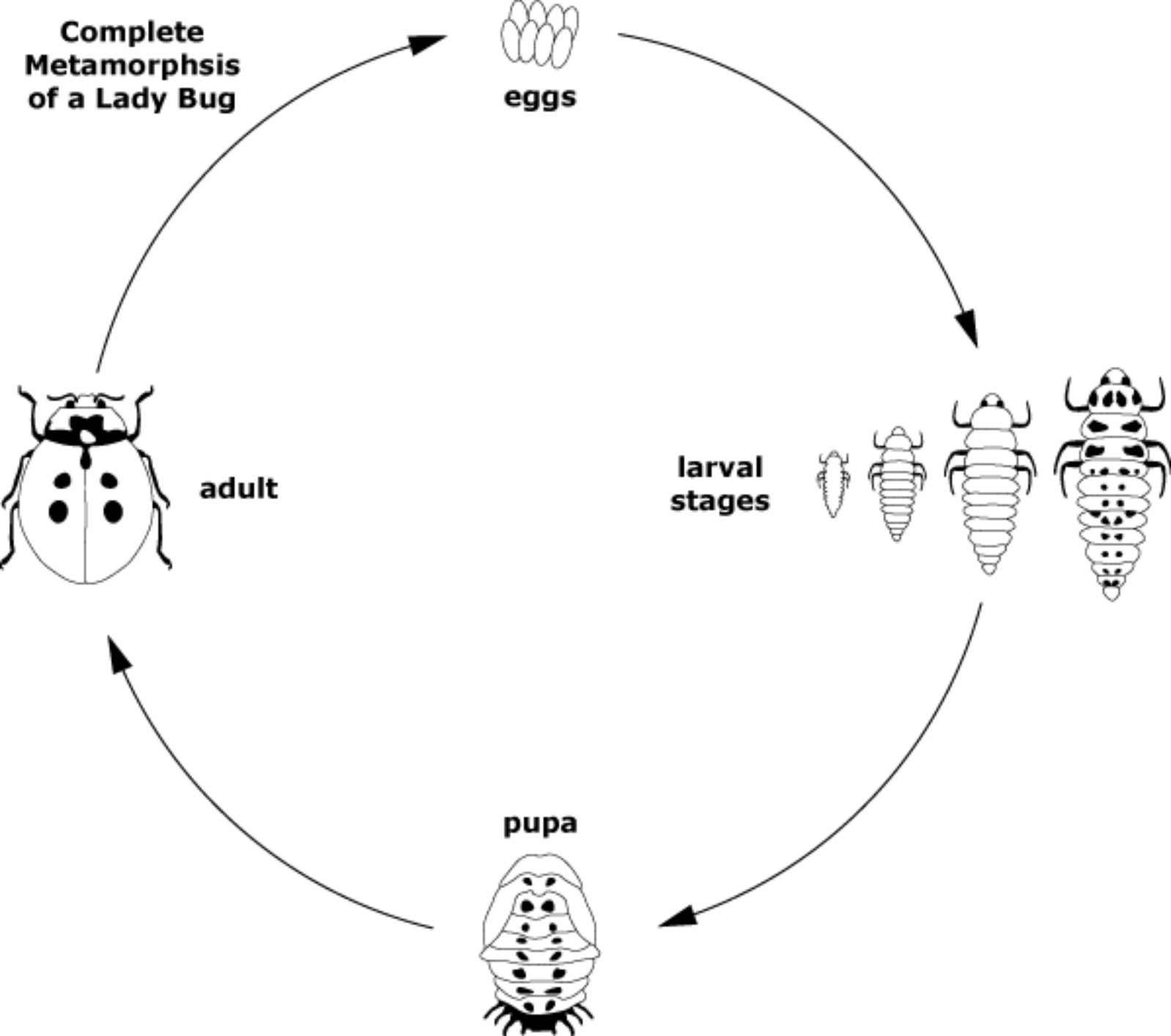
Wasps are insects belonging to the order Hymenoptera, which consists of sawflies, horntails, wasps, ants, and bees. Some 15000 species of wasps have been identified on earth, including 4000 in the United States. Of these, 15 are known as paper wasps. Paper wasps are social wasps whose nests consist of paper-like cells and are built under protective structures. In the wild, this is usually under branches of trees and shrubs. However, human structures provide ideal nest sites such as eaves of homes, under decks, in vents, and attic rafters. Nests are made from scraping

fiber from plant stems, boards, and dead trees. The fibers are chewed up and mixed with saliva to form a pulpy building material, which when dry, feels like paper. Paper wasps are often confused with hornets or yellow jackets. Paper wasp nests have exposed cells while hornet nests are cells surrounded by a cocoon of papery envelopes (like paper mache).□□In springtime, single queens begin to construct new nests. Throughout the summer, as the nest becomes more and more active, female workers forage for insect prey, nectar, and wood pulp for nest construction, building new cells onto the edge of the nest, and caring for the brood and nonworking adults of the colony. In early August, reproductive forms begin to emerge — males and new queens — and soon begin to leave the nests and cluster. Mating takes place and with the onset of winter the males die off and the females search for suitable places to hibernate. Adult female wasps will **overwinter** in cracks and crevices in trees, stumps, underground, anywhere they are protected from the elements — including walls, attics, false ceilings, and chimneys. Come spring, the wasps do not always crawl out the same way they crawled in, and will wind up buzzing around the living room!□

Before They Were Pests (Grades 3-5)

Diagrams: Incomplete Metamorphosis of a Dragon Fly and Lady Bug

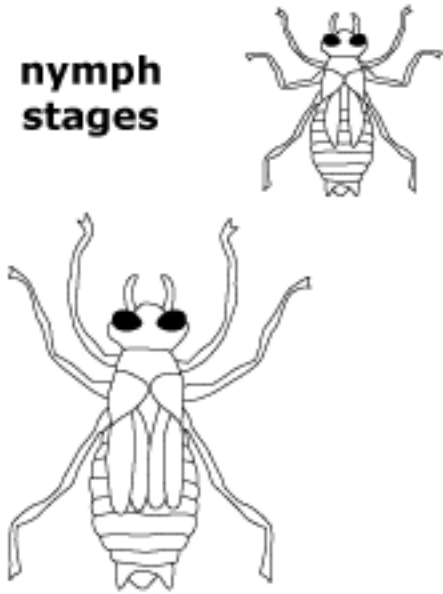
- Make a copy of each of these diagrams for your students.


Complete
Metamorphsis
of a Lady Bug
eggs
larval
stages
pupa
adult

Incomplete Metamorphsis of a Dragonfly

egg

nymph stages



adult